OPERATION
HOUSING SYSTEMS PROPOSALS FOR
break-through

The Operation BREAKTHROUGH program to demonstrate solutions to the problem of providing quality housing in large volume generated a tremendous number of responding proposals. In my February 1970 announcement of the selection of 22 housing system producers for final contract negotiations under Operation BREAKTHROUGH, I reaffirmed the Department's judgement that all the proposals submitted to us had considerable merit. Indeed, their respective strengths made final selection particularly difficult, and we hope that all of the proposers will proceed to make important contributions to the volume production of quality housing for our nation.

George Romney
Secretary of Housing and Urban Development

The resource of Operation BREAKTHROUGH housing systems proposals represents an aggregate view of the technical state-of-the-art, and therefore this compilation of proposals is of value to all those contributing to the advancement of residential development. In undertaking this effort, the Department contracted with the National Academy of Sciences to have its Building Research Advisory Board objectively extract and prepare for publication the technical data contained in the Operation BREAKTHROUGH proposals. We appreciate the cooperation of the proposers in making available the systems concepts, and are confident that they will serve as an important benchmark from which to measure future progress.

Harold B. Finger
Assistant Secretary for Research and Technology

HOUSING SYSTEMS PROPOSALS FOR OPERATION break-through

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C.

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contents

introduction

Operation BREAKTHROUGH was formally announced on May 8, 1969, by George Romney, Secretary of Housing and Urban Development, at conferences with governors, mayors, leaders of labor, industry, and the design professions.

Operation BREAKTHROUGH is a broad residential development program designed to resolve a multitude of problems in order to make available quality housing in large quantities. It aims to do this by utilizing modern design and technology, and through contemporary approaches to financing, marketing, land use, and management. By helping to create substantial local, regional, and perhaps national markets, BREAKTHROUGH is intended to demonstrate the extent of the potential demand—and how it can be aggregated—to those capable of, and interested in, producing both housing and sites for housing. One major objective of the program is to demonstrate that with the kind of large, continuous market enjoyed by the manufacturers of other consumer products, producers of housing in volume can realize economies of scale: they can recover their investments—in research and development, in improvements to their design methods and concepts, and in plants and equipment necessary for volume production. Operation BREAKTHROUGH involves industry, labor, private enterprise, consumers, and all levels of government in the provision of good housing for all income levels.

The program was initiated with invitations to local governments and private citizens and organizations for response in the areas of prototype sites, site planners, site developers, and housing systems producers. The independent requests were designed to develop advanced housing approaches, to locate them on suitable regional sites in accordance with improved planning concepts, and to effectively manage the evolution of the various site communities as prototypes for marketing, and subsequently as integral parts of their localities. Efforts were made in the case of each invitation to encourage quality levels above those adopted as minimal, and to obtain a maximum number of responses to assure the greatest competition.

The publication presents the technical description of those housing systems proposals submitted in response to this Request for Proposals [1] which have been released for publication by the proposer. Listed in Appendices IV, V, and VI, are those respondents to the related invitations for sites, site developers, and site planners.

A data classification vehicle was developed so that the proposal information could be extracted in an organized and uniform manner. This was structured to serve the widest possible range of potential users and to include as broad a range of technical characteristics and as much detail as was deemed necessary and feasible to serve these users, and took the form of a detailed outline questionnaire. (2) Subsequently, data were extracted from those proposals for which the Department had received release by their proponents for publication. Of the proposals received by HUD, 244 were Type A proposals, dealing with design, testing and evaluation of complete housing systems, and 388 were Type B proposals dealing with both "hardware" and "software" concepts relating to housing that require further design and development before being reduced to practice. 423 proposals were released for publication and are reported here.

The technical data is organized by type of proposal (A and B) and then under each type of section as follows: (1) Proposals containing fairly *complete information* (presenting all or most of the data called for under the RFP); (2) proposals containing *limited information* (applicable to Type A proposals presenting only part of the data called for); and (3) *unreleased proposals* (a listing of proposers who, because of proprietary interests or for other reasons, did not agree to release their proposal data for publication). Proposals in each of the sections are in alphabetical order. Where a proposer submitted more than one proposal in a type, each has been abstracted and reported separately under the one major proposer heading.

The data presented in this publication is, of necessity, limited. The text presents a very brief abstract of the major concepts set forth in each proposal, and the chart and illustrations provide a summary of pertinent data and characteristics. The intent is to provide the reader with an overview of the essential technical elements. Generic terms have been substituted insofar 'as possible for trade and proprietary names.

Every effort was made to present each proposer's material in an objective, consistent and accurate manner. No judgment is presented herein by HUD or by its contractors or by their personnel and advisors, as to the merit or authenticity of the concepts presented. The primary aim is to systematically convey the intentions of the proposers with as high a degree of accuracy as possible. Each abstract and summary chart was submitted to the appropriate proposer for review as to accuracy of abstraction from his proposal, and approval for presentation in this publication. Thus, inclusion of material does not necessarily constitute endorsement of any approach, and the proposers themselves are responsible for the technical accuracy of the information. This process of data presentation was quite distinct from those evaluations of the proposals which were made by the Department of Housing and Urban Development for purposes of contract awards.

This publication is based only on material actually contained in the Operation BREAKTHROUGH proposals received by HUD, and does not necessarily represent the current status of a proposer's concepts, systems, organizations and facilities. Those readers desirous of more detailed and current information are urged to contact the identified proposers directly.

The received proposals included the work of many of the nation's most experienced housing professionals and producers, as well as those who approach the housing problem from a totally new vantage point. Over 1000 individual firms were involved. As these Operation BREAKTHROUGH proposals represent a significant set of indicators of the state-of-the-art in residential development, this technical publication contributes to the goal of advancing residential development in quantity and quality.

(1) Department of Housing and Urban Development, Request for Proposal No. H-55-69, Operation BREAKTHROUGH-Application of Improved Housing Systems Concepts for Large Volume Production, the Department Washington, D.C., June 1969. Reprinted in "Industrialized Housing," Hearings before the Subcommittee on Urban Affairs of the Joint Economic Committee, Congress of the United States, U.S. Government Printing Office, Washington, D.C., 1969.

(2) See Appendix (III) "Abstracting Process"

abstract explanation

Each abstract for Type A and Type B proposals includes a brief description, a summary information chart, and appropriate illustrations where suitable graphics were available.

The chart accompanying each proposal abstract provides a concise description of certain phases of the total housing process. The 40 items in the chart have been distilled from the much larger classification outline used in the extracting process.[3] The term "housing system" refers to the total process of providing housing—from initial concept and production through final occupancy. Proposals submitted for complete housing systems (Type A proposals) would theoretically address all 40 items in the chart.

Type B proposals, on the other hand, may not be as comprehensive and, therefore do not always include concepts which address all 40 items. Also, those concepts included sometimes overlap several of the items. However, for purposes of quick comparison and identification, Type B proposal information has been related as closely as possible to the items on the chart. Some duplication under separate items on the chart was purposely included so that the reader might scan the various proposal abstracts to compare a single item without missing a salient point.

The Master Summary Chart provides a description of the general type of information addressed for each chart item. Again, due to limitations of space, it was not possible in all instances to include all relevant material. Some general explanatory statements follow regarding the major chart sections.

Site System

The site system relates to those elements which together make up the total site planning process. Not included are those considerations which apply to spaces and functions within individual building and dwelling units or their subsystems, or to site economic factors (such as cost and financing and production/construction of various site items).

Item 2: Where the proposer offered a wide range of densities, or alternative site situations, housing types and combinations of types, the lower and upper figures are reported.

MASTER SUMMARY CHART

SITE SYSTEM

1	**Site Situation**	Urban; urban renewal; suburban; rural, new towns; situations of specific note
2	**Density Range**	Lower & Upper range of dwelling units per acre indicated, including mixed densities of varying housing types
3	**Topography**	Indicated as adaptable to all normal topographies & soils (as outlined in the RFP-H-55-69), unless specific exception is cited
4	**Climate**	Indicated as adaptable to all national climates (as outlined in the RFP-H-55-69) unless specific exception is cited
5	**Planning Concepts**	Specifically cited planning concepts such as: cluster, planned unit development, open spaces, neighborhood & community developments
6	**Nonresidential Functions**	Those functions cited as being included as a part of the site plan such as: recreational, commercial, educational, social & service facilities
7	**Circulation**	Stated pedestrian & vehicular traffic circulation planning concepts such as: cul-de-sacs, grid patterns, traffic separation, overpasses & underpasses
8	**Site Planning Services**	Indication of extent to which planning services are to be a function of the proposer, proposer's affiliate, or local planners & extent of control
9	**Community Involvement**	Extent of involvement by members of the community—tenants, social organizations, local business, or other groups—in the site planning process
10	**Utilities**	Indication of specific note regarding site utilities such as: energy sources, solid waste & sewage disposal, communications, drainage systems

BUILDING SYSTEMS

11	**Housing Types**	As outlined in the RFP—single-family detached; single-family attached; multifamily low-rise (nonelevated structures not more than three-stories above grade); multifamily high-rise (elevated structures, more than three-stories above grade).
12	**Unit Variations**	Stated range of bedroom unit variations usually within the range of efficiency to 6 bedrooms
13	**Design Selection**	Method offered for building planning such as: from standard plans with options, flexible planning dependent only on configuration of building modules or component units offered, or flexible open planning usually based on a design module & not restricted by physical building modules or components
14	**State of Development**	Indication of state of development in terms of the building system; design stage, development, prototype construction, marketing—and in terms of production facility: design stage; built & operational
15	**Community Involvement**	Extent of involvement in building & dwelling unit design by members of the community such as: prospective tenants, social organizations

BUILDING SUBSYSTEMS

16	**Structure**	Basic load-bearing structural elements such as self-supporting volumetric modules; structural framing; wall, floor and roof panels and/or subsystems
17	**Exterior Elements**	Nonstructural elements such as nonbearing walls, finishes & additions (garages, porches, screens)
18	**Interior Elements**	Nonstructural elements such as partitions, finishes, circulation & service core units
19	**Foundations**	Description when given; noted as conventional and/or designed for site conditions when indicated; or unconventional as described

Item 5 through 10: Unless specific considerations were addressed as functions of proposed site planning for the proposed housing system, data have not been reported. *Item 6* includes only those spaces or facilities which contribute planned functions for a specific or general planning concept. *Item 9* relates only to direct or associated involvement of members of the community in the site planning process.

Building System

The building system relates to the planning of spaces and functions of building(s) which include(s) dwelling units. With the exception of *Item 14,* only design consideration of spaces and functions within the building are addressed.

Item 14: For the sake of brevity and comprehension, the state of development of the production process, as well as that of the building system concept, has been included.

Item 15: Community involvement relates to direct or associated involvement of members of the community in the building design process.

Building Subsystems

The data included under this section is intended to describe the physical characteristics of the building system in terms of its various basic parts.

Item 16: The basic structural description is given, including only those elements or subsystems necessary for the structural integrity of the building. The term "module" indicates a three-dimensional component, assembled or fabricated before its final placement.

Items 17 and 18: Included are nonstructural elements and elements which may be load bearing but not a part of the basic structural system per se. Due to limitations of space, all finish and like alternatives put forth by the proposers could not be included and these often have been reported as "conventional" or "optional," as the case may be. In all cases, an effort has been made to single out those items or practices which deviate from standard practice.

20	**Comfort System**	Heating, ventilating, & cooling systems described in terms of energy (gas, oil or electric), type of system (forced air, hydronic or space unit); specific features & the extent to which equipment & distribution is integrated with the building system
21	**Plumbing**	Domestic and drainage distribution systems, bathroom & kitchen facilities described in terms of materials, specific features & extent to which distribution, fixtures & appliances are integrated with the building system
22	**Electrical**	Wiring, service equipment, lighting described in terms of specific features & extent to which distribution is integrated with the building system
23	**Furnishings**	Items of furniture & furnishings not including standard items of storage such as closets & kitchen cabinets

PRODUCTION

24	**Offsite Production**	Specific elements of the housing system indicated as being produced in a plant facility not located on or immediately adjacent to the building site
25	**Onsite Production**	Specific elements of the housing system indicated as being produced in an onsite plant facility or facility immediately adjacent to the building site
26	**Onsite Construction**	Necessary work performed onsite (not including plant production) in completing the dwelling units proposed (such as foundations; construction of frame, placing of modules or erection of components, finishing, utility installation or hook-ups)
27	**Labor**	Level of skills required in the production & construction processes: skilled, semiskilled or unskilled, & specific characteristics
28	**Labor Training Programs**	Indication of anticipated or available programs
29	**Community Involvement**	Extent of involvement by members of the community in the production or construction processes such as self-help, use of local labor, contractors, community organizations & businessmen

ECONOMICS

30	**Construction Costs**	In terms of cost (or range of costs per dwelling unit or cost per sq. ft.), generally not including cost of land
31	**Financing Methods**	Stated short-term (production & construction) & long-term mortgage financing
32	**Useful Life**	Stated useful life of building structure & specific elements or subsystems

MANAGEMENT

33	**Proposer Organization**	Indication of structure of proposer organization such as: private company, corporation, consortium, professional, educational facility
34	**Internal Functions**	Those functions stated as being performed directly by proposer organization
35	**External Functions**	Those functions stated as being performed by proposer affiliates or others
36	**Market Area**	Stated market distribution area for the building system
37	**Delivery Rate**	Generally, rate in terms of delivery of completed dwelling units per year noting minimum, optimum (best rate), and maximum where indicated
38	**Consumer Protection**	Warranties stated by the proposer for the building system or its parts

GENERAL

39	**Major Innovative Concepts**	To the extent possible, description of innovation embodied in the proposal
40	**Codes**	Stated adaptability to or variance from model codes for the building system, subsystems or elements

summary of proposal information

At the conclusion of the abstracting process, an analysis was made of the summary outline information charts for all Operation Breakthrough proposals and the information was summarized. In the case of multiple proposals submitted by an individual proposer, each proposal concept is treated as a separate proposal. The results of this analysis follows.

TYPE A PROPOSALS

Sixty-two percent of the total Type A proposals received by HUD are included in this analysis. As noted earlier, the proposers did not address all chart items in all cases. Thus, the percentages given are generally based on the number of respondents to a particular item. For Items 20, 21, and 22 (Comfort, Plumbing, and Electrical Systems), many proposers were not explicit in describing the type of system offered and either indicated that the choice could be flexible in terms of energy source and type of system, referred to the systems in general terms, or referred to them as conventional. Throughout, an attempt has been made to isolate those items which could be generally compared.

TYPE B PROPOSALS

Forty-eight percent of the Type B proposals received by HUD are analyzed here. They can be divided into three major categories: (1) *Complete housing systems* (similar to Type A, but requiring further development); (2) *Hardware* (partial structural systems, subsystems, materials, elements, and components); and (3) *Software* (concepts relating to the housing process).

The complete housing systems totaled 80 and have been summarized in the same manner as the Type A proposals. The "hardware" and "software" proposals could not be clearly divided because several hardware proposals also embodied software concepts to a significant degree. However, analysis reveals that 112 Type B proposals can be classed generally as "hardware," approximately 20 percent of which embodied software concepts as well; and 76 can generally be classed as software. The accompanying breakdowns give: (1) an indication of the type of research and development addressed as a percentage of the total hardware proposals; and (2) the total software concepts addressed (including those hardware proposals which addressed software concepts to a significant degree).

TYPE A

SITE SYSTEM

1 **Site Situation:** (82% of total responding)

Situation	Percent of Respondents
Urban/Suburban	78
Suburban	9
Urban	6
New Towns	10

2 **Density Range:** (75% of total responding) Low-1 to 15 dwelling units per acre, Medium-15 to 40 dwelling units per acre; High-over 40 dwelling units per acre.

Density Range	Percent of Respondents
Low	20
Medium	10
Low/Medium	32
Medium/High	8
High	12
Low/Medium/High	18

5 **Planning Concepts:** Addressed by 68% of total

8 **Site Planning Services:** Not offered by 70% of proposers.

9 **Community Involvement:** Addressed by 42% of total

BUILDING SYSTEMS

11 **Housing Types** (100% of total responding)

Housing Types	Percent of Total
Single-Family	18
Single-Family/Multifamily low-rise	32
Multifamily High-rise	4
Multifamily Low-& High-rise	6
Single-family/Multifamily low- & high-rise	40

15 **Community Involvement:** Not addressed by 70% of proposers

BUILDING SUBSYSTEMS

16 **Structure** (100% of total responding)

Structure	Percent of Total
Modules	32
Modules/Frame	7
Panels	39
Panels/Frame	9
Frame	7
Other [1]	6

16 **Structure** (continued)

Dominant Material[2]	Percent of Total for each system: Module	Panel	Frame
Concrete	33	41	27
Wood	36	27	22
Metal	8	11	38
Plastic	12	9	-
Combination	8	12	13
Optional	3	-	-
	(100)	(100)	(100)

19 **Foundations** (90% of total responding)

Type	Percent of Respondents
Conventional	93
Prefabricated/Unconventional	7

20 **Comfort Systems**[3] (81% of total responding)

	Percent of Respondents
Energy Source	
Optional Fuels	26
Electric	20
Degree of Industrialization	
Mechanical Core	16
Integrated with building system	40
Type of System	
Forced Air	28
Hydronic	17
Unit	22
Cooling Optional	23

21 **Plumbing**[3] (86% of total responding)

	Percent of Respondents
Unitized Modules	33
Factory Fabricated Elements[4]	63
Plastic Pipe	43

22 **Electrical**[3] (71% of total responding)

	Percent of Respondents
Innovative Electrical Concepts	22
Prewiring integrated with building system	86

PRODUCTION[5]

		Percent of Respondents (91% of total)
24	**Offsite Production**	92
25	**Onsite Production**	6
26	**Onsite (Conventional) Construction**	9
	Optional	13

27 **Labor:**

	Percent Responding
Level of Skills	(74% of total)
Skilled	41
Semiskilled	43
Unskilled	77
Self-help	(34% of total)

29 **Community Involvement:** Addressed by 78% of total

ECONOMICS

31 **Financing Methods** (61% of total responding)

Type of Financing	Percent of Respondents
Conventional (including HUD-FHA/VA)	68
Proposer Supplied	34
Equity Participation	4

MANAGEMENT

33 **Proposer Organization** (100% of total responding)

Type	Percent of Total
Corporation	44
Consortium	38
Private Company	11
Educational Facility	1
Professional	6

37 **Delivery Rate** (68% of total responding)

Rate (Dwelling Units per Year)	Percent of Respondents
1-500	15
501-1,000	41
1,001-5,000	30
5,001-10,000	4
Over 10,000	10

GENERAL

40 **Codes:** 3% of total indicated that code problems were anticipated, i.e. that code requirements either could not or would not be met and that the system was not adaptable to current model codes.

SUMMARY OF TYPE B PROPOSALS

Complete Housing Systems	30%
Hardware	41%
Software	29%

TYPE B PROPOSALS - COMPLETE HOUSING SYSTEMS

SITE SYSTEM

1 **Site Situations** (71% of total responding)

Situation	Percent of Respondents
Urban/Suburban	70
Urban	14
Suburban	18
New Towns	7

2 **Density Range:** (35% of total responding)

Range	Percent of Respondents
Low	19
Medium	16
Low/Medium	19
High	16
Low/Medium/High	30

5 **Planning Concepts:** Addressed by 39% of total
8 **Site Planning Services:** Offered by 12% of total
9 **Community Involvement:** Addressed by 19% of total

BUILDING SYSTEMS

11 **Housing Types:** (99% of total responding)

Housing Types	Percent of Respondents
Single-Family	17
Single-Family/Multifamily low-rise	34
Multifamily low-rise	3
Multifamily low-rise and high-rise	10
Multifamily high-rise	5
Single-Family/Multifamily low- & high-rise	31

15 **Community Involvement:** Addressed by 12% of total

BUILDING SUBSYSTEMS

16 **Structure:** (98% of total responding)

Structure	Percent of Respondents
Module	42
Panel	31
Frame	6
Module/Frame	3
Panel/Frame	14
Optional	3
Other	1

	Percent of Respondents		
Dominant Material*	Module	Panel	Frame
Concrete	14	40	28
Wood	14	14	28
Metal	9	17	44
Plastic	31	11	-
Combination	26	3	-
Optional & Undefined	6	15	-

*Because of many possible combinations of module/panel/frame, judgment was exercised in associating the dominant material with the dominant structural system.

19 Foundations (80% of total responding)

	Percent of Respondents
Conventional	80
Unconventional	20

20 Comfort Systems** (64% of total responding)

	Percent of Respondents
Energy Source	
Optional Fuels	14
Electric	24
Degree of Industrialization	
Mechanical Core	24
Integrated with building systems	73
Type of System	
Forced Air	16
Hydronic	2
Unit	14
Cooling Optional	16

21 Plumbing** (62% of total responding)

	Percent of Respondents
Unitized Module	47
Factory Fabricated Elements*	61
Plastic Piping	16

*Includes prefabricated trees, plumbing walls, and prefabricated partial kitchen and bath units.

22 Electrical** (54% of total responding)

	Percent of Respondents
Innovative Electrical Concepts	9
Prewiring integrated with building system	95

**A composite summary of possible subsystems proposed could not be arrived at because respondents either (1) failed to address all considerations, (2) gave scant reference to conventional methods; or (3) gave a number of alternatives within a single proposal.

PRODUCTION*

		Percent of Respondents (98% of total)
24	**Offsite Production**	70
25	**Onsite Production**	15
26	**Onsite Construction**	10
	Optional (on or offsite production)	5

*Variations in possible production techniques indicated some latitude in degree of offsite and onsite production and construction.

27 Labor

	Percent of Respondents
Level of Skills	(57% of total)
Skilled	30
Semiskilled	40
Unskilled	70
Self-help	(49% of total)

29 Community Involvement: Addressed by 53% of total

ECONOMICS

31 Financing Methods (30% of total responding)

Proposed Financing	Percent of Respondents
Conventional	61
Proposed Supplied	21
Equity Participation	18

MANAGEMENT

33 Proposer Organization (100% responding)

Type of Organization	Percent of Total
Corporation	40
Consortium	11
Private Company	16
Educational Facility	4
Professional	29

37 Delivery Rates (36% of total Responding)

Rate (Dwelling Units per Year)	Percent of Respondents
1-500	25
501-1,000	35
1,001-5,000	30
5,001-10,000	-
Over 10,000	10

GENERAL

40 Codes: 10% of total indicated that code problems were anticipated; i.e., that code requirements either could not or would not be met and that the system was not adaptable to current model codes.

HARDWARE

Systems and Subsystems	**Percent of Total Hardware**
General Structural	4
Modules	18
Panels	21
Wall	10
Floor	2
Roof	5
Foundation	10
Materials	25
HVAC	20
Plumbing	21
Sewage & Solid Waste Disposal	7
Electrical	14
Other*	

*Miscellaneous components, equipment, machinery, special engineering considerations

SOFTWARE

Concept	**Percent of Total Software***
Community Development	38
Urban Design and Land Planning Services	33
Land Economics	19
Design Services	26
Financing	11
Marketing	5
Labor	2
Construction/Production Process	6
Zoning Ordinances, Codes, Legal Instruments	15
Information Systems	26
Computerized Systems	23

*Includes hardware proposals embodying software concepts.

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[1] Optional, Module/panel, Dome, etc.

[2] Because of many possible combinations of module/panel/frame, judgment was exercised in associating the dominant material with the dominant structural system.

[3] A composite summary of possible subsystems proposed could not be arrived at because respondents either (1) failed to address all considerations; (2) gave scant reference to conventional methods; or (3) gave a number of alternatives within a single proposal.

[4] Includes prefabricated trees, plumbing walls and prefabricated partial kitchen and bath units.

[5] Variations in possible production techniques indicated some latitude in degree of offsite and onsite production and construction.

type A proposals

COMPLETE INFORMATION

Aitken Collin & Associates

PROPOSER

Aitken/Collin & Associates, Architects, Berkeley, California

AFFILIATES

First California Company; Hexcel Corporation; SFO Helicopter Airlines; Sierra Pacific Distributers; Montague Fisher; Hales Testing Laboratories; Bank of California; Comtel Leasing, Inc.

Foldable, reusable plastic sandwich panels, which form a hexagonal living unit with folded plate roof, are the basis of this approach to high-volume, low-cost housing.

The structures, engineered to be erectible within 2 to 6 hours by unskilled labor, manually or with helicopter assistance, are especially suitable for providing "instant" housing after emergencies such as hurricanes, for housing of persons temporarily relocated pending construction of new, permanent low-cost replacement housing, for shelter for migrant farm workers, for temporary classrooms, or for housing refugees.

The structures are to be erected in clusters of 2, 3, 4, 5, or 6, each unit requiring a hexagonal plot of at least 1,000 sq. ft. for the structure alone, the balance of the land being given to common open land and community facilities.

Two types of foundations are proposed for the units. A slab-on-grade type is made of concrete cast within a permanent folded metal frame (of 1/8-in. x 3-in. strip). A space frame foundation (for uneven terrain) consists of 12-in. x 12-in. metal joists on 12-in. sq. x 1/8-in. bearing pads. Springing from the foundations is a collapsible, hinged framing system, with the apex of each triangular frame joining the others at the common apex of the volumetric module formed by the plastic panels. The panels are fastened to this frame and to the foundations, and together form a common structural system.

Twelve of the patented, triangularly shaped panels are required to form a dwelling, each of six pairs forming a peaked-roof section of the hexagon. The triangular opening formed under the peak typically has a base of 20 ft., an apex over 14 ft., and is glazed or paneled against the weather except where units join each other in cluster arrangements. A party wall closes off the opening.

The floor and roof panels for the resultant hexagonal module, 34 ft. in diameter, are sandwiches of rigid urethane foamed core, but with skins of filon sheet. Integrally colored extruded members are used for trim, both inside and out.

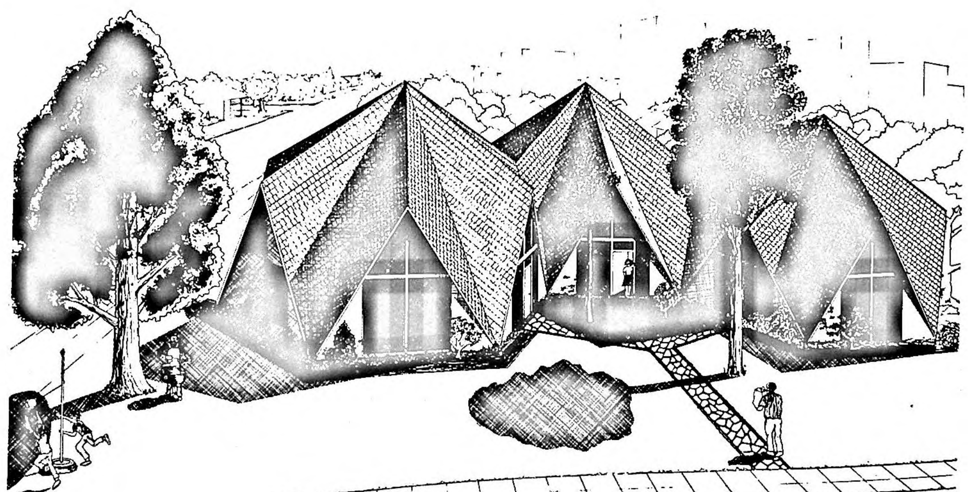
Interior partitions and second-story ceiling-floor systems (when specified) are suspended from the space frame system, with the partitions being tied to the floor with plunger dowels. A circular aluminum staircase at the core of the structure leads to the second floor. Unitized bathroom and kitchen modules are included as part of the living unit package.

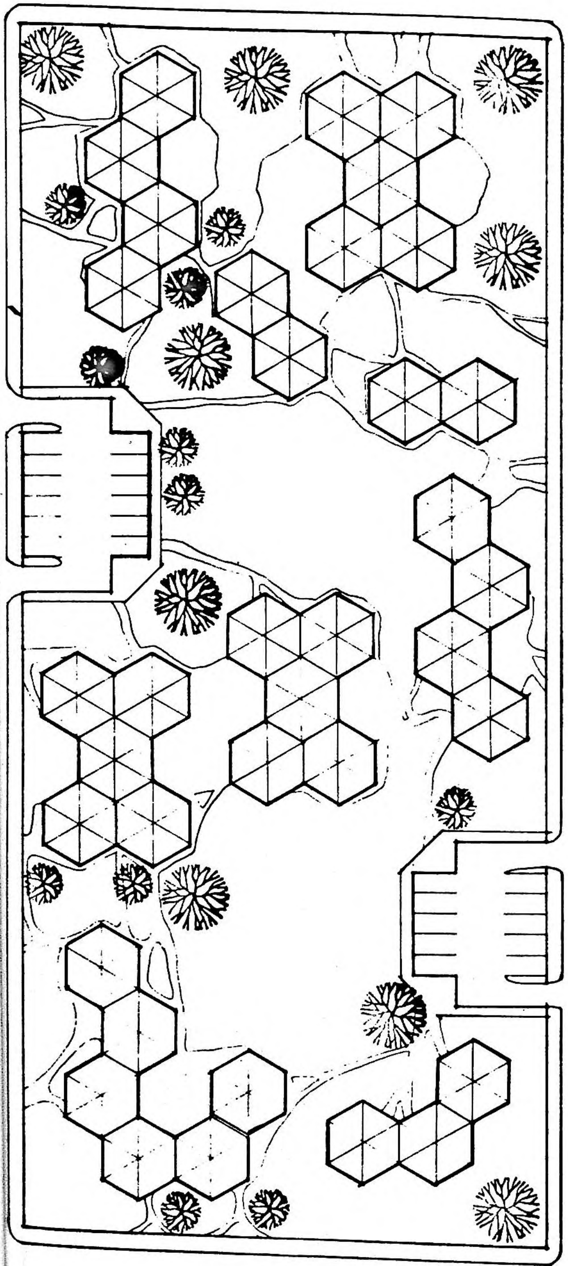
An all-electric utility system is proposed for the clustered modules. The heating and air conditioning generating equipment for each cluster is to be located remote from the modules in a central core and connected via cannon plug connectors or quick-coupled precharged lines to stubouts from the harness assembly built into the foundations (either slab or space frame). Two types of heating are proposed: one to consist of shielded resistance wires within the lower half of all interior walls to furnish total indirect heat, the other to consist of piping within the walls for hot water to give uniform radiant heating. Used with chilled water, this same piping provides absorptive cooling.

For structures without a second story, illumination will be provided by flat panels of particle-activated materials which respond in color and brightness to an ultrasonic high-frequency wave generator. Buildings with second stories, however, will have lighting fixtures built into the prefabricated ceiling-floor system.

Natural ventilation of the apex-shaped structure will be provided by floor vents where the six roof valleys join the floor system, and by a roof cap with gravity or fan vent. The fan may not be necessary, because the structure itself is expected to set up a chimney action which will lead to high-velocity gravity air flow.

A working model of the hexagonal structure has been erected, and proposed factory production of the foldable plastic panels, using low-skilled assemblers, will have an optimum rate of 4,228 units a year.





Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; RURAL; SUBURBAN
2	Density Range	9.6 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTERS
6	Nonresidential Functions	EDUCATION & RECREATION FACILITIES
7	Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION; STREET GRID; WALKWAYS
8	Site Planning Services	PROPOSER
9	Community Involvement	
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12	Unit Variations	1 TO 6 BEDROOMS
13	Design Selection	
14	State of Development	PRODUCTION PLANT, DESIGN STAGE; PROTOTYPE CONSTRUCTED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	SITE-ERECTED COLLAPSIBLE FRAME
17	Exterior Elements	FIBERGLASS PANELS
18	Interior Elements	FIBERGLASS PANELS; URETHANE FOAM CORE
19	Foundations	PREFABRICATED CONCRETE & METAL INTEGRAL WITH WALL PANELS
20	Comfort Systems	ELECTRIC WIRES & WATER PIPING IN WALLS FOR HEATING & COOLING
21	Plumbing	CONVENTIONAL
22	Electrical	CONVENTIONAL
23	Furnishings	PREFABRICATED & HUNG ON WALL

PRODUCTION

24	Offsite Production	ALL MAJOR COMPONENTS
25	Onsite Production	
26	Onsite Construction	DWELLING UNIT UNFOLDED & UTILITIES CONNECTED
27	Labor	UNSKILLED; SEMISKILLED
28	Labor Training Programs	PROGRAMS TO TRAIN LABOR IN PRODUCTION & ERECTION
29	Community Involvement	SELF HELP COMPLETION & ERECTION

ECONOMICS

30	Construction Costs	$4,754 TO $6,836
31	Financing Methods	
32	Useful Life	

MANAGEMENT

33	Proposer Organization	PROFESSIONAL
34	Internal Functions	ALL
35	External Functions	
36	Market Area	
37	Delivery Rate	1,000 TO 4,228 DWELLING UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	FOLDABLE, RELOCATABLE, SELF-CONTAINED DWELLING UNIT
40	Codes	

Allied General, Inc.

PROPOSER

Allied General Inc., Princeton, Florida.

Two molded, monolithic halves of a ferro-cement sandwich, factory-manufactured, completely finished inside and out, are joined together at the site to form one complete single-family home in the housing system proposed. However, the concept also has applicability to townhouses and two- or three-story low-rise apartment structures.

The house halves, in essence self-supporting monolithic modules, are a molded, proprietary hollow-core sandwich section consisting of inner and outer faces of 1/2-in. to 3/4-in.-thick ferro-cement, the void being filled with 3 in. of molded-in-place insulation. The resultant 4-in.-thick, five-sided structures, when joined together at site, produce a weather envelope capable of resisting temperature extremes ranging from freezing to subtropical.

The two halves, typically not more than 12 ft. wide (to permit over-the-highway shipment) and 45 ft. long, are joined by mechanical connectors to form a two to four bedroom house with overhanging roof, 20 ft. x 45 ft. in rectangular plan. Exterior finishes of the ferro-cement structures are varied by offering a choice of textures and colors in the panels. Interiors are completely finished and painted in the factory; kitchen cabinets and counter are built in, floor covering, wall receptacles, and lighting fixtures are included.

Foundations, which may be conventional or may be stilts, are the responsibility of the purchaser, although plans for this work will be provided as part of the house package. A prepackaged, unitized kitchen-bathroom module is built into one-half of the factory-built home, with provision also being made for easy, later installation of optional heating and air conditioning equipment.

The proposed system is put forward as being particularly suitable for low-density projects and on scattered lots, its salient advantage being that it is a factory-produced permanent masonry structure, road and rail transportable, and therefore ready for rapid installation on any prepared site without the unsightly clutter that accompanies usual site-built housing.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN; RURAL
2	Density Range	LOW TO HIGH DENSITY
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4	Climate	ADAPTABLE TO ALL CLIMATES & SOILS, & HIGH WIND AREAS; SOUTHEASTERN STATES
5	Planning Concepts	
6	Nonresidential Functions	
7	Circulation	
8	Site Planning Services	BY JOINT VENTURE WITH HUD OR PRIVATE COMPANIES
9	Community Involvement	
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	1 TO 4 BEDROOMS
13	Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14	State of Development	DESIGN COMPLETE; SAMPLE PANELS TESTED; PROTOTYPE MODULE CONSTRUCTED
15	Community Involvement	INTERIOR MODIFICATIONS BY OCCUPANT POSSIBLE

BUILDING SUBSYSTEMS

16	Structure	MOLDED, FERRO-CEMENT SANDWICH SECTION, MONOLITHIC MODULES
17	Exterior Elements	
18	Interior Elements	CONVENTIONAL PARTITIONS
19	Foundations	OPTIONAL OR CONVENTIONAL STILTS; INSTALLATION BY PURCHASER
20	Comfort Systems	OPTIONAL HEATING-COOLING SYSTEM
21	Plumbing	PREPACKAGED UNITIZED KITCHEN-BATHROOM; ELECTRICAL WATER HEATER
22	Electrical	
23	Furnishings	

PRODUCTION

24	Offsite Production	MASONRY MODULES
25	Onsite Production	
26	Onsite Construction	FOUNDATION; PLACING OF MODULES; INTERIOR WORK; INSTALLATION OF UTILITIES
27	Labor	
28	Labor Training Programs	
29	Community Involvement	SELF-HELP, PLANS PROVIDED, HOUSE DELIVERED IN ANY STATE OF COMPLETION

ECONOMICS

30	Construction Costs	$10,150 PER UNIT (990 SQ. FT.), 1,000 UNITS PER YEAR
31	Financing Methods	
32	Useful Life	COMPARABLE TO CONVENTIONAL HOUSING

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	DESIGN AND PRODUCTION
35	External Functions	FOUNDATIONS
36	Market Area	PRIMARILY THE SOUTHERN STATES
37	Delivery Rate	1,000 UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	MEETS ALL CODE MODEL REQUIREMENTS

Alpha-Plus

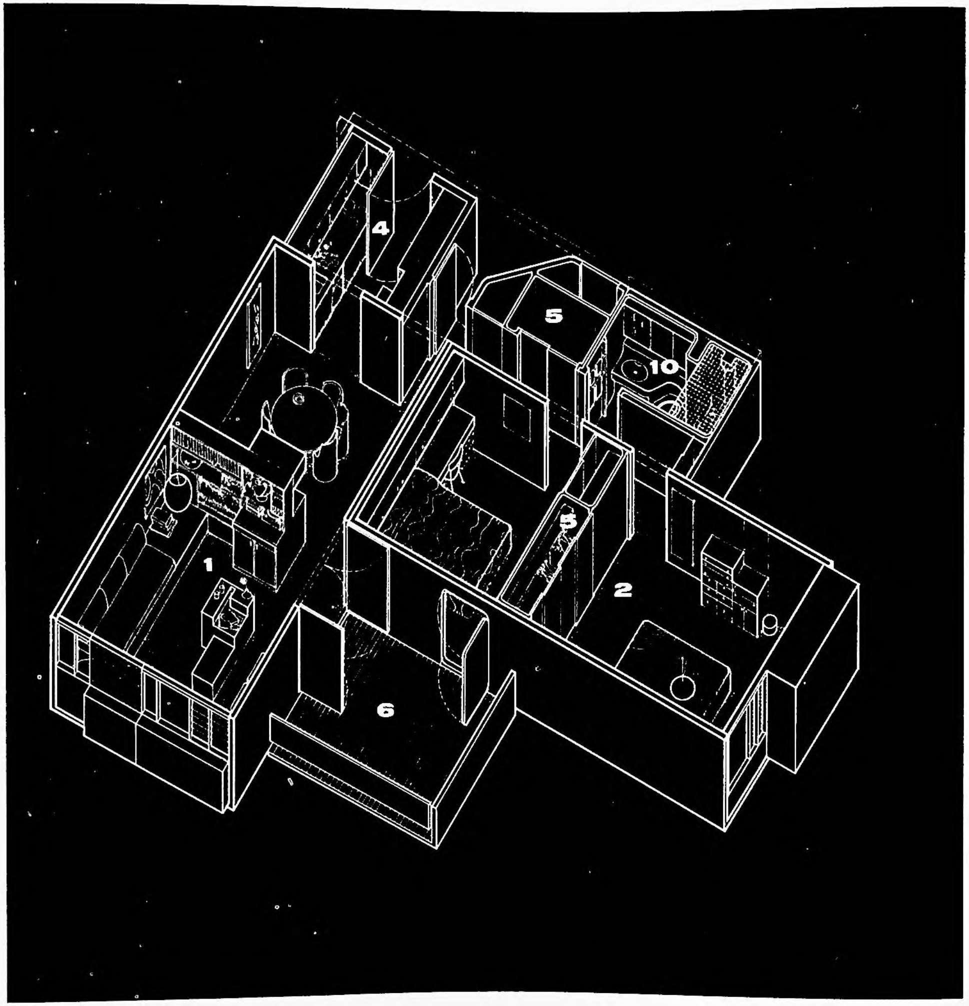
PROPOSER

Alpha-Plus Associates, Ft. Lauderdale, Florida.

A concept of shelter as fulfilling three functions, with a distinctly different module for each of the functions, underlies this housing system. The adaptability of these modules to varying needs and the flexibility of their combination offer the designer a building-block approach to low-cost, high-volume housing. Starting with the smallest module, the designer considers a combination of factory-produced modules to form a living unit, then a cluster of living units, and, finally, combinations of clusters that form a building.

"Hard," "soft," and "pallet" designate the three types of modules that make up the system. The "hard" module is a self-supporting structural box of precast lightweight concrete used to form living and sleeping quarters. The "soft" module, of a nonstructural material like fiberglass, encompasses all the utility functions such as food preparation, bathing, and storage. The "pallet" is a concrete slab that spans between the structural "hard" modules and affords horizontal circulation external to the living and utility modules (such as corridors in a typical high-rise apartment building) and also serves as support for the nonstructural "soft" modules.

The "hard" modules are basically 12 ft. wide and 8 ft. 4 in. high, but may be 8, 15, or 24 ft. long. This choice of lengths affords the designer flexibility in the use of the modules. For example, a living-dining module might be used as a two-bedroom sleeping module, while a smaller one-bedroom module might be used as living space. Adding to this flexibility are the prefabricated interior partitions of wood-framed, painted gypsum board. Future renovation, remodeling, or even replacement by the owner of interior partitions becomes economically feasible due to this use of prefabricated, nonstructural members—a possibility that extends to exterior end walls, which also are non-loadbearing, being factory-made from wood, steel, aluminum, and plastic.



Terrazo-finished floor and painted gypsum board ceiling may be integral with the modules. Insulation against both heat and cold is afforded by the material of the "hard" module itself—lightweight concrete.

The "soft" modules of the system not only furnish each living unit with facilities such as kitchen, storage, and unitized bath, but they also serve to integrate the electrical and mechanical systems for the entire building by their built-in vertical chases and horizontal plenums, through which services are distributed. Completing this distribution system is the network of wiring precast into the "hard" modules (thus eliminating onsite wiring) and the plastic (PVC) piping for water and sewage, also incorporated into the self-supporting structural living units.

Several options for heating are offered—gas-fired hot water or forced air for either the entire building, the individual dwelling unit, or the individual room; or electric strip heating. A salt-water, stainless-steel heat-transfer unit is proposed for cooling, with ventilation vents to be factory-precast into the "hard" modules.

The flexibility of layout afforded the designer also means flexibility in renovation or remodeling. The building may be partially or completely disassembled for replacement of obsolescent modules by more recent modules, or for removal to and erection at another site.

Because the basic "hard" modules are self-supporting structural units, the system is considered suitable for almost any terrain and can be built over marshy land or on steep hillsides, the "hard" units being supported by piers or footings. Employment onsite of semiskilled and unskilled local labor will be feasible. Self-help by tenants or owners through completion of interior finishes is planned as a way to further economy and to achieve community involvement.

Development of the system and production facilities are in the design stage, but plants may be built locally as market conditions warrant.

Summary Information

SITE SYSTEM

1	Site Situation	
2	Density Range	1 TO 300 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTER
6	Nonresidential Functions	
7	Circulation	
8	Site Planning Services	PROPOSER
9	Community Involvement	
10	Utilities	CONVENTIONAL WITH SCHEDULE 50 PVC PIPING

BUILDING SYSTEMS

11	Housing Types	
12	Unit Variations	
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION FACILITIES REQUIRE FURTHER RESEARCH & DEVELOPMENT
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	SELF SUPPORTING, PRE-CAST CONCRETE VOLUMETRIC MODULE
17	Exterior Elements	EXTERIOR END WALLS FACTORY MADE FROM WOOD, PLASTIC, STEEL, ALUMINUM
18	Interior Elements	PREFABRICATED INTERIOR WOOD-FRAMED PARTITIONS
19	Foundations	
20	Comfort Systems	GAS-FIRED FORCED AIR HEATING; HEATING & COOLING INTEGRATED WITH BUILDING SYSTEM
21	Plumbing	PVC PLASTIC PIPE INTEGRATED WITH BUILDING SUBSYSTEM
22	Electrical	INTEGRATED WITH MODULE
23	Furnishings	

PRODUCTION

24	Offsite Production	FACTORY PRODUCED VOLUMETRIC MODULES
25	Onsite Production	
26	Onsite Construction	CONNECTION OF UNITS & UTILITIES HOOK-UP
27	Labor	SEMISKILLED AND UNSKILLED
28	Labor Training Programs	
29	Community Involvement	LOCAL LABOR; SELF-HELP

ECONOMICS

30	Construction Costs	$1,852 PER DWELLING UNIT FOR 35-UNIT BUILDING
31	Financing Methods	
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	ALL
35	External Functions	POSSIBLE SUBCONTRACTORS
36	Market Area	
37	Delivery Rate	
38	Consumer Protection	FIRE-RESISTANT CONSTRUCTION

GENERAL

39	Major Innovative Concepts	STANDARDIZATION OF DETAILS & MODULAR DIMENSIONS
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Alcoa

PROPOSER

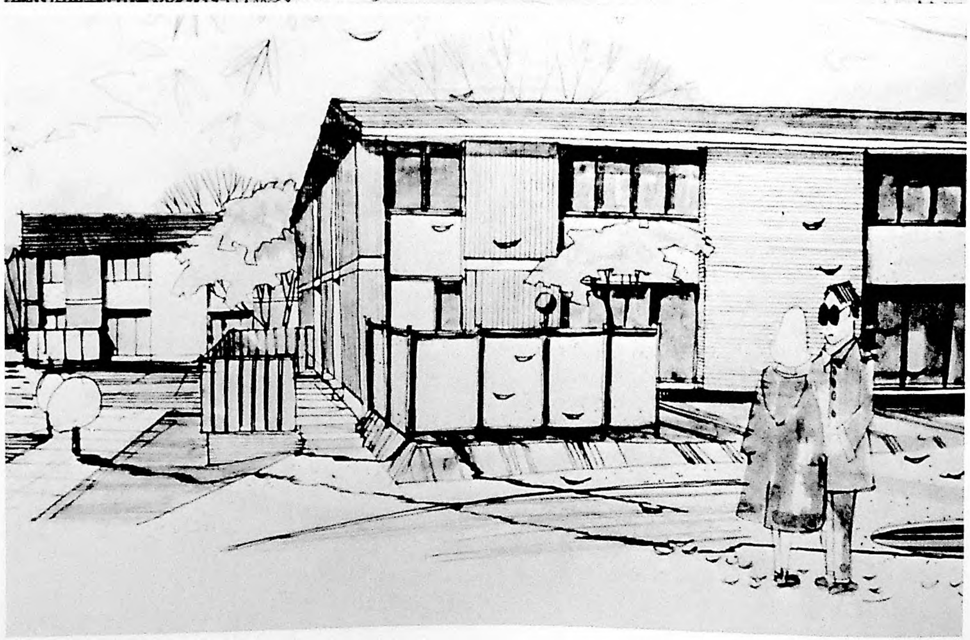
Aluminum Company of America, Pittsburgh, Pennsylvania

AFFILIATES

Alcoa Properties, Inc.; Alcoa Building Products, Inc.; Housing Corporation of America; Collins & Kronstadt-Leahy, Hogan, Collins, Architects-Engineers; Component Building Systems, Ltd.; Malcolm E. Dudley and Beacon Construction Company, Construction Consultant; Christian Frey, Architectural Consultant; Andrew T. Kostanecki, Inc., Industrial Designers; Ryan Homes, Inc., Home Builders; The Perkins & Will Partnership, Architects; Slayter Associates, Inc., Environmental Design and Technology; Tishman Research Corporation; Urban Design Associates, Architects and Planners; Urban Systems, Inc., Urban Consultants; American Standard, Plumbing Products; Amstore Corporation, Furniture Products; Borg-Warner Corporation, Mechanical Systems; Bryant Air Conditioning Company; Carrier Corporation; General Bronze Corporation, Architectural Metalwork; Otis Elevator Company; Rohr Corporation, Housing Systems; Tappan Company, Appliances; United States Gypsum Corporation; Whelan Manufacturing, Inc., Curtain Walls; BAW Construction Company, Inc.; Beacon Construction Company; C.W. Blakeslee & Sons, Inc., Contractors; Crossgates, Inc., Construction; Dickerson Enterprises, Construction; J.A. Jones Construction Company; Strescon Industries, Concrete Products; Sectional Structures, Inc., Modular Building Systems; Tishman Realty & Construction Company, Inc.

That industrialization not imply uniformity is the concern which underlies the proposer's approach in submitting this multifaceted proposal. Twelve different building systems, executed in a variety of mixes on six different site systems, comprise the proposal. And, although each system is a result of a rationalized, industrialized approach to manufacture of components and their erection, uniformity is minimized through the variety of combinations and permutations possible.

Common to the 12 systems is the concept that good housing production is the optimization of what can best be produced at the factory and what can best be produced at the job site. For example, high-cost elements—kitchens, bathrooms, laundry facilities, mechanical subsystems, stairways, and walls, floors, ceilings and finishes for these items—are particularly suited to standardization and assembly-line, in-plant manufacture. By combining many of these elements in a modular unit, the factory-controlled economies of industrialization are achieved, and the unit may eco-



nomically be shipped a considerable distance, since shipping costs are but a fraction of its total value. Service cores thus are basic to most of the 12 systems.

On the other hand, shipment over long distances of volumetric modules of relatively lesser-cost living space is economically unfeasible, shipping cost for space enclosures and air representing a large share of the total cost of the unit. Therefore, subsystems for enclosing space for the most part are shipped knocked-down and assembled onsite.

Each of the site systems proposed includes a mix of single-family dwellings and multifamily medium or high-rise structures, with the diversity afforded by the 12 building systems making each site plan distinctive and strong emphasis being placed on greenbelts and common open spaces.

Through the diversity of site and building system combinations, accommodation of a wide range of social groupings and income levels is anticipated, with local participation and involvement in site planning, construction, and possibly eventual ownership-management being fostered through establishment of a community advisory board.

Some, but not all, of the 12 systems proposed have been mass-produced; some are fully developed and being marketed. But the proposer, intending to utilize current technology to effectuate any or all of the systems, is confident that the means to produce the systems exists or can be arrived at readily. The proposer anticipates a total volume production capability of 12,000 units per year—1,000 units per system.

Four of the 12 building systems put forward are for medium- and high-rise structures, and each offers its own particular advantages, which may be more pertinent in one site situation than in another. The 12 building systems are as follows:

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; RURAL; VACANT URBAN STEEP LOTS; AIR RIGHTS
2 Density Range	MIXED DENSITIES: 40 TO 80 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	LINEAR PARK; PLANNED UNIT DEVELOPMENT; CLUSTERS; GREENBELTS; AIR-RIGHT SPACES
6 Nonresidential Functions	PLAYFIELDS; MEDICAL, COMMERCIAL, COMMUNITY, DAY-CARE & FACILITIES
7 Circulation	SEPARATE VEHICULAR & SERVICE TRAFFIC; GRID & LOOP STREETS; CUL-DE-SACS
8 Site Planning Services	
9 Community Involvement	COMMUNITY ADVISORY BOARD; DEVELOPER-COMMUNITY-RESIDENT PLANNING MEETINGS
10 Utilities	CONVENTIONAL; UNDERGROUND ELECTRICAL SERVICES

BUILDING SYSTEMS

11 Housing Types	
12 Unit Variations	
13 Design Selection	
14 State of Development	
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	
17 Exterior Elements	
18 Interior Elements	
19 Foundations	
20 Comfort Systems	
21 Plumbing	
22 Electrical	
23 Furnishings	

PRODUCTION

24 Offsite Production	
25 Onsite Production	
26 Onsite Construction	
27 Labor	UNSKILLED ONSITE
28 Labor Training Programs	MINORITY GROUP TRAINING FOR ONSITE CONSTRUCTION AND ERECTION
29 Community Involvement	USE OF LOCAL ARCHITECTS, LAWYERS, PLANNERS, AND DEVELOPERS; SELF-HELP

ECONOMICS

30 Construction Costs	
31 Financing Methods	WILL WORK WITH OTHERS TO DEVELOP INNOVATIONS IN FINANCING VEHICLES
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	RESEARCH & DEVELOPMENT; DESIGN; CONSTRUCTION
35 External Functions	ARCHITECTURAL DESIGN; ENVIRONMENTAL DESIGN; RESEARCH ON NEW MATERIALS
36 Market Area	
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR PER SYSTEM; 12,000 DWELLING UNITS, TOTAL, PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Alcoa (continued)

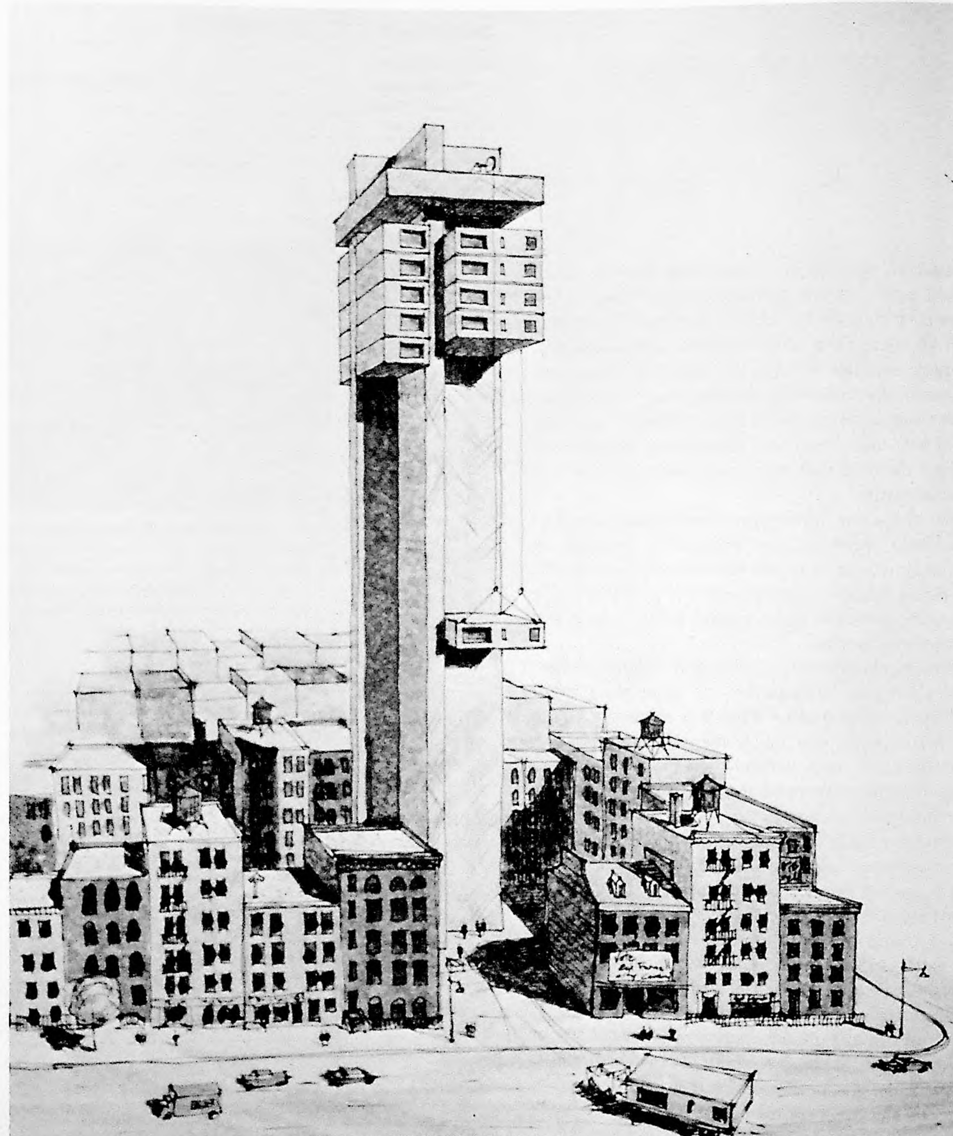
(1) The *tension-framed* system consists of steel- or aluminum-framed volumetric modules, suspended in series from pairs of deep steel trusses which span the tops of monolithic concrete core towers. Within these cores are elevators, stairwells, and utility ducts.

The modules, which may be factory- or site-assembled, are positioned under the temporary hoisting rig placed atop the trusses, and lifted up into position, the top-floor modules going into place first and being secured to the truss and the core. Then the module for the next lower floor is hoisted, secured to that above, and so on. Since each module is supported from above, there is not the usual crushing load on the lower units, as in bearing wall construction. This permits lightweight construction and the omission of modules for architectural effect, or modules may be recessed or projected to achieve textural relief.

The *tension-framed* system is considered particularly suitable in renewal situations because less ground space is needed during construction, permitting existing housing to remain in use until the new structure (10 to 30 stories) is ready for occupancy.

(2) The *steel-skeleton frame* system exemplifies the concept of optimization of operations best done at the site. Here, preengineered, prefabricated structural steel framing elements, floor trusses, and prestressed concrete floor slabs are speedily combined to outline a high-rise apartment building. Staggering of the trusses for alternate floors, bay-by-bay, not only effects a material savings, but also affords the required rigidity to the resultant structure.

The space delineated by the steel skeleton frame is closed in with aluminum, brick, or concrete modular panels, prefabricated and lifted into place on a CPM schedule, with aluminum balconies and trim adding architectural interest to the exterior. Storage wall modules, utility, bath and kitchen core, and conventional finishes complete the apartment suites, along with facilities for common use such as elevators, stairwells, and utility runs.



System No. 1

BUILDING SYSTEMS

11	Housing Types	MULTIFAMILY HIGH-RISE
12	Unit Variations	EFFICIENCIES, 1 & 2 BEDROOMS
13	Design Selection	FROM STANDARD PLANS
14	State of Development	BUILDING SYSTEMS, DESIGN STUDIES COMPLETED; PRODUCTION PLANT, OPERATIONAL
15	Community Involvement	COMMUNITY ADVISORY BOARD; DEVELOPER-COMMUNITY-RESIDENTS PLANNING MEETINGS

BUILDING SUBSYSTEMS

16	Structure	STEEL OR ALUMINUM-FRAME MODULES SUSPENDED FROM STEEL TRUSSES OVER CONCRETE TOWERS
17	Exterior Elements	ALUMINUM, BRICK OR CONCRETE SURFACES; ALUMINUM BALCONIES, TRIM & FINISHING
18	Interior Elements	STORAGE-WALL MODULES; ELEVATOR SHAFTS; STAIRWELLS; UTILITY & SERVICE FACILITIES
19	Foundations	CONVENTIONALLY DESIGNED
20	Comfort Systems	OPTIONAL ENERGY CENTRAL HYDRONIC HEATING; INTEGRATED COOLING
21	Plumbing	UNITIZED KITCHENS, BATHROOMS; SERVICE WALLS; PLASTIC PIPING; UNI-VENT WASTE SYSTEMS
22	Electrical	CONVENTIONAL; ALUMINUM WIRING; INTEGRATED WITH BUILDING SUBSYSTEMS
23	Furnishings	STORAGE-WALL MODULES; BUILT-IN FURNITURE, DRAWERED AND SHELVED UNITS

PRODUCTION

24	Offsite Production	MODULES; TRUSSES; UNITIZED KITCHENS & BATHROOMS; SERVICE & STORAGE WALLS
25	Onsite Production	OPTIONAL ASSEMBLY OF MODULES ON PREFABRICATED FRAMES
26	Onsite Construction	FOUNDATIONS; TOWERS, ELEVATORS, STAIRWELLS; TRUSSES; MODULE JOINING

System No. 2

BUILDING SYSTEMS

11	Housing Types	MULTIFAMILY HIGH-RISE
12	Unit Variations	EFFICIENCIES & 1 TO 3 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	STEEL SKELETON FRAME; FLOOR TRUSSES, CONCRETE, FIBERGLASS, OR METAL FLOOR PANELS
17	Exterior Elements	ALUMINUM, BRICK OR CONCRETE SURFACES; ALUMINUM BALCONIES, TRIM & FINISHING
18	Interior Elements	UTILITY CORE; STORAGE-WALL MODULES; CONVENTIONAL FINISHES
19	Foundations	CONVENTIONALLY DESIGNED
20	Comfort Systems	HEATING & COOLING SYSTEM PER DWELLING UNIT; INTEGRATED WITH UTILITY CORE
21	Plumbing	CONVENTIONAL; BATHROOM, KITCHEN, PLUMBING INTEGRATED IN UTILITY CORE
22	Electrical	CONVENTIONAL; ALUMINUM WIRING; INTEGRATED WITH SUBSYSTEMS
23	Furnishings	STORAGE-WALL MODULES; BUILT-IN FURNITURE, DRAWERED & SHELVED BEDROOM UNITS

PRODUCTION

24	Offsite Production	STEEL FRAME; FLOOR PANELS; UTILITY CORE; EXTERIOR WALLS; STORAGE-WALL MODULES
25	Onsite Production	
26	Onsite Construction	FOUNDATION; ERECTION OF FRAME & COMPONENTS; ELEVATORS; STAIRWELLS; HOOK-UPS
27	Labor	
28	Labor Training Programs	
29	Community Involvement	

ECONOMICS

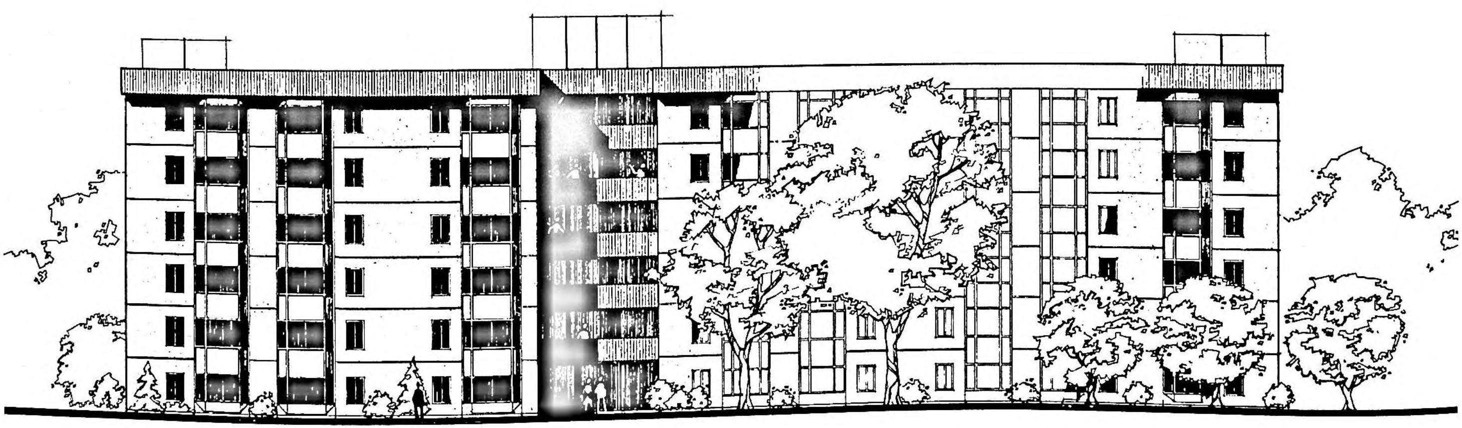
30	Construction Costs	\$16.00 PER SQUARE FOOT; \$14,800 PER UNIT
31	Financing Methods	
32	Useful Life	

Alcoa (continued)

(3) The *concrete-framed* system for efficiency and one-bedroom high-rise apartment buildings utilizes prefabricated, precast concrete modular wall and floor panels for assembly into a framed structure. The spaces outlined by the concrete framing members are closed in with aluminum, brick, or concrete surfaces, with aluminum balconies, trim and other finishing materials. Interior elements consist of storage-wall modules, unitized bathrooms and kitchens, and conventional finishes.

System No. 3

BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY HIGH-RISE
12 Unit Variations	EFFICIENCY & 1 BEDROOM
13 Design Selection	FLEXIBLE
14 State of Development	
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE WALL & FLOOR PANELS
17 Exterior Elements	ALUMINUM, BRICK OR CONCRETE SURFACES; ALUMINUM BALCONIES, TRIM & FINISHING
18 Interior Elements	STORAGE-WALL MODULES; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONALLY DESIGNED
20 Comfort Systems	OPTIONAL ENERGY CENTRAL HYDRONIC HEATING; INTEGRATED COOLING
21 Plumbing	UNITIZED KITCHEN & BATHROOMS; SERVICE WALLS; PLASTIC PIPING; UNI-VENT WASTE SYSTEM
22 Electrical	CONVENTIONAL; ALUMINUM WIRING; INTEGRATED WITH SUBSYSTEMS
23 Furnishings	
PRODUCTION	
24 Offsite Production	PANELS; UNITIZED KITCHENS AND BATHROOMS; SERVICE & STORAGE WALLS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF COMPONENTS; KITCHEN PLACEMENT & BATHROOM HOOK-UPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$21.60 PER SQ. FT.; $15,300 PER UNIT
31 Financing Methods	
32 Useful Life	



(4) The *componentized* system consists essentially of two subsystems: an apartment floor-framing module made up of open web joists and girders; and X-braced steel frames acting as columns. The floor-framing module, assembled off site, is complete with exterior spandrels, sliding window tracks, baluster, railings, air distribution ductwork including boots is relatively simple: a boom crane positions several vertical, X-braced frames for a typical bay and they are kept in position relative to each other by lateral bracing. Next, the crane lifts and slides into place, floor by floor, over the lateral bracing, the floor framing modules, there being approximate 6 in. of clearance between the edges of the module and vertical column members. As each module is tied into the X-bracing members, the resultant structure acquires rigidity.

Additional X-bracing is added to the original stacks of floor framing modules and the cycle repeated as the building grows horizontally to its design plan. The approximate 12 in. of space between the floor modules serves a dual function of providing for vertical and horizontal distribution of utilities and for acoustical treatment between apartments.

The *componentized* system is one of the lightest weight (dead load per sq. ft.) building systems in existence and is therefore particularly suitable for sites with marginal soil conditions.

System No. 4

BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY HIGH-RISE
12 Unit Variations	EFFICIENCY & 1 BEDROOM
13 Design Selection	FLEXIBLE
14 State of Development	
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	STEEL COLUMN & JOIST FRAME; STEEL FRAME FLOOR PANELS
17 Exterior Elements	ALUMINUM, BRICK OR CONCRETE SURFACES; ALUMINUM BALCONIES, TRIM & FINISHING
18 Interior Elements	STORAGE WALL-MODULES; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONALLY DESIGNED
20 Comfort Systems	OPTIONAL ENERGY CENTRAL HYDRONIC HEATING; INTEGRATED COOLING
21 Plumbing	UNITIZED KITCHENS, BATHROOMS; SERVICE WALLS; PLASTIC PIPING; UNI-VENT WASTE SYSTEM
22 Electrical	CONVENTIONAL; ALUMINUM WIRING; INTEGRATED WITH SUBSYSTEMS
23 Furnishings	PREFABRICATED STORAGE WALL MODULES; DRAWERED & SHELVED BEDROOM UNITS
PRODUCTION	
24 Offsite Production	FRAME & PANELS; UNITIZED KITCHENS AND BATHROOMS; SERVICE & STORAGE WALLS
25 Onsite Production	OPTIONAL ASSEMBLY OF MODULES ON PREFABRICATED FRAMES
26 Onsite Construction	FOUNDATIONS; FRAME & PANEL ERECTION; KITCHEN & BATHROOM PLACEMENT; HOOK-UPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$16.90 PER SQ. FT.; $14,700 PER UNIT
31 Financing Methods	
32 Useful Life	

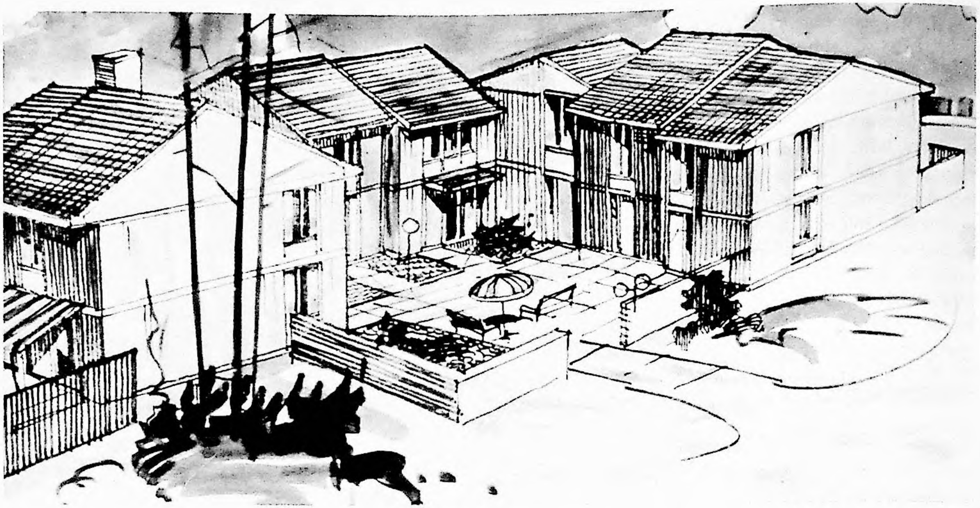
Alcoa (continued)

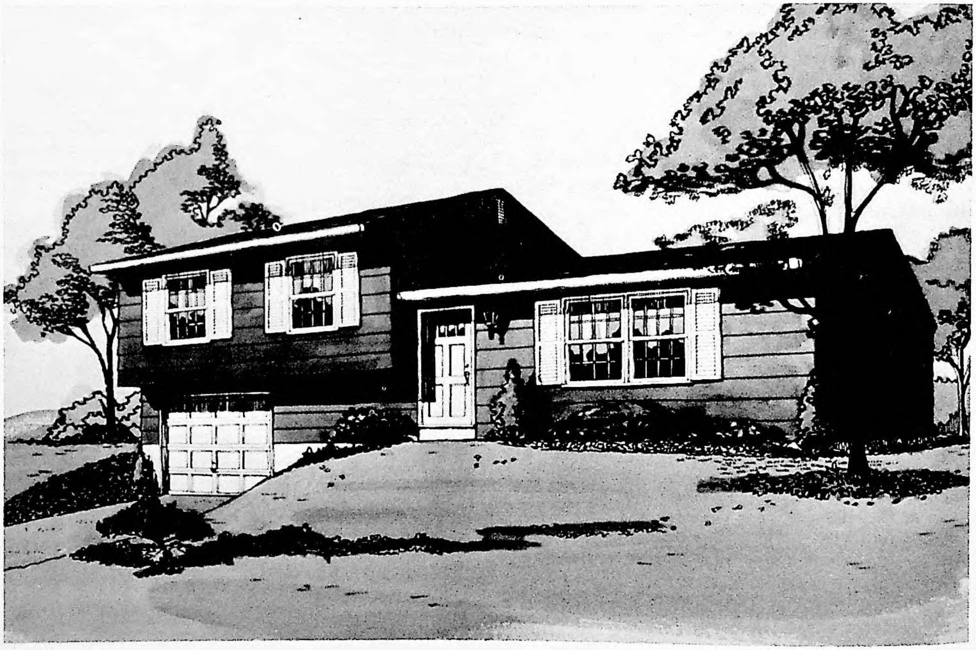
(5 through 12) All but two of the remaining eight building systems proposed are for single-family homes; the two exceptions being for low-rise apartment structures in two configurations—back-up units and through-the-building units. All of these systems are built of self-supporting, factory-fabricated wall, floor and roof panels.

Again reflecting the variety and diversity inherent in this approach, three types of walls may be furnished: (1) load-bearing sandwich construction, of prefinished, formed, ribbed aluminum sheet, polystyrene insulation, and gypsum-board interior finish, with windows, doors, flashing and trim included; (2) conventional wood-framed walls, with aluminum siding, sheathing, batt insulation and gypsum-board finish, complete with doors, windows and trim; and (3) aluminum-framed wall, with aluminum siding and gypsum-board finish. A veneer of brick or stone may be applied to the surface of the latter two wall types.

Basic to each of these housing systems is the service module with floor plans being designed around the several variations available. Modules for the townhouse plan include stairwells, as well as all mechanical services.

The eight single-family and low-rise systems afford a wide range of homes, from townhouses of two and three stories to one-story, single-family detached homes.

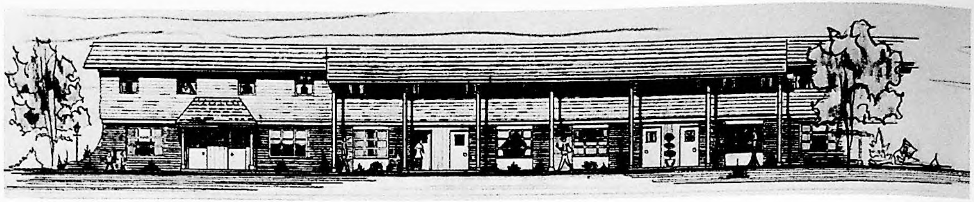


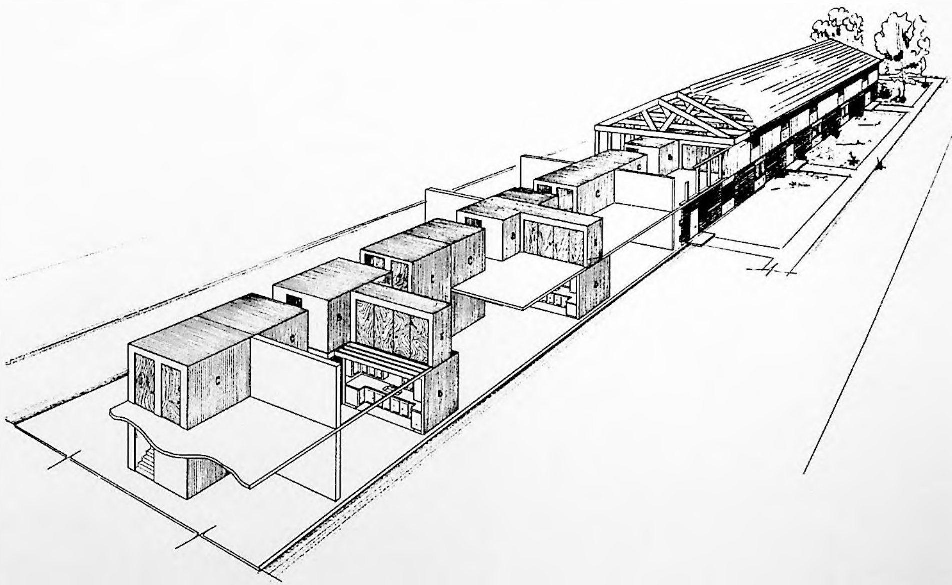


System No. 5 — System No. 12

BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 **Unit Variations**	2 TO 5 BEDROOMS
13 **Design Selection**	
14 **State of Development**	
15 **Community Involvement**	
BUILDING SUBSYSTEMS	
16 **Structure**	WALL, FLOOR & ROOF PANELS (OPTIONAL RIBBED ALUMINUM SHEET OR ALUMINUM OR WOOD FRAME)
17 **Exterior Elements**	ALUMINUM, BRICK VENEER OR STONE SURFACES; ALUMINUM TRIM & FINISHING MATERIALS
18 **Interior Elements**	UTILITY CORE; STORAGE WALL MODULES; CONVENTIONAL FINISHES
19 **Foundations**	CONVENTIONALLY DESIGNED
20 **Comfort Systems**	OPTIONAL FUEL CENTRAL FORCED AIR HEATING PER BUILDING; INTEGRATED COOLING
21 **Plumbing**	CONVENTIONAL; BATHROOM, KITCHEN, INTEGRATED IN SERVICE MODULE
22 **Electrical**	CONVENTIONAL; ALUMINUM WIRING; INTEGRATED WITH SUBSYSTEMS
23 **Furnishings**	STORAGE WALL MODULES; BUILT-IN FURNITURE, DRAWERED AND SHELVED BEDROOM UNITS
PRODUCTION	
24 **Offsite Production**	PANELS; SERVICE MODULE; STAIRWAYS; STORAGE WALL MODULES
25 **Onsite Production**	
26 **Onsite Construction**	FOUNDATION; PANEL & WALL ERECTION; (SERVICE MODULE) PLACEMENT; UTILITIES HOOK-UPS
27 **Labor**	
28 **Labor Training Programs**	
29 **Community Involvement**	
ECONOMICS	
30 **Construction Costs**	$9.30 TO $14.80 PER SQ. FT.; $10,600 TO $15,300 PER UNIT
31 **Financing Methods**	
32 **Useful Life**	

American Group





PROPOSER

The American Group, Inc., Plymouth, Michigan

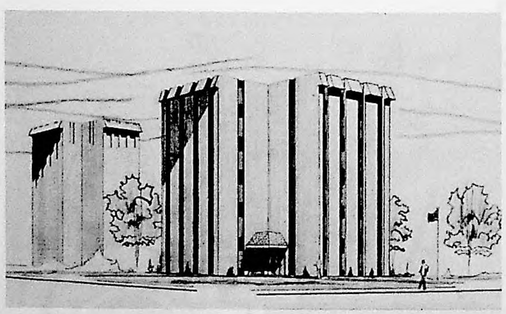
This system is referred to by the proposer as the Inside-Out method of construction. The proposer has borrowed techniques from the automobile industry, manufacturing the innermost components first and then placing the outer envelope over the assembled parts. The approach saves a significant amount of on-site labor and material consumed in conventional frame building. This might be termed phased, or sequence, construction, proceeding from foundation and utility layout through foundation construction and utility roughin to placement of factory-built components, including utility room, bath and kitchen, and stairwell and closets. The final construction phase involves lifting of the exterior walls and roof framing, lifting interior partitions into place and completing final component hookups and miscellaneous detail work.

This innovative sequence of construction, tested, built, and operational, permits wide flexibility for interior layout. The processes are sufficiently simple that, under supervision, semi-skilled and unskilled labor can perform the site assembly tasks. Skilled and semiskilled workers would be employed in component manufacturing plants, offering an expanded local labor market wherever these are located. In this phased approach, utility room component construction is scheduled to begin when initial site work gets underway. This close timing, carried on through the entire process, effects a major cost saving, and provides shelter more rapidly than systems not similarly phased.

The building system is basically the volumetric module and panels for enclosure. Four module sizes are stated: 8 ft. x 9 ft., 8 ft. x 12 ft., 6 ft. x 12 ft., and 16 ft. x 12 ft. Panels for exterior application are wood frame and comprise a self-supporting unit when in place. Interior partitions, nonstructural, are also factory produced. Both kitchen and bathroom subsystems employ 1/2-in. gypsum board for wall and ceiling construction with all surfaces painted. Heating for each living unit is supplied through electric baseboard runs.

A producing corporation with central responsibility is proposed for manufacturing components and merchandising the finished units. Local component production plants and equipment would be licensed, local builders employed, and union labor used to place components and erect the envelope. Training for local plant managers is proposed, to cover management and business techniques.

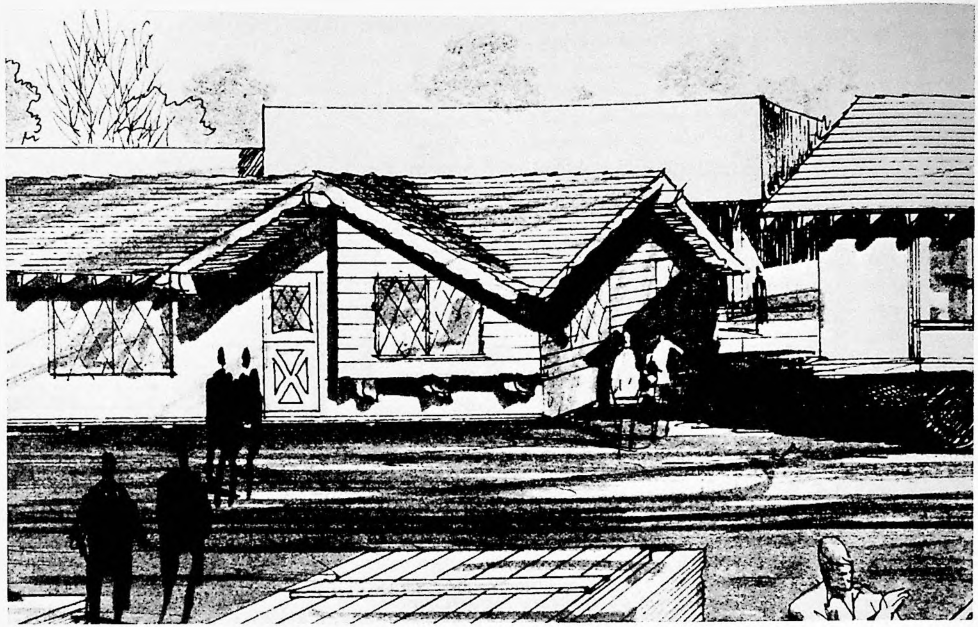
In certain circumstances, individuals could assist in the assembly of their own housing with limited training and supervision. Provision is made in user considerations for expansion of living space as occupant families increase in size. The housing is readily adaptable for elderly persons.



Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	13.29 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; FLEXIBILITY OF MOVEMENT
6 Nonresidential Functions	RECREATIONAL FACILITIES; PLANNED LEISURE AREAS
7 Circulation	CUL-DE-SACS; CURVILINEAR STREETS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOWRISE & HIGHRISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	DESIGN PHASE COMPLETED, READY FOR FULL SCALE PRODUCTION
15 Community Involvement	LOCAL CONTRACTORS
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC SELF-SUPPORTED WOOD FRAME MODULE
17 Exterior Elements	FACTORY FABRICATED EXTERIOR WALLS & ROOF FRAMING
18 Interior Elements	BATHROOM, KITCHEN, UTILITY ROOM COMPONENTS
19 Foundations	CONVENTIONAL
20 Comfort Systems	CONVENTIONAL ELECTRIC BASEBOARD HEAT
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM IN FACTORY
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM IN FACTORY
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULES; WALLS; PANELS
25 Onsite Production	
26 Onsite Construction	ASSEMBLY
27 Labor	SEMISKILLED
28 Labor Training Programs	TRAINING LOCAL PLANT MANAGERS & ERECTION CREWS
29 Community Involvement	LOCAL PLANTS USING LOCAL LABOR
ECONOMICS	
30 Construction Costs	
31 Financing Methods	CONVENTIONAL
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	SEQUENCE OF CONSTRUCTION
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

American Home Industries



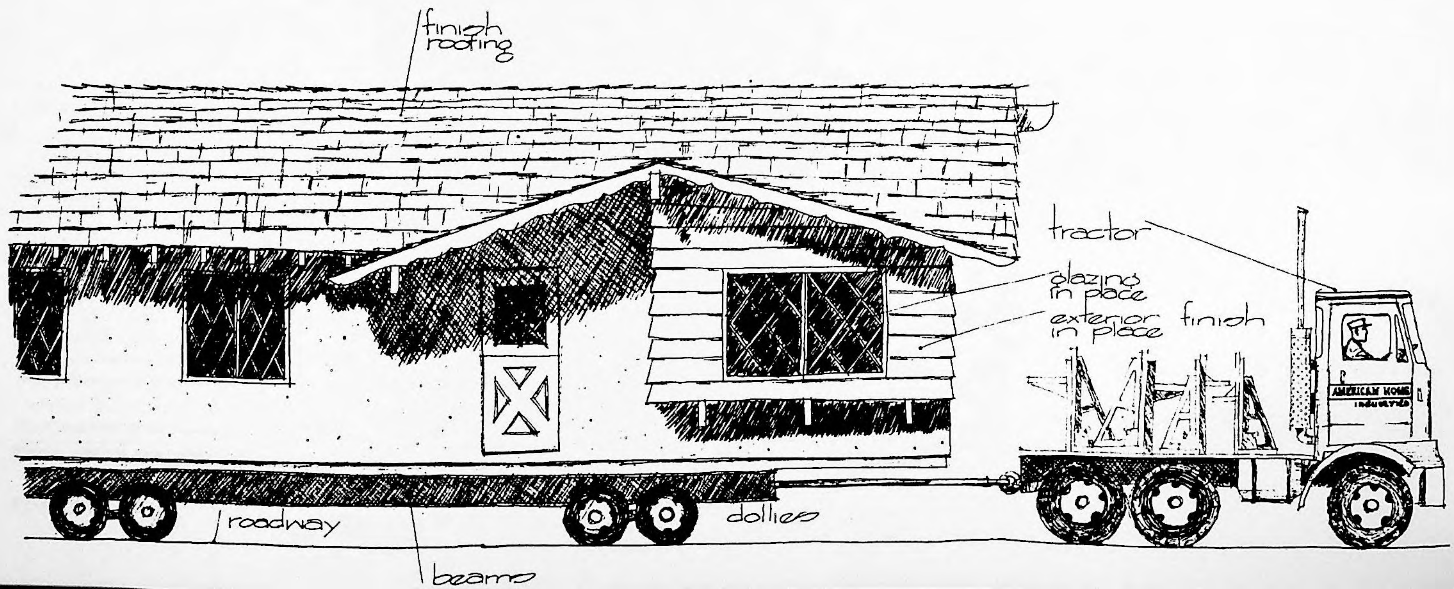
PROPOSER CONSORTIUM

Dave Gardner Cross Associates, Architects and Planners; Bakersfield, California
Mobil Home Corporation; Bakersfield, California
John Deeter; Bakersfield, California

AFFILIATES

North American Rockwell Corporation

Nearly complete factory fabrication is a feature of this proposal, with a volume production of up to 2,000 units per year proposed. Very little site work is required—a minimum of roof, flooring, and interior finish work. Kitchen, bathroom, heating, cooling, ventilating, and electrical components are prefabricated and factory-installed in the volumetric module before shipment to the site as is the precast concrete foundation-floor element.



Preassembled wood-frame wall units are set in place by using assembly line techniques. Mechanical core assemblies are installed on the concrete foundation floor. The roof structure and roofing are plant-installed, and final interior work and cabinetry form the final phase of the plant operation. The frame box portions of the system are trucked to site and erected with unskilled labor. The modules measure 12 ft. wide and vary in length up to 50 ft. Interior finish floor consists of conventional tile and/or carpeting.

The system is presently developed and is being marketed with trial marketing proposed by location. Self-help labor can be used for all steps of construction, and the tenant can relocate his home.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN; RURAL
2	Density Range	3 TO 30 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	COMMON OPEN SPACES
6	Nonresidential Functions	POOL; PLAYGROUND; CHILD CARE CENTER; SCHOOLS; OFFICE FACILITIES
7	Circulation	SEPARATE PEDESTRIAN CIRCULATION; CURVILINEAR THROUGH STREETS; CUL-DE-SACS
8	Site Planning Services	
9	Community Involvement	
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	EFFICIENCY; 1 TO 5 BEDROOMS
13	Design Selection	
14	State of Development	BUILDING SYSTEM—COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WOOD FRAME, CONCRETE SLAB VOLUMETRIC MODULES FOR PARTIAL OR COMPLETE LIVING UNITS
17	Exterior Elements	FOLD-DOWN ROOF OVERHANG; BAY WINDOWS; CONVENTIONAL FINISHES
18	Interior Elements	CONVENTIONAL FINISHES
19	Foundations	CONCRETE FLOOR SLAB INTEGRAL WITH MODULE
20	Comfort Systems	CENTRAL FORCED WARM AIR GAS OR ELECTRIC INTEGRATED HEATING & COOLING
21	Plumbing	COPPER OR PVC PLUMBING ASSEMBLY CORE; KITCHEN-BATH PACKAGES
22	Electrical	INTEGRATED WITH BUILDING SUBSYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES WITH FOUNDATION-FLOOR; MECHANICAL-ELECTRICAL ASSEMBLIES
25	Onsite Production	OPTIONAL ONSITE MODULE PRODUCTION FOR SITES OF MORE THAN 300 DWELLING UNITS
26	Onsite Construction	PLACING AND JOINING MODULES; FLOORING & INTERIOR FINISHING
27	Labor	UNSKILLED, SEMISKILLED, & SKILLED FOR PLANT PRODUCTION & SITE CONSTRUCTION
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS; SELF-HELP FOR CONSTRUCTION

ECONOMICS

30	Construction Costs	\$5.05 PER SQ. FT.
31	Financing Methods	
32	Useful Life	BUILDING—30 TO 50 YEARS

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	PLANNING, PRODUCTION, MARKETING, LAND DEVELOPMENT, CENTRAL RESPONSIBILITY
35	External Functions	MANAGEMENT SYSTEMS DEVELOPMENT
36	Market Area	
37	Delivery Rate	500 TO 2,000 UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

American Systems Building Company

PROPOSER CONSORTIUM

American Systems Building Company, Inc., Washington, D.C.
Constructions Edmond Coignet S.A., Paris, France
Charles H. Brewer, Architect, New Haven, Connecticut
John S. Coke, Architect, Columbus, Ohio

AFFILIATES

Syska & Hennessy Inc., Engineers; Trans World Financial Company

The building system proposed is adaptable for single-family attached housing, but emphasis is placed on high-rise construction, with structures up to 25 stories being the most economical. A 12-story building of 130 units requires 4 months' total construction time. Unskilled labor can be used for the most part both in the factory and onsite.

Structurally, this French-developed system provides volume housing by joining precast concrete components onsite by pouring concrete into component voids. Exterior walls (sandwich panels with expanded polystyrene cores for insulation) are cast in horizontal beds in enclosed plants. These components are transported to the site in vehicles equipped with special shock absorbers and are erected story by story by conventional cranes. Partitions and small floor slabs are cast vertically in the plant and transported similarly. All are manufactured to close tolerances.

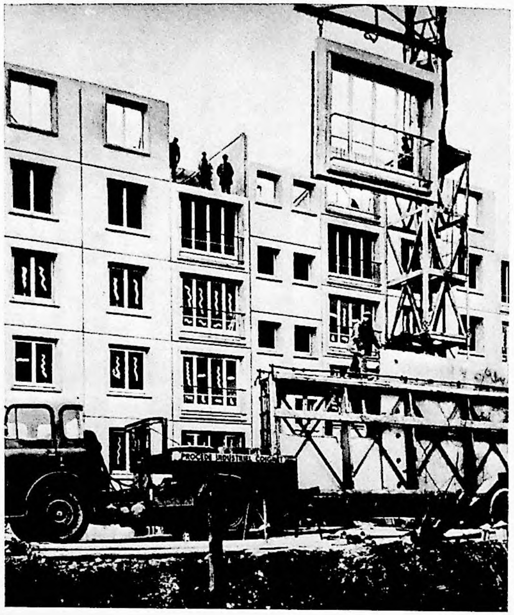
The average apartment contains 23 components with windows glazed and all mechanical and electrical installation work done at the manufacturing site. Only connections are required at the building site.

Floor components are cast in room size, and finely finished ceiling slabs are painted after installation. Exterior wall finish can be any type, with brick cladding one of the proposed methods. Slabs are stored for 2 to 3 weeks after casting in special plant locations before transportation to site.

Field connection techniques involve two concrete projections per panel. These are held by simple stays while the continuity concrete is poured. Plastic gaskets and fabric flashings make the joints watertight.

A central heating plant for large-scale developments provides hot water for circulation through pipes embedded in the floor slab.

Some 70,000 units employing this system have been constructed in several foreign countries.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN; RURAL; URBAN RENEWAL
2	Density Range	210 TO 290 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY WHERE CRANE CAN BE USED
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	INFILL HOUSING; MOST ECONOMICAL IN 25-STORY TOWERS
6	Nonresidential Functions	COMMON OPEN SPACES; PLAYGROUND; SWIMMING POOL; BATH HOUSE
7	Circulation	CURVILINEAR CIRCULATION UTILIZING CUL DE SACS; HUMPS IN PAVEMENT TO SLOW TRAFFIC
8	Site Planning Services	COMPLETE PLANNING SERVICES AVAILABLE
9	Community Involvement	SITE PLANNING TO CONFORM TO USER NEEDS
10	Utilities	CONVENTIONAL PLUMBING & ELECTRIC; PNEUMATIC GARBAGE COLLECTION & INCINERATION SYSTEM

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY HIGH-RISE
12	Unit Variations	1 TO 6 BEDROOMS; EFFICIENCY APARTMENTS IN HIGH-RISE
13	Design Selection	SELECTION FROM STANDARD PLANS; ADAPTABLE TO PLANS CONVENTIONALLY PREPARED
14	State of Development	PRODUCTION & BUILDING SYSTEMS OPERATIONAL IN SEVERAL FOREIGN COUNTRIES
15	Community Involvement	FINISHES, BUILDING DESIGN (UNIT TYPES & SIZES) TO REFLECT USER NEEDS

BUILDING SUBSYSTEMS

16	Structure	PRECAST CONCRETE FLOORS & WALLS & EXTERIOR WALL PANELS (POLYSTYRENE CORE)
17	Exterior Elements	PRECAST CONCRETE PANELS
18	Interior Elements	PRECAST CONCRETE PARTITIONS; ELEVATOR TOWERS (HIGH-RISE)
19	Foundations	CONVENTIONAL FOUNDATIONS DESIGNED FOR SPECIFIC SITE CONDITIONS
20	Comfort Systems	CENTRAL HYDRONIC (BASEBOARD) HEATING; OPTIONAL RADIANT PANEL SYSTEM
21	Plumbing	INTEGRATED WITH THE BUILDING SUBSYSTEM; PREFABRICATED PLUMBING WALL
22	Electrical	PROVISION FOR TELEVISION ANTENNA, TELEPHONE & DUAL INTERCOM SYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	PRECAST CONCRETE WALLS & FLOOR SLABS; FABRICATED BATHROOMS; COMPONENT PANELS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; COMPONENT ASSEMBLY WITH CAST-IN-PLACE CONCRETE; FINISHES
27	Labor	UNSKILLED FOR FACTORY & SITE
28	Labor Training Programs	LOCAL FACTORY & SITE LABOR TRAINING
29	Community Involvement	SELF-HELP POSSIBLE; PARTICIPATION IN FACTORY OWNERSHIP & OPERATION

ECONOMICS

30	Construction Costs	
31	Financing Methods	CONVENTIONAL; MARKET RATE 75% LOAN BY LOCAL BANK & 25% BY MAJOR BUSINESS
32	Useful Life	

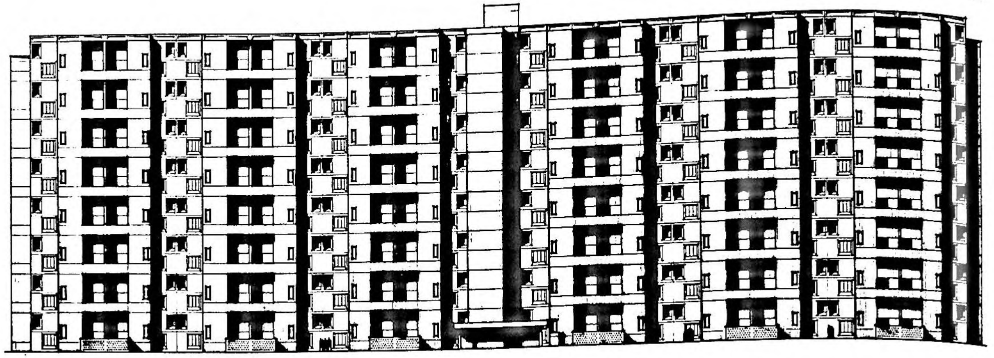
MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	DESIGN CONCEPT; LAND USE CONCEPTS; COST PROJECTIONS; MARKETING
35	External Functions	FINANCING
36	Market Area	NATIONAL
37	Delivery Rate	4 TO 6 DWELLING UNITS PER DAY PER FACTORY
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	RADIANT PANEL HEATING; COMPONENT JOINING OF BUILDING SYSTEM
40	Codes	

Ashtrom-Cafritz



PROPOSER CONSORTIUM

Ashtrom-Cafritz, Washington, D.C.

AFFILIATES

Cohen, Haft & Associates, Architects; Shefferman & Bigelson Company, Mechanical Engineers; T.D. Donovan & Associates, Land Planners; Tadjer-Cohen Associates, Structural Engineers; Housing Development Corporation; J. Bory, Cebus, U.S., Inc., System Technical Advisor

Use of a panelized, precast-concrete construction system is proposed for single-family attached and multifamily low- and high-rise structures. This system (known as the Cebus system, developed in France) utilizes room-sized floor panel elements, load-bearing crosswalls, exterior walls, interior walls and partitions, and many other components to build a self-supporting structure of up to 25 stories. The system is completely developed and an onsite production facility is in operation in Maryland, producing the precast elements for construction of a home for the elderly. The proposer states that a 12,000 sq. ft. plant would be required to achieve an optimum production of 600 units per year.

The panels of stone-concrete and conventional reinforcements, some of which may weigh up to 10 tons, may be cast offsite and moved to the site where they are crane-placed and joined. Although leveling usually is precise, the components having been shaped for close, correct fit, field adjustments may be made with wood wedges or threaded bolts. Temporary shoring, when required, supports the panels while the field-cast joint is being made, with the threaded bolts being retracted to avoid any point support of the panels. Tie beams across the joints especially in the plane of the floor slabs, reinforce the joints.

Exterior wall panels are nonbearing (carrying only their own weight and the weight of similar panels above), except at the corners of building where they share the floor panel load with the structural crosswalls. Cross section of a typical exterior wall panel is 3-in. outer face, 1-in. insulation (polystyrene or similar), and 4-in. load-bearing concrete inner face. The

panels may be finished with a variety of exterior treatments, but interiors are smooth-finished, as are the interior walls and partitions.

The floor slabs are smooth-finished, ready for installation of carpeting, wood, tile or plastic wearing surface, while ceilings (the soffits of the floor slabs) also are smooth-finished, ready for painting.

Much of each dwelling unit's mechanical services would be concentrated in a service wall incorporating not only plumbing, drainage and wiring, but also a refuse chute and ventilation. This service wall is expected to be precast in the offsite factory. Separate central heating and cooling systems will be provided for each dwelling unit, with heat distribution being by coils and chilled air by registers. The cooling system will be linked to its refrigerant lines previously built into the floor slab.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN RENEWAL; URBAN
2 Density Range	12 TO 50 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	COMMON OPEN SPACES; SWIMMING FACILITIES; COMMUNITY BUILDING
7 Circulation	STREET GRID; CUL-DE-SACS; SIDEWALKS; PLAZA
8 Site Planning Services	SITE PLANNER; COMMUNITY PARTICIPATION
9 Community Involvement	PARTICIPATION IN SITE PLANNING
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS OR CUSTOM DESIGN
14 State of Development	ONSITE PRODUCTION PLANT IN OPERATION; BUILDING SYSTEM MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	STRUCTURAL PRECAST CONCRETE FLOOR & ROOF PANELS & WALLS; CAST-IN-PLACE JOINTS
17 Exterior Elements	NONBEARING CONCRETE WALL PANELS; BALCONIES; OUTSIDE WEATHERING FACE
18 Interior Elements	CONCRETE PARTITIONS; STAIRS; REFUSE CHUTE PRECAST IN SERVICE WALL
19 Foundations	EITHER PRECAST OR CONVENTIONAL
20 Comfort Systems	HEAT DISTRIBUTED BY COILS; COOLING REFRIGERANT LINES INTEGRATED IN FLOOR SLABS
21 Plumbing	PLUMBING & DRAINAGE CONCENTRATED IN PRECAST SERVICE WALL
22 Electrical	WIRING IN PRECAST SERVICE WALL
23 Furnishings	
PRODUCTION	
24 Offsite Production	CONCRETE WALLS; CONCRETE FLOOR & ROOF PANELS; STAIRS; SERVICE WALLS; TIE BEAMS
25 Onsite Production	OPTIONAL ONSITE PRODUCTION OF MAJOR COMPONENTS
26 Onsite Construction	FOUNDATION; ERECTION OF PANELS & ELEMENTS; POURING OF CONCRETE JOINTS
27 Labor	SKILLED TRADESMEN; SEMI-SKILLED CONSTRUCTION WORKERS; UNSKILLED FACTORY WORKERS
28 Labor Training Programs	ON-THE-JOB
29 Community Involvement	LOCAL LABOR; SELF-HELP FABRICATION, PAINTING, FLOORING & INSTALLATION
ECONOMICS	
30 Construction Costs	$9,220 TO $13,820 PER DWELLING UNIT, 600 UNITS PER YEAR
31 Financing Methods	USE OF GOVERNMENT SUBSIDY PROGRAMS
32 Useful Life	MECHANICAL & ROOFING—25 YEARS; FLOOR COVERING/CABINETS/APPLIANCES—15 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	OVERALL DESIGN, MANAGEMENT, PRODUCTION & CONSTRUCTION
35 External Functions	
36 Market Area	100 TO 150 MILE RADIUS FROM PLANT
37 Delivery Rate	600 UNITS PER YEAR, OPTIMUM
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	CONFORMS TO APPLICABLE CODES

Associated Home Builders of Greater East Bay

PROPOSER

Associated Home Builders of Greater East Bay, Berkeley, California

AFFILIATES

Gentry Companies, Developers; Norman Dyer, Architect and Planner

Single-family attached homes, incorporating private patio courtyards comprise the housing system being proposed. The homes are built side-by-side and back-to-back at a density of 10 per gross acre, on lots about 3/5th the normal subdivision size. However, living space is ample, and privacy is achieved by siting each unit and all its individual rooms around a large, walled-in patio.

Despite this intensive land use, only about half of the small lot actually is occupied by structure, the patio-court-yard, a parking apron and landscaped front yard accounting for the balance of the area.

Although the proposed housing is of conventional wood, platform frame (supported by steel foundation beams on individually set jacks), two major factors set it apart from usual construction. First, wall stud spacing is increased to 24 in. on center (instead of the conventional 16 in.), employing only less expensive utility grade lumber; and second, a portable, relocatable, production facility using mobile home production techniques, is proposed for onsite manufacture of the homes.

To support the use of increased stud spacing, a test structure having Engelmann spruce (utility grade) studs on 24-in. centers stood up under a 19,800-lb. roof load and a wind force on the the naked studs of 92 mph. After the siding was applied, the structure successfully withstood gale force winds of 120 mph. Use of this stud spacing would be expected to save from $200 to $300 per home.

There being no openings in the walls abutting neighboring structures, no side of the patio is adjoined by living or dining areas, and a 9-ft. high concrete wall encloses the patio completing visual privacy between houses. Audio privacy is protected by acoustical treatment of the walls and by having no patios adjoining each other. Exterior finishes for the homes may be prefinished plywood, and the interior may be prefinished with conventional materials.

Instead of the conventional plumbing stacks piercing the roof, the proposer reduces the vent size from the usual 2-in. stack to 3/4 in. and exhausts them through the eaves. This innovative concept, which also has been successfully tested, is expected to reduce initial plumbing outlay and prevent future maintenance problems.

Heating of the proposed homes is to be an integrated electrically powered water-space heating-cooling unit which is expected to reduce construction expenses through minimizing onsite installation time and to reduce operating costs. All other appliances and equipment are electric, with service for the project and hookup being underground.

The proposed portable, assembly-line plant for onsite manufacture of the houses is still in the thinking-planning-evaluation stage, and prototype homes are being erected presently using conventional building methods.

Self-help in onsite production of the proposed system is expected to be possible for anyone having a sixth grade education and having average manual dexterity. Because of the basic system's flexibility, modifications of the structure are expected to pose no difficulty, although in the case of the patio floor plan, additions could not be made which would go beyond the exterior side or rear walls.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	10 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PRIVATE PATIO COURTYARDS
6 Nonresidential Functions	NEIGHBORHOOD PARK
7 Circulation	CUL-DE-SAC; LOOP STREETS; SEPARATION OF PEDESTRIAN & VEHICULAR CIRCULATION
8 Site Planning Services	BY PROPOSER ORGANIZATION
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED
12 Unit Variations	3 BEDROOMS
13 Design Selection	
14 State of Development	PRODUCTION PLANT, DESIGN STAGE; BUILDING SYSTEM, DEVELOPED BUT NOT MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	CONVENTIONAL WOOD-FRAME
17 Exterior Elements	PRE-FINISHED PLYWOOD WALLS
18 Interior Elements	PRE-FINISHED WALLS
19 Foundations	STEEL BEAM SYSTEM WITH INDIVIDUALLY SET JACKS
20 Comfort Systems	INTEGRATED WATER SPACE HEATING & COOLING UNIT
21 Plumbing	PLASTIC VENT STACKS EXHAUSTED THROUGH EAVES
22 Electrical	CONVENTIONAL
23 Furnishings	

PRODUCTION

24 Offsite Production	STEEL FOUNDATIONS ELEMENTS
25 Onsite Production	WOOD FRAME COMPONENTS (PORTABLE FACTORY)
26 Onsite Construction	FOUNDATION; CONVENTIONAL ERECTION
27 Labor	SEMISKILLED; UNSKILLED
28 Labor Training Programs	LABOR TRAINING PROGRAMS
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP

ECONOMICS

30 Construction Costs	$10.00 PER SQ. FT., 1000 UNITS PER YEAR
31 Financing Methods	CONVENTIONAL
32 Useful Life	ROOF-25 YEARS; OTHER SYSTEMS-50 YEARS

MANAGEMENT

33 Proposer Organization	ASSOCIATION
34 Internal Functions	PRODUCTION; ARCHITECTURE; PLANNING
35 External Functions	DESIGN ENGINEERING
36 Market Area	
37 Delivery Rate	1,000 UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	REDUCED-SIZE PLASTIC VENT STACK EXHAUSTED THROUGH EAVES
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Bechtel Corporation

PROPOSER CONSORTIUM

Bechtel Corporation, San Francisco, California
Stressed Structures, Inc., Denver, Colorado
Building Systems Development, Inc., San Francisco, California

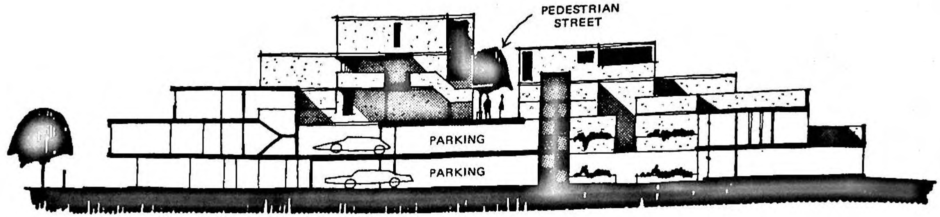
AFFILIATES

Northern California Uniment, West Coast Fabrication Subcontractor; Atlantic States Uniment, East Coast Fabrication Subcontractor

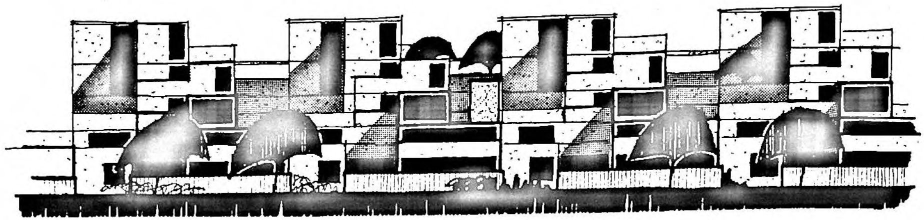
Modular, completely or partially enclosed concrete modules that utilize an expansive cement to become self-stressing, permitting use of thinner (thus lighter) sections, can be assembled into single-family and multi-family low- or high-rise dwellings under the concept proposed. In single-family or low-rise configurations, the modules become the structural system as well as dwelling unit components; in high-rise structures an additional structural frame is required. A volume production of 5,000 units per year is projected, and the system is also planned for use in constructing ancillary structures such as central laundry facilities, commercial and service facilities.

The size, shape and appearance of the individual modules and the location of openings can be varied to suit most residential requirements. Finish textures can be of many types, and flat, pitched, or vaulted roof designs are feasible. Size is limited, of course, by shipping restrictions—but with the capability of forming double-sized spaces from castings with one side omitted, the shipping limitation does not impose dimensional constraints.

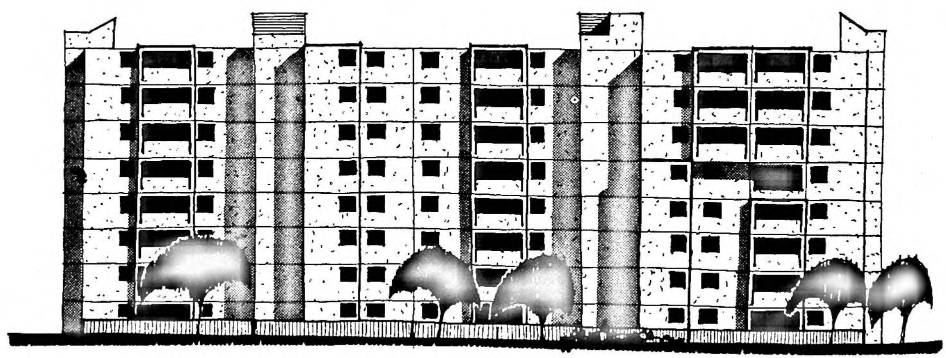
Basic element of structure and enclosure is a three-dimensional casting of reinforced concrete, made with high-strength mesh reinforcement, lightweight aggregates and controlled expansive cement. A typical casting is formed in two pieces, joined together at the factory as a rectangular box, and includes integrally-cast partitions. A ribbed ceiling and a ribbed floor slab are cast integrally with the walls and partitions. With the



SECTION



ELEVATION



exception of the ribs in the slabs, all walls are approximately 2 in. thick. (Partitions not of concrete may be installed, if desired, after casting.)

In a typical casting, the ribs in both floors and ceilings are offset, and stop short of the opposing slab (when a second box is placed above), thus providing a plenum space that can be used for distribution of air and other services. And, since the ribs are not in contact with the slab above, impact noise transmission is considerably lessened. In multi-story buildings, the castings are placed side by side, separated by a gap, the size of which is determined by plumbing and structural needs. Voids between castings in any type of structure can provide sound insulation between units and space for distribution of services. In addition, where required, insulation can be applied to the inner or outer faces of a wall, or can be cast into the center.

Onsite construction consists mainly of grading, foundation work, installation of utility distribution systems, and erection and of joining modules. Modules may be projected, recessed, set diagonally with reference to the building line, or even set on end vertically. The inherent strength of the modular structure makes large cantilevers practical and safe.

Connection of the modules can be either by bolting (recommended for up to three-story construction), by welding of inserted steel connections, or by cast-in-place concrete joints.

The units are as completely finished as possible in the factory with smooth walls, ceilings and floors, and may be further finished to include paint or other wall covering, floor coverings, complete kitchen and bathroom utilities and cabinetry, and doors and windows. In low-rise structures, a counterflow gas-fired furnace with or without air conditioning equipment is mounted for warm air heating through the plenum; in large-scale structures, a central heating and air conditioning plant is used, with fan-coil units substituted for local heaters. Standard plumbing materials and techniques are used, with vertical runs passing through blocked-out sections of the concrete floor.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	2 to 40 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	TERRACE HOUSING; PLANNED UNIT DEVELOPMENT; CLUSTERS; COURTYARD ATRIUM
6 Nonresidential Functions	DAY CARE, NURSERY SCHOOL, LAUNDRY, COMMERCIAL & SERVICE FACILITIES
7 Circulation	
8 Site Planning Services	
9 Community Involvement	COMMUNITY PARTICIPATION ENCOURAGED IN SITE PLANNING
10 Utilities	CENTRAL GAS SERVICE

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
14 State of Development	PRODUCTION FACILITIES OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	PROSPECTIVE BUYERS TO WORK WITH ARCHITECT TO MAKE PRESENTATION OF MODELS

BUILDING SUBSYSTEMS

16 Structure	SELF-SUPPORTING PRECAST CONCRETE MODULE; PARTIALLY CANTILEVERED
17 Exterior Elements	PORCHES; BALCONIES; PREFABRICATED EXTERIOR WALLS
18 Interior Elements	SELF-SUPPORTING BATHROOM, KITCHEN & STORAGE MODULES; INTERIOR PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS WARM AIR HEATING, OPTIONAL COOLING; HIGH-RISE CENTRAL HEATING-COOLING SYSTEM
21 Plumbing	FIXTURES & PIPING INTEGRATED IN MODULE
22 Electrical	ELECTRICAL WIRING HARNESS INTEGRATED IN MODULE
23 Furnishings	

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES & COMPONENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF VOLUMETRIC MODULES; UTILITY HOOK-UPS
27 Labor	SOME SKILLED TRADES IN PLANT & ONSITE
28 Labor Training Programs	LOCAL AREA RESIDENTS EMPLOYED AS TRAINEES OR JOURNEYMEN
29 Community Involvement	USE OF LOCAL SUBCONTRACTORS; ADAPTABLE TO SELF-HELP PROJECTS

ECONOMICS

30 Construction Costs	$9.92 PER SQ. FT., 5,000 DWELLING UNITS PER YEAR
31 Financing Methods	
32 Useful Life	STRUCTURE—100 YEARS

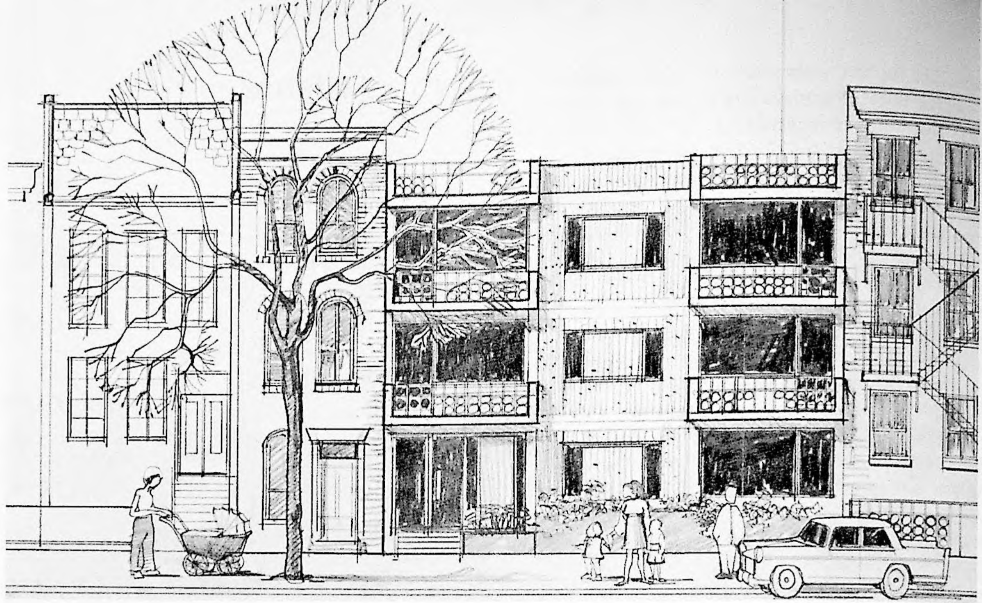
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	CONSTRUCTION; ADMINISTRATION; PRODUCTION ENGINEERING; DESIGN FABRICATION
35 External Functions	ARCHITECTURAL DESIGN, FABRICATION
36 Market Area	50 MILE RADIUS OF PLANT
37 Delivery Rate	5,000 UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM: CONCRETE MATERIALS; INTEGRATED PLUMBING & WIRING HARNESS
40 Codes	

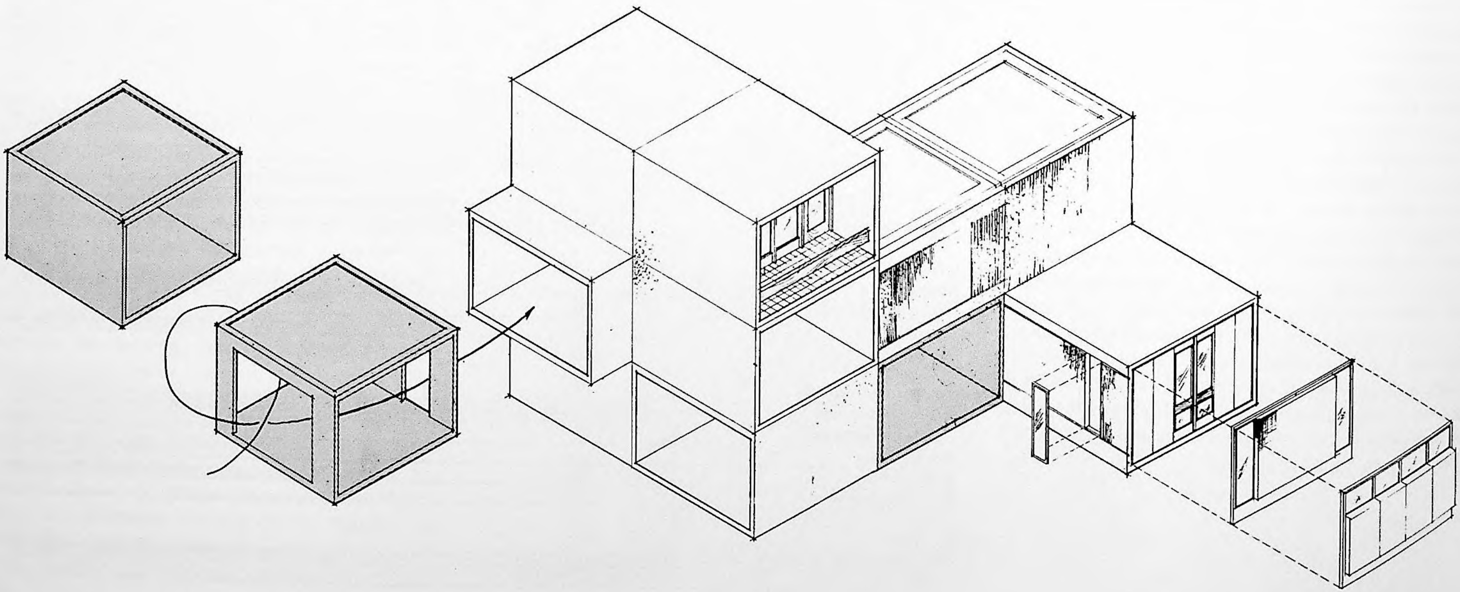
Belin Systems



PROPOSER CONSORTIUM

Belin Systems, East Orange, New Jersey
Louis Berger, Inc., Prime Contractors, East Orange, New Jersey
LEASCO Systems and Research, Operations Research, New York, New York
Intergroup, Architects and Engineers, New York, New York
Lincoln Property Company, Real Estate Managers, Dallas, Texas
George A. Fuller, Building Contractor, New York, New York
Mozel Development, Building Contractor, Washington, D.C.

The plant fabrication of reinforced concrete modules, fully outfitted in the factory, forms the basis of this proposal. In addition, the proposal offers a fully comprehensive approach to all environmental systems related to housing. Plant production labor is hired locally with a ratio of 75% unskilled to 25% skilled. The production facilities are designed as portable or semi-portable types, each capable of serving a 30-mile radius



area, or 2,800 square miles. The units are being marketed currently and can readily be developed to a higher degree of sophistication. The quality of design, construction and finishes now is high and a strong demand for dwellings of this type is anticipated.

Four of the basic structural modules are combined to form a single dwelling unit in the field. The modules are manufactured in two sizes—12 ft. x 12 ft. x 8 ft. and 12 ft. x 14 ft. x 8 ft. They can be used in various vertical arrangements for one-story, single-family dwellings or for medium- and high-rise occupancy by stacking the self-supporting modules. Partitions and end walls are of conventional hollow wall construction. The exterior of the concrete is exposed aggregate, patterned, stuccoed or painted. Ceilings are exposed concrete, painted with sand-finish paint. Floors are tiled or carpeted in the plant and standardized kitchen and bathroom assemblies are completely preassembled with plumbing, electrical and heating components included as an integral part of the module at the factory.

Sitework involves only final connections from risers to units, and from each module to the module above it by a simple wedge system or by field bolting. A warm air heating system uses spaces between ceiling and floor for distribution. The proposal calls for through-wall air conditioning involving heat pumps and fan coil units, and preassembled wiring subsystems are installed in raceways within the modules. Central sewage treatment plants or communal septic tanks will serve the larger clusters of dwelling units.

One feature of the system is equity labor to be provided by the owner. Buyers can complete work on their units themselves, or make use of organized community assistance. A member of the proposer consortium already is financing and operating a technical training program for students from Africa and for other underprivileged persons. This training will be extended to local labor where plants are located. The consortium has the financial and technical ability to produce dwellings by this method at a rate of 1,000 per year, using less skilled labor per unit than traditional methods.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2	Density Range	UP TO 40 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; CLUSTERS; COMMON OPEN SPACES
6	Nonresidential Functions	COMMUNITY BUILDINGS; OPTIONAL EDUCATIONAL, HEALTH, CULTURAL & RECREATIONAL
7	Circulation	SEPARATE VEHICULAR TRAFFIC; WALKING PATHS CONNECTING RESIDENTIAL & CENTRAL AREAS
8	Site Planning Services	PROPOSER TO USE JOINT DEVELOPMENT TEAM
9	Community Involvement	SOCIO-ECONOMIC STUDIES OF WORKERS' GROUPS; SOCIAL SERVICE PROGRAMS
10	Utilities	OPTIONAL FUEL TYPES; TOTAL SITE OR INDIVIDUAL BUILDING SERVICE SYSTEMS

BUILDING SYSTEMS

11	Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	EFFICIENCY TO 4 BEDROOMS
13	Design Selection	STANDARD PLANS WITH OPTIONS; FLEXIBLE
14	State of Development	BUILDING SYSTEM BEING MARKETED; PRODUCTION PLANT: DESIGN STAGE
15	Community Involvement	FEEDBACK FROM OCCUPANTS; USER CHOICE OF MANY OPTIONS

BUILDING SUBSYSTEMS

16	Structure	CONCRETE SELF-SUPPORTED VOLUMETRIC MODULES
17	Exterior Elements	END PANELS; METAL STAIRS; COVERED BALCONIES
18	Interior Elements	DRYWALL PARTITIONS; CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20	Comfort Systems	ELECTRIC HYDRONIC HEATING; OPTIONAL COOLING; INTEGRATED WITH BUILDING SYSTEMS
21	Plumbing	PLASTIC PIPING & FIXTURES; PACKAGED KITCHENS, BATHROOMS & LAUNDRY FACILITIES
22	Electrical	PREFABRICATED WIRING INTEGRATED WITH BUILDING SUBSYSTEMS & UTILITY MODULES
23	Furnishings	

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES; PANELS; PARTITIONS; UTILITY MODULES; MECHANICAL ASSEMBLIES
25	Onsite Production	OPTIONAL PRODUCTION OF VOLUMETRIC MODULES, PARTITIONS, UTILITY MODULES, ETC.
26	Onsite Construction	FOUNDATIONS; PLAEMENT OF VOLUMETRIC MODULES; UTILITY HOOK-UPS
27	Labor	SKILLED, SEMISKILLED, & UP TO 75% UNSKILLED FOR PRODUCTION
28	Labor Training Programs	PRESENT TECHNICAL TRAINING PROGRAM EXTENDED TO INCLUDE LOCAL LABOR
29	Community Involvement	SELF-HELP OR ORGANIZED COMMUNITY ASSISTANCE TO COMPLETE WORK

ECONOMICS

30	Construction Costs	EXCLUDING LAND: $10.38 to $11.69 PER SQ.FT., 500 UNITS PER YEAR
31	Financing Methods	CONVENTIONAL
32	Useful Life	SYSTEM STRUCTURE: 100 TO 150 YEARS; SUBSYSTEMS; 20 YEARS

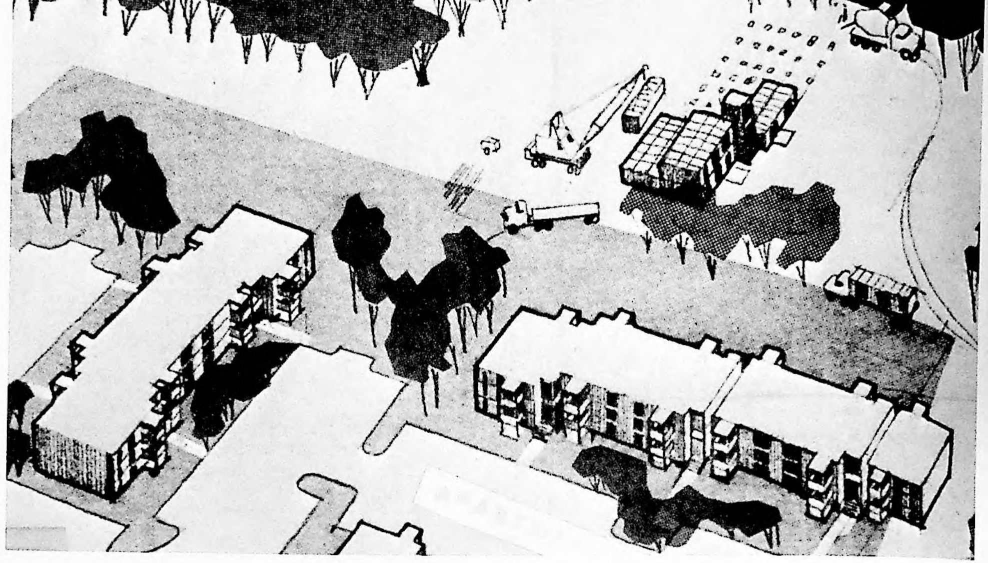
MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	MGT. PLANNING; INTERNAL & EXTERNAL LIAISON; SUPERVISION STAFFING & FINANCING
35	External Functions	
36	Market Area	WITHIN 30 MILE RADIUS OF PRODUCTION PLANT
37	Delivery Rate	
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	ON SITE OR NEAR SITE FACTORY
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Berwick-Lewis



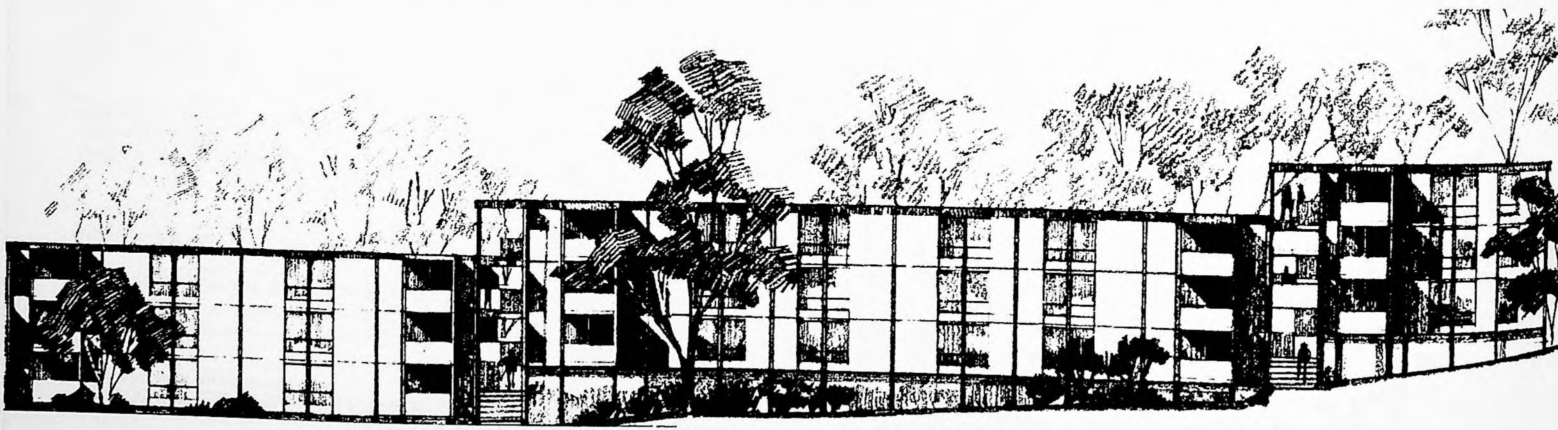
PROPOSER CONSORTIUM

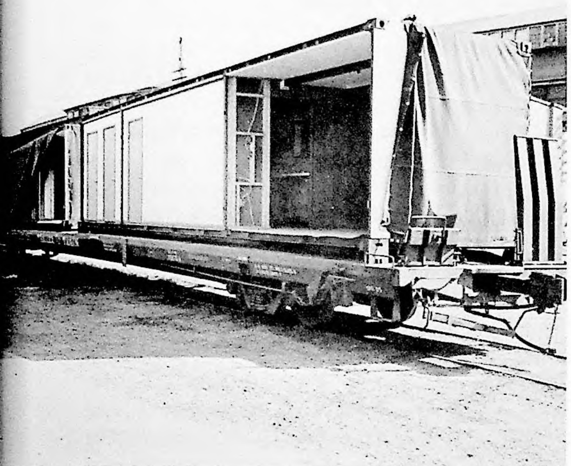
Berwick-Lewis, Inc., Berwick, Pennsylvania
Stein and Rowland Associates, Berwyn, Pennsylvania
CoMan Company, Inc., Berwick, Pennsylvania

Proposed here is a simple system of factory-produced modules in standard size (40 ft. long x 8 ft. wide x 8 ft. 6 in. high), identical in nature, which can be readily shipped to the site by rail, truck, ship, or plane and combined to provide housing for occupancy in single-family and multifamily low-rise structures. Floor plans separate living units from traffic flow requirements, providing maximum site adaptability.

Steel or aluminum is the supporting material used with insulated infill panels to form the identical modules. The proposal embraces the design and manufacture of a modular housing unit capable of being transported on existing facilities and moved easily within a rather large marketing area. Transportation of the factory product is emphasized with the recognition that the presently overburdened highway network would be incapable of meeting the challenge without a specially designed unit which can be transported easily and without restrictions. The dimensions selected lend themselves to construction of a unit suitable in size for easy transport. The measurements already constitute a standard in the container industry.

The total building system concept proposed requires cooperation and commitments from utilities, land developers, local municipal governments, regional economic development associations, and many other elements, including local industrial complexes with mass production capacities. The proposer offers to undertake control, direction and coordination of a consortium management system to manufacture and ship the volumetric units in large numbers. A factory output of 80,000 to 100,000 units per year is expected within two years. Financing will be through local institutions and private investors.





The self-supporting modules will be erected on foundations designed for specific site conditions, but columns or piers with spread footing or piles can be employed for locating on any type of soil.

The interior module finish incorporates gypsum board or prefinished plywood surfaces; the exterior finish can be roughsawn plywood, cement asbestos, aluminum or steel sheet, or plastic material. Kitchens are finished in vinyl-surfaced gypsum wallboard, as are the bathrooms.

Copper pipe is specified for cold and hot water systems, with copper, cast iron, or plastic for drainage. An integrated cooling-heating system is called for with local conditions dictating use of oil, gas, or coal as the basic fuel source. Individual units will have small air handling packages to use hot or chilled water supplied by remotely located central heating and cooling generators.

Wiring is carried under buildings in an enclosed mechanical spine, together with telephone, TV antenna, water lines, and any other required services. An insulated above-ground feed system allows rapid installation, maintenance, and repair. Electrical lines in the units themselves run in combination baseboard-conduit units, acting as shoes for partitioning. Switches are in hollow door frames, and general space lighting is in valance units.

Summary Information

SITE SYSTEM

1 Site Situation	SUBURBAN; RURAL
2 Density Range	8 TO 25 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO MILD CLIMATIC REGIONS; UNSUITABLE TO SEISMIC PROBLEM REGIONS
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW RISE
12 Unit Variations	2 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT OPERATIONAL; PROTOTYPE BEING TESTED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STEEL OR ALUMINUM FRAME VOLUMETRIC MODULE; SELF-SUPPORTED
17 Exterior Elements	COVERED BALCONIES; EXTERIOR STAIRS; CONVENTIONAL FINISHES
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	FUEL OPTIONAL; INTEGRATED HEATING—COOLING; INDIVIDUAL UNITS
21 Plumbing	CONVENTIONAL; PLASTIC PIPING IN DRAINAGE SYSTEM; INTEGRATED IN MECHANICAL "SPINE"
22 Electrical	INTEGRATED IN MECHANICAL "SPINE"; BASEBOARD CONDUITS
23 Furnishings	

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES; INFILL PANELS; MECHNICAL SPINE
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; MODULE PLACEMENT & JOINING
27 Labor	SKILLED FOR PRODUCTION
28 Labor Training Programs	FACILITIES OF REGIONAL TECHNICAL TRAINING SCHOOL
29 Community Involvement	LOCAL CONTRACTORS; LANDSCAPING SELF-HELP

ECONOMICS

30 Construction Costs	$13,000 TO $16,000 PER DWELLING UNIT FOR 1,000 UNITS
31 Financing Methods	CONVENTIONAL
32 Useful Life	BUILDING ELEMENTS: 25 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	CENTRAL RESPONSIBILITY
35 External Functions	
36 Market Area	
37 Delivery Rate	1,000 TO 5,000 UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	PREFABRICATED MECHANICAL "SPINE" TO CARRY ELECTRICAL, TV, AND WATER LINES
40 Codes	PLUMBING PIPING & FITTINGS: NON-COMPLIANCE WITH NATIONAL MODEL CODE

Beyer-Blinder Associates

PROPOSER CONSORTIUM

Beyer-Blinder Associates, Architects—Planners, New York, New York
Faellestegnestuen, Engineers & Contractors, Copenhagen, Denmark
Hancock Hawkes Associates, Planners, London, England

A system combining heavy precast-concrete panel bearing walls and lighter-weight concrete panel interior party walls, with wood-base, lightweight facade units is aimed particularly at community developments of low- and medium-rise apartments and townhouses. The building system also is applicable to ancillary structures suitable for such facilities as stores and recreation areas, and laundry areas. The planning increment is 12 in.; structural thicknesses and component dimensions are chosen to meet requirements of design and erection; floor-to-ceiling height is 7 ft., 9 in.

One advantage of the system is that the exterior of the buildings—including roofing and glazing—is constructed in one operation, thereby providing a weatherproof enclosure within which all finishing work can be done under most favorable conditions.

Floors are framed with wood joists and steel girders that span from one external wall to the other and are finished with parquet or other type of wood flooring. Bathroom floors, however, are composed of prefabricated concrete slab construction, which is tiled.

The heavy wall units are of sandwich construction with 2-in. mineral wool batt insulation. Party walls between dwelling units are 8-in.-thick concrete panels. These units are shaped so that their tops intersect with the roof units (with cast-in-place fittings). Roof sections are framed with wood rafters, to which 1/2-in.-thick waterproof plywood is glue-nailed in the factory to form a base for site application of built-up roofing; attached to the bottom of the rafters is an open lathing behind which is 3/8-in. mineral wool batt insulation with a kraftpaper surface supported on wire netting. A plastic foil is affixed to the underside of the lath and rafters, and the ceiling is finished with plaster.

Window units in the face of the structure are wood-framed, load-bearing structures and story-height, with an external finish of waterproof plywood and finished on the interior with plaster. Insulation is inserted before plaster finishing. The windows themselves are double-glazed. Interior partitions are also wood-framed, and covered with a 1/2-in. prepainted wood hardboard. Kitchen cabinetry and cupboards are made of chipboard and painted; countertops are plastic laminate with a stainless steel sink. All components are factory-finished.

The main part of the mechanical services system is installed at the site, with units that are delivered in proper lengths and sizes, and with some piping pre-assembled. Precast external walls include wiring ducts, and bathroom floors and wet wall sections are prepared for plumbing installation in the factory. Heating is by means of a conventional hydronic system, supplied from a district heating station; each dwelling unit contains its own hot-water tank.

Summary Information

SITE SYSTEM

1	Site Situation	PROPOSED STUDY FOR U.S. SITES (NEW TOWN IN DENMARK)
2	Density Range	
3	Topography	
4	Climate	
5	Planning Concepts	TO BE DETERMINED BY STUDY
6	Nonresidential Functions	
7	Circulation	
8	Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	
10	Utilities	CENTRAL PLANT FOR HOT WATER HEATING

BUILDING SYSTEMS

11	Housing Types	MULTIFAMILY HIGH-RISE & LOW-RISE
12	Unit Variations	2 TO 4 BEDROOMS FOR UNITS IN DENMARK
13	Design Selection	
14	State of Development	BUILDING SYSTEM MARKETED IN DENMARK; RESEARCH REQUIRED FOR U.S. PLANT
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	PRECAST CONCRETE WALL PANELS; WOOD WINDOWWALL, ROOF & FLOOR FRAMING
17	Exterior Elements	PLYWOOD SURFACES ON WINDOW WALLS
18	Interior Elements	WOOD FRAME PARTITION; PLASTER CEILINGS; WOOD FLOORING; BATHROOM TILED FLOOR
19	Foundations	CONCRETE PERIMETER FOOTINGS WITH PRECAST CONCRETE FOUNDATION BEAMS
20	Comfort Systems	CENTRAL HYDRONIC HEATING-COOLING SYSTEM; UNDER FLOOR SPACE POWER VENTILATED
21	Plumbing	PRECUT FITTING FOR SITE ASSEMBLY; SOME INTEGRATION OF COMPONENTS WITH WALL PANELS
22	Electrical	WIRING DUCTS INTEGRATED WITH SOME WALL UNITS; UNDER HOUSE MAINS
23	Furnishings	

PRODUCTION

24	Offsite Production	WALL & WINDOW PANELS; FOUNDATION BEAMS; ROOF UNITS; BATHROOM SLABS; PARTITIONS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; ERECTION OF COMPONENTS; UTILITY INSTALLATIONS & HOOK-UPS
27	Labor	
28	Labor Training Programs	
29	Community Involvement	

ECONOMICS

30	Construction Costs	PROPOSED COST ANALYSES; $6,700 TO $10,000 PER UNIT IN DENMARK
31	Financing Methods	
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	SITE PLANNING & DEVELOPMENT; DESIGN; TESTING; PROTOTYPE CONSTRUCTION
35	External Functions	
36	Market Area	
37	Delivery Rate	VOLUME WHICH SITE CONTRACTOR IS ABLE TO ACCEPT; 2 TO 3 HOUSES PER DAY
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	SIMPLIFIED FOUNDATION; ONE-OPERATION BUILDING ENCLOSURE
40	Codes	PROPOSED STUDY OF ANTICIPATED CONSTRAINTS

Boise Cascade

PROPOSER

Boise Cascade Corporation, Boise, Idaho

AFFILIATES

Dalton-Dalton-Little, Architects and Engineers; Computer Applications, Inc., Production Management; David A. Crane & Associates, Urban Design and Planning; Brevard Engineering Co., Design and Planning.

A housing system in which numerous components—complete, factory-built housing sections or combinations of complete modules, complete cores, and panels and assemblies—are available to suit a homeowner's needs and desires, is the heart of this proposal.

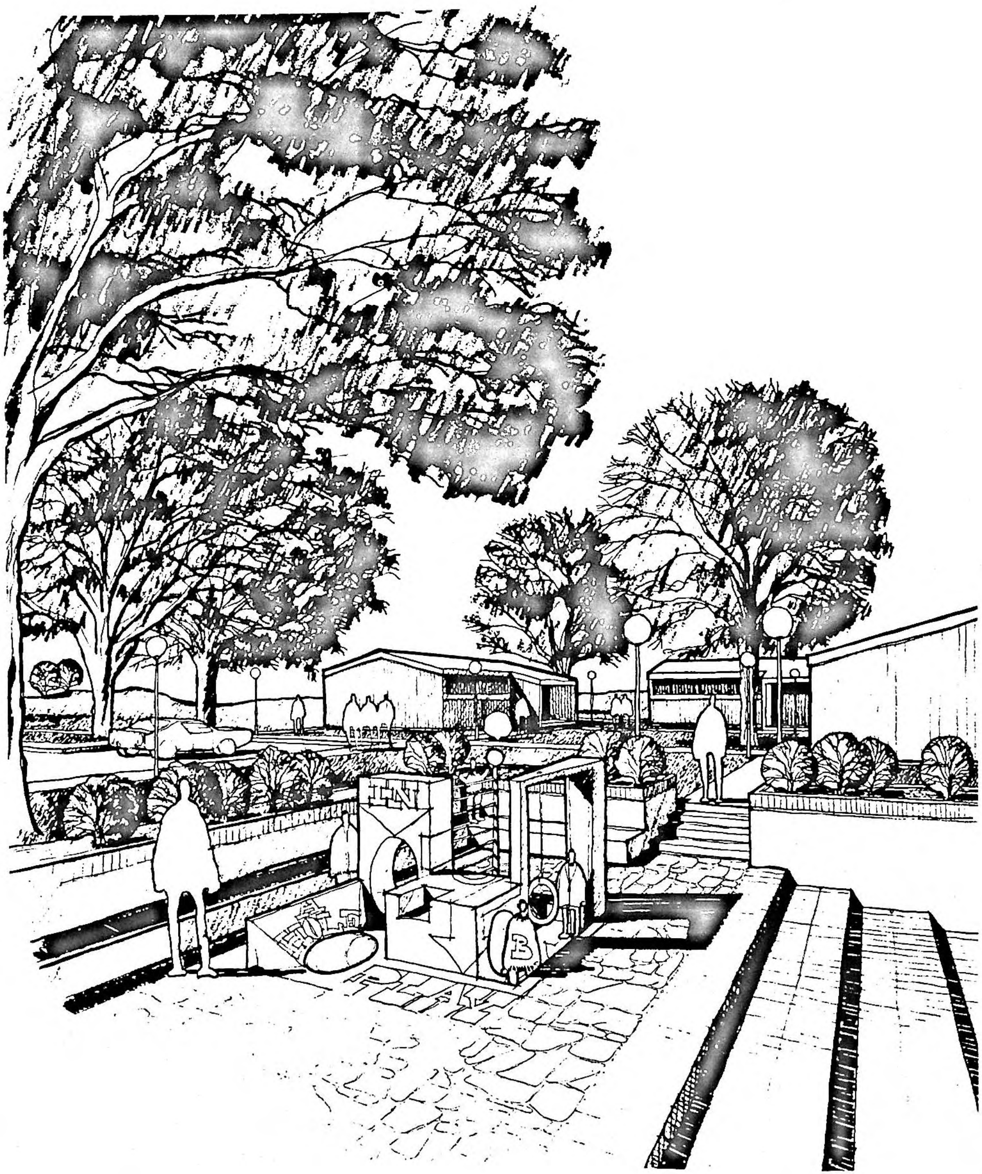
The combinations make a total of five prototype housing units available (designated as A, B, C, D, and E). They range from small, single-family, detached to sizable townhouse or low-rise apartment buildings with possible future adaptation to multifamily high-rise, and they make possible numerous variations within each prototype category, even use of the same concepts for community buildings, schools, and other common-use structures.

All of the identified systems making up these combinations utilize conventional (though lightweight, where possible) materials, structural systems, and assembly methods. Wood, in general, is the principal material. All systems are designed to take advantage of existing factory facilities, materials, and the current state-of-the-art knowledge of contractors and workers on the construction site.

Basic systems concepts are:

1. A panel system, generally for construction of homes with complex floor plans, or which do not otherwise lend themselves to module construction. The proposer asserts that panels have a major competitive advantage, particularly where self-help programs can be organized, or where craft labor is readily available at the site at relatively low cost.

Generally, panels and subassemblies are made up in the manner of conventional wood construction.



Floors are carried by 2-in. x 8-in. wood joists, with a 5/8-in. plywood subfloor; roofs consist of wood trusses on 24-ft. centers, with an exterior plywood sheathing finished with two layers of felt and shingled; exterior walls are built around 2-in. x 4-in. stud panels, surfaced with 5/8-in. plywood (though other sidings, including masonry, can be added or supplied); interior wall surfaces are 1/4-in. prefinished plywood paneling glued to the studs; interior panels are carried on 2-in. x 3-in. studs; and 1/2-in.-thick acoustical ceiling finish is used throughout.

Insulation is in the form of mineral wool batts, and fire protection is provided by gypsum board. Doors, windows, and trim are of wood; flooring finish is seamless cushion-back vinyl sheet. Hardwood flooring and carpeting are optional.

2. Where appropriate, a panel-with-core unit can be substituted for a completely panel-built house. In this case, the portion of the structure containing expensive mechanical subsystems and appliances (such as kitchen, bath, heating, and air conditioning) is completely finished in the factory and shipped to the site for assembly with the panels, in numerous possible combinations.

3. Single-family houses are also produced in a complete sectional system. Factory-finished modules, complete in every detail, and in 12-ft. widths, can be shipped to the site and mated there to form a complete home, erected in less than one day (with footings, slab, or basement and utility runs previously placed). Even with this more rigid system, such devices as staggering adjacent modules can produce several different floor plans, entrances, and patio spaces, and atrium and garden-court designs. A volume production capability of 100,000 or more modules per year is indicated for this system concept.

For two-story and larger homes, the panel system is employed almost exclusively, particularly where demand does not justify tooling up a sectionalized assembly line in the factory. The panel-with-core system is of special interest in models where an upstairs core can be located immediately over a similar downstairs unit. The sectional system can also be used for certain two-story models, a typical one being composed of

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL; NEW TOWN
2 Density Range	4 TO 30 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; COMMON OPEN SPACES
6 Nonresidential Functions	OUTDOOR RECREATION FACILITIES; LIBRARY; MEDICAL CLINIC; SOCIAL FACILITIES
7 Circulation	SEPARATE VEHICULAR CIRCULATION; PRIMARY STREETS & RESIDENT ACCESS ROADS
8 Site Planning Services	PROPOSERS CENTRAL COORDINATING ARCHITECT
9 Community Involvement	STUDIES OF USER NEEDS
10 Utilities	CONVENTIONAL

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; TECHNICAL STUDIES; PRODUCTION; SITE OPERATIONS; FINANCING; MARKETING
35 External Functions	SITE PLANNING; COMMUNITY DEVELOPMENT; PRODUCTION MANAGEMENT; FINANCIAL
36 Market Area	NATIONAL
37 Delivery Rate	100,000 (OR MORE) MODULES PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO MODEL CODES

Prototype A

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	2 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION PLANTS OPERATIONAL; BUILDING SYSTEMS BEING MARKETED
15 Community Involvement	EXPERIMENTS WITH NEW SOLUTIONS TO SHELTER-RELATED PROBLEMS

BUILDING SUBSYSTEMS

16 Structure	WOOD SELF-SUPPORTED SECTIONAL MODULES
17 Exterior Elements	PLYWOOD SIDING; OTHER SIDING OR MASONRY OPTIONAL
18 Interior Elements	PLYWOOD PANEL WALLS; PLASTIC TILE BATH; ACOUSTICAL CEILING; CUSHION VINYL FLOORS
19 Foundations	CONVENTIONAL; CONCRETE OR TREATED WOOD
20 Comfort Systems	CONVENTIONAL GAS OR OIL HOT AIR HEATING; OPTIONAL COOLING
21 Plumbing	CONVENTIONAL; INTEGRATED WITH MODULE BUILDING SUBSYSTEM; APPROVED PLASTIC MATERIALS
22 Electrical	WIRING HARNESSES INTEGRAL WITH MODULE BUILDING SUBSYSTEM

PRODUCTION

24 Offsite Production	COMPLETELY FINISHED SECTIONAL MODULES
26 Onsite Construction	FOUNDATIONS; ERECTION; JOINING OF MODULES; UTILITY HOOK-UPS
27 Labor	UNSKILLED
29 Community Involvement	LOCAL BUSINESSMEN; CONTRACTORS; LOCAL FIRMS; POSSIBLE SELF-HELP

ECONOMICS

30 Construction Costs	$10,000 TO $11,400 PER UNIT; (960 SQ. FT.)
31 Financing Methods	PROPOSER FINANCING; LEASING WITH PURCHASE OPTION FOR MULTIFAMILY LOW-RISE

Boise Cascade (continued)

four modules, each 12-ft. wide, stacked two high. Similar techniques can be applied to garden-apartment or townhouse construction of up to three stories, with panels, panel-core, or sectional systems (or combinations of them) to provide variety and economical construction.

For mid-rise (4-story) apartment construction, the sectional concept is used with intermediate modules being split along the long axis. A steel space frame used in lieu of the conventional stud framing permits cantilevering of modules, and large openings can be framed between modules.

High-rise construction is also possible, using prebuilt frames of structural concrete or steel with an elevator core. Each apartment would consist of one or more finished sections or modules.

Mechanical and electrical equipment and certain hardware and furnishing (kitchen cabinets, plumbing fixtures, and service lines) are included in the sectional structures and in the core section. Panels can be precut and prewired during factory assembly, for easy site installation.

Special attention has been directed to the heating-cooling-ventilating problem. In single-family detached sectional houses, for example, a furred-out down-hall plenum eliminates the need for return-air ductwork. Return-air openings beneath each window pick up chilled air to prevent draft, drawing it into the crawl space (in houses without basements) and thus back into the upflow furnace. The crawl space thus becomes a plenum, keeping floors warmer and preventing frozen pipes.

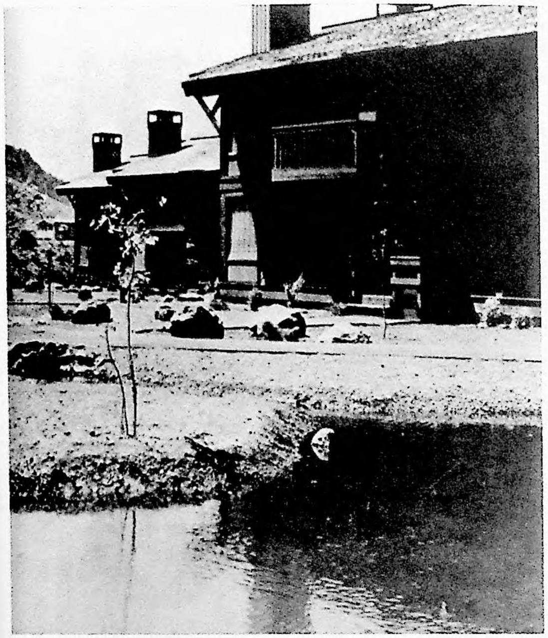
In the two-story townhouses, the truss space between the lower-level ceiling and the underside of the upper floor becomes a pressurized supply plenum, and the truss space under the floor at the lower level becomes the return-air plenum.

Prototype B

BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY DETACHED
12 Unit Variations	3 TO 5 BEDROOMS
13 Design Selection	
14 State of Development	
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAME WALL, FLOOR & GABLE PANELS
17 Exterior Elements	WOOD HORIZONTAL LAP SIDING IN COMBINATION WITH BRICK VENEER
18 Interior Elements	WOOD PARTITION PANELS; CUSHIONED VINYL FLOOR; OPTIONAL WALL MATERIALS
19 Foundations	CONVENTIONAL; CONCRETE SLAB
20 Comfort Systems	CONVENTIONAL HOT AIR GAS OR OIL HEATING; AIR CONDITIONING OPTIONAL
21 Plumbing	PLUMBING TREE INTEGRATED WITH COMPONENT WALL; APPROVED PLASTIC MATERIALS
22 Electrical	WIRING HARNESSES; SOME INTEGRAL WITH PANELS
23 Furnishings	
PRODUCTION	
24 Offsite Production	WALL, FLOOR & GABLE PANELS; ROOF-TRUSSES; MECHANICAL COMPONENT WALL; PARTITIONS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PANEL ERECTION; ROOF CONSTRUCTION; WIRING HARNESS INSTALLATION
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$18,540 (SLAB), 1,900 SQ. FT., 2-STORY, SINGLE-FAMILY DETACHED, 4 BEDROOMS

Prototype C

BUILDING SUBSYSTEMS	
16 Structure	WOOD WALL, FLOOR & CEILING-FLOOR PANELS
17 Exterior Elements	REDWOOD PLYWOOD SIDING WITH BATTENS IN COMBINATION WITH BRICK VENEER
18 Interior Elements	WOOD PARTITION PANELS; FLOOR-CUSHIONED VINYL; OPTIONAL WALL MATERIALS
19 Foundations	CONVENTIONAL; SLAB-ON-GROUND
20 Comfort Systems	CONVENTIONAL; HOT AIR GAS OR OIL FURNACE; AIR CONDITIONING OPTIONAL
21 Plumbing	INTEGRATED WITH MECHANICAL CORE FOR KITCHEN, BATH & UTILITY ROOM; APPROVED PLASTIC
22 Electrical	WIRING HARNESSES; INTEGRAL WITH BUILDING SUBSYSTEMS
23 Furnishings	
PRODUCTION	
24 Offsite Production	CORES; WALL, FLOOR & CEILING-FLOOR PANELS; ROOF TRUSSES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PANEL, ROOF TRUSS & CORE ERECTION; ROOF SHEATHING & ROOFING
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$71,230 FOR 8,736 FT. GARDEN APARTMENT ($8,900 PER UNIT)



Prototype D

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED
12 Unit Variations	2 TO 5 BEDROOMS
13 Design Selection	
14 State of Development	
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD SELF-SUPPORTED VOLUMETRIC MODULES
17 Exterior Elements	WOOD INSULITE SIDING; EXTERIOR WOOD PAINTED
18 Interior Elements	WALLS & PARTITIONS SPRAYED PLASTER; WOOD SURFACES PAINTED
19 Foundations	CONVENTIONAL CONCRETE BLOCK WITH BRICK FACING ABOVE GRADE
20 Comfort Systems	CENTRAL HOT AIR GAS FURNACE; ELECTRIC CONDENSERS FOR COOLING
21 Plumbing	COPPER TUBING WATER SUPPLY, SOIL & WASTE SYSTEM; INTEGRATED WITH BUILDING SUBSYSTEM
22 Electrical	WIRING HARNESSES; INTEGRAL WITH BUILDING SYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULES COMPLETELY FINISHED & EQUIPPED
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; MODULE PLACEMENT & JOINING
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$49,000, 5,048 SQ. FT. TOWN HOUSE CLUSTER (4 UNITS)

- INDUSTRY AND STRIP COMMERCIAL
- RESIDENTIAL
- (1) NEW HOUSES LOW DENSITY DEV'T. MID./HIGH INCOME
- (2) MIXED RESIDENTIAL MEDIUM DENSITY MOD./MID. INCOME
- (3) OLD AREA - HOUSES MEDIUM DENSITY LOW/MOD. INCOME
- MAJOR HIGHWAYS
- ARTERIALS
- LOCAL STREETS
- STREAM
- WOODED AREA

Prototype E

BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE
12 Unit Variations	3 & 4 BEDROOMS
BUILDING SUBSYSTEMS	
16 Structure	STEEL & WOOD FRAME SELF-SUPPORTED VOLUMETRIC MODULE
17 Exterior Elements	BALCONIES; CANTILEVERED WALKS; ALUMINUM SIDING; WOOD-FRAME INFILL PANELS
18 Interior Elements	SPRAYED PLASTER WALL & CEILING FINISH; OPTIONAL PARTITION FINISHES
19 Foundations	PILINGS
20 Comfort Systems	WARM-AIR DUCT SYSTEM WITH GRAVITY COLD-AIR RETURN; AIR CONDITIONING OPTIONAL
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM; APPROVED PLASTIC (DRAIN)
22 Electrical	INTEGRATED WITH BUILDING SYSTEM; CONVENTIONAL
PRODUCTION	
24 Offsite Production	MODULES, COMPLETELY FINISHED & EQUIPPED
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; MODULE PLACEMENT & JOINING; UTILITY HOOK-UPS
ECONOMICS	
30 Construction Costs	$13,000 PER UNIT (1,152 SQ. FT.); $1,560,000 120-UNIT MID-RISE

Franklin Bollman Company

PROPOSER

Franklin D. Bollman Company, Dallas, Texas.

A preformed concrete block with semicircular grooves on top, bottom, and both ends is the basic unit of the housing system proposed. Development of a mobile block fabrication machine which will permit casting of the grooved blocks onsite is the key to the concept that makes the construction team self-supporting, if a central plant is not nearby.

As the preformed blocks are stacked to form double exterior walls for the housing units, the semicircular grooves align with those in adjacent blocks to form hollow tubes, both vertically and horizontally, which are then reinforced with 1/4 in. bars and grouted, the resultant structure becoming effectively a solid, load-bearing wall.

The proposer envisions his system as developing on three levels. Level 1 is intended to offer the shortest route to volume housing production by utilizing currently available building skills, the preformed block, and other readily available materials, to erect housing in accordance with existing floor and site plans. These blocks, along with conventional foundations, interior gypsum-board finish, and conventional sloped-roof construction, constitute Level 1 of the proposed system. The exterior surfaces of the block would be simulated brick, with maximum use of wood trim to increase consumer acceptance.

As consumer acceptance and production technology permit, the proposer anticipates an evolution of his system from Level 1 to Level 3, where the maximum in economy should be achieved through the greatest departure from conventional construction methods. Level 2 is expected to be a transition phase between Levels 1 and 3, with a mixture of conventional and advanced techniques and applications.

At Level 3 it is expected that the exterior and interior surfaces of the preformed block would offer a variety of architectural treatments through sculturing and patterning, and exposure of aggregates. Cabinetry, instead of being conventional, would be integrated with the block walls, as would windows, furniture, and trim. Terrazo flooring would replace more conventional tile or carpeting. Probably the most advanced of the features expected to be available on Level 3 would be a cast-in-place lightweight concrete T-roofing system, with the development of quickly placed and stripped, reusable forms making this concept feasible. Silicone, or other long-life waterproofing treatment would complete the weather envelope.

On all lelevels, the preformed block is basic to the system. To permit stacking by one man, the block will be kept relatively small and manageable. This factor, plus the development of the portable site-casting machine, will offer maximum opportunity to the small, local businessman or building subcontractor to start immediately to erect housing, using unskilled local labor.

In addition to the vertical and horizontal reinforcement the double lines of block are tied together by 1/4-in. galvanized U-bars forming a unity wall. The cavity space is filled with foamed-in-place urethane, mixed with thermosetting resins to provide a self-extinguishing, insulated, sound-absorbent moisture barrier.

While kitchen and bath of Level 1 would be provided by currently available fixtures and fittings installed onsite, on Level 3 these facilities and the mechanical subsystem for the dwelling units would be factory fabricated and integrated, including pre-assembled plastic piping networks and ductwork in the cavity walls and in the foamed-in-place plastic ceilings.

Although the system presently is only at the design stage, production could readily begin on Level 1 work, since the preformed block can be manufactured in existing block plants with existing equipment, and existing floor plans can be converted to the double-block walls.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN, SUBURBAN, RURAL, NEW TOWNS
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	PROPOSER & LOCAL PROFESSIONAL PLANNERS OR DEVELOPERS
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT & BUILDING SYSTEM IN DESIGN STAGE
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	GROOVED CONCRETE BLOCK REINFORCED WALLS
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	BATHROOM-KITCHEN MODULES; KITCHEN CABINET MODULES
19 Foundations	CONVENTIONAL
20 Comfort Systems	FACTORY-FABRICATED HEATING & COOLING SYSTEM
21 Plumbing	PLASTIC PIPE; KITCHEN & BATHROOM MODULE INTEGRATED WITH BUILDING SYSTEM
22 Electrical	CONVENTIONAL
23 Furnishings	KITCHEN CABINET MODULES

PRODUCTION

24 Offsite Production	GROOVED CONCRETE BLOCK (OPTIONAL)
25 Onsite Production	GROOVED CONCRETE BLOCK
26 Onsite Construction	CONVENTIONAL; BLOCKS CAN BE HANDLED BY ONE MAN
27 Labor	LOCAL CARPENTRY SKILLS; UNSKILLED; SELF-HELP
28 Labor Training Programs	LOCAL VOLUME PRODUCTION PLANTS
29 Community Involvement	

ECONOMICS

30 Construction Costs	$10.00 PER SQ. FT.
31 Financing Methods	PRIVATE EQUITY CAPITAL; DEBT CAPITAL
32 Useful Life	STRUCTURE—80 YEARS

MANAGEMENT

33 Proposer Organization	COMPANY
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	DOUBLE EXTERIOR WALLS WITH FOAM INSULATION INFILL; CAST CONCRETE ROOF
40 Codes	

Building Block Investment Group

PROPOSER

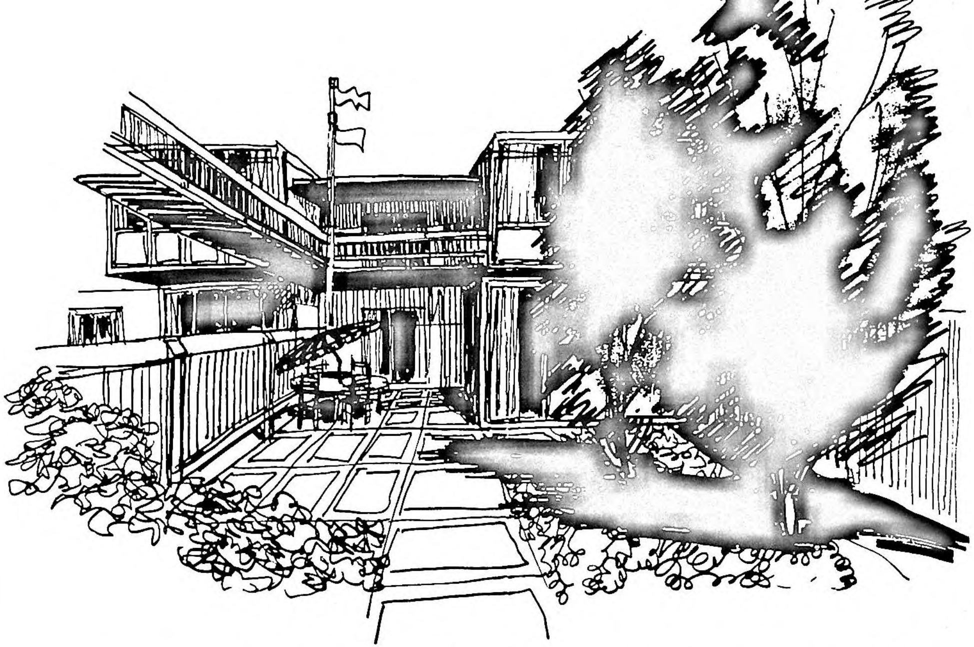
Building Block Investment Group, Oakland, California

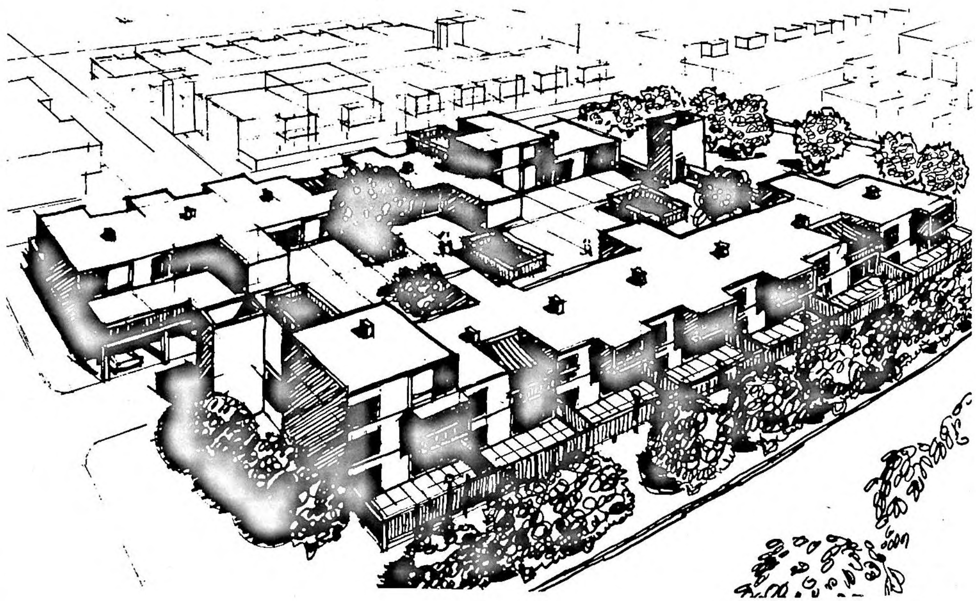
Open-ended rectangular tubes of concrete are the room-sized modules which constitute the "blocks" of the housing system proposed. The precast modules, 12 ft. 8 1/2 in. wide, 8 ft. 8 1/2 in. high, and up to 12 ft. long, are structurally self-supporting and can be stacked without framework.

Factory manufacture of the modules, using semi-skilled or unskilled labor, with most of the mechanical services being installed ready for use, is expected to cut sitework to a minimum. Concrete for the module is cast in steel forms; steam accelerates curing of the concrete and permits use of the forms at least three times per day. Floor, ceiling, and sidewalls are cast monolithically in a single, continuous operation so that the module becomes a single structural entity. The module actually is cast on its end in a vertical position. By raising or lowering the floor of the steel forms, the module may be varied in length up to 12 ft. After the module is cured to half its design strength (2,500 to 3,000 lbs. per sq. in.), it is rotated to a horizontal position for finishing.

Walls of the concrete module are 4 in. thick, with doors, archways, and openings for services and ductwork being formed by placing inserts in the forms. Adjustments on the steel forms permit shaping angular side-walls, thus permitting architectural variations such as sloping roofs, mansard roofs, skylights, and clerestory windows.

Exterior and interior nonbearing walls, completely finished, and all other components of the module are installed at the factory, including kitchen cabinets, bathroom vanities, a plumbing wet wall, and kitchen and bathroom fixtures. Plastic conduit and outlet boxes are precast into the modules and wiring is installed in the factory. Vertical chases for heating, air conditioning, and piping are formed by inserts in the sidewall forms, while a precast horizontal utility chase for insertion in a blocked-out part of the ceiling is





being developed.

The space formed between the floor of one module and the ceiling of the unit below may be used optionally as a heating and air conditioning plenum. Heating, which may be a central system for a building or individual for each dwelling unit, will be fueled by gas, electricity, or oil, depending upon what is most economical locally.

By stacking the modules alternately, or checkerboard fashion, additional space may be generated between the units, and this space then is finished onsite. Shipped with the modules are the required prefabricated interior partitions and exterior walls to form added rooms. Alternate stacking results in elimination of redundancy of walls and floor-ceilings, and by dovetailed connections, the overall structure becomes a simple bearing-wall system.

However, vertical stacking of opposing modules permits almost complete finishing of modules before they leave the factory and results in less pieces to be handled onsite. By turning modules 90 degrees to each other, the need for additional shear walls is eliminated and interior crosswalls are automatically provided. Remaining interior walls are steel-framed, gypsum board partitions.

To implement occupant and community involvement in site planning and development of facilities and amenities, the proposer will open a community development corporation office at each site, staffed by local employees. The relocation of persons displaced by building development might be the concern of such an office.

Continuing involvement of owners and occupants might be encouraged through the self-help potential inherent in installation of both prefabricated partitions and cabinets, while on-the-job training of unskilled labor for work in the factory is contemplated. Such plants are expected to be within a 75-mile radius of proposed sites as a matter of shipping economy, but this distance can be increased to 150 miles (a one-day return trip by truck). Plants are expected to turn out 500 to 2000 housing units per year when operational.

A number of pilot projects have been produced from the proposer's research and development plant and a full-scale production facility is under construction. A licensing program has also been initiated.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; URBAN RENEWAL; NEW TOWN
2 Density Range	70 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; UNIT DEVELOPMENT; LARGER PLANNING UNITS
6 Nonresidential Functions	RECREATION FACILITIES; COMMUNITY CENTERS; SHOPPING CENTERS
7 Circulation	CUL-DE-SACS; SIDEWALKS
8 Site Planning Services	SYSTEM DESIGN IN CENTRAL LOCATION
9 Community Involvement	
10 Utilities	ELECTRIC ENERGY OR FOSSIL FUELS

BUILDING SYSTEMS

11 Housing Types	SINGLE FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY, 1, 2, 3, 4, & 5 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STACKED CONCRETE VOLUMETRIC MODULES
17 Exterior Elements	EXTERIOR STAIRS
18 Interior Elements	FACTORY INSTALLED KITCHEN & BATHROOMS; GYPSUM BOARD WALLS
19 Foundations	PERIMETER FOOTINGS OR PIERS
20 Comfort Systems	GAS HOT AIR HEAT; COOLING OPTIONAL
21 Plumbing	CONVENTIONAL, PREFABRICATED PLUMBING TREE
22 Electrical	INTEGRATED WITH MODULA
23 Furnishings	FACTORY INSTALLED

PRODUCTION

24 Offsite Production	CONCRETE MODULE & MOST FINISHING; SERVICE SUBSYSTEM
25 Onsite Production	
26 Onsite Construction	ASSEMBLY & JOINING OF MODULES & MECHANICAL SUBSYSTEMS
27 Labor	10% SKILLED, 15% SEMI-SKILLED, 75% UNSKILLED IN FACTORY
28 Labor Training Programs	
29 Community Involvement	

ECONOMICS

30 Construction Costs	\$7.00 PER SQ.FT. AT PLANT; \$11-12.00 PER SQ.FT. IN PLACE
31 Financing Methods	INVESTMENT GROUP—400 LIMITED PARTNERS
32 Useful Life	EXTERIORS—20 YEARS; SHELL—100 YEARS; BUILDING—40YEARS

MANAGEMENT

33 Proposer Organization	LIMITED PARTNERSHIP
34 Internal Functions	MANAGEMENT
35 External Functions	
36 Market Area	150 MILE RADIUS OF PLANT
37 Delivery Rate	500 TO 2,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	CONCRETE STRUCTURAL SYSTEM, ALMOST COMPLETELY FINISHED IN FACTORY
40 Codes	ADAPTABLE TO NATIONAL MODEL BUILDING CODES

Building Systems International, Inc.

PROPOSER

Henry C. Beck Company, Dallas, Texas
Balency-MBM-US Corporation, New York, New York
Raymond D. Nasher Company, Dallas, Texas

AFFILIATES

Borg-Wagner Corporation; Keyes, Lethbridge & Condon, Architects; Sulton and Campbell, Architects; William R. Morris, Minority Programs; Shefferman & Bigelson Company, Consulting Engineers; Irwin Speyer, Design.

The proposed industrialized building process is for a total system capable of producing all types of housing units from single-family detached to high-rise. The finest examples of its application are in the deck house, mid-rise, and high-rise structures. These units provide a quality living environment in urban areas where land availability and cost is at a premium. The system also lends itself easily to later construction of ancillary facilities.

Actually, the system proposed has been used in Europe for high-rise elevator apartments of up to 20 stories. By offsetting succeeding decks, and through use of varied architectural treatments on exterior panels, considerable variety in appearance as well as added living space can be achieved.

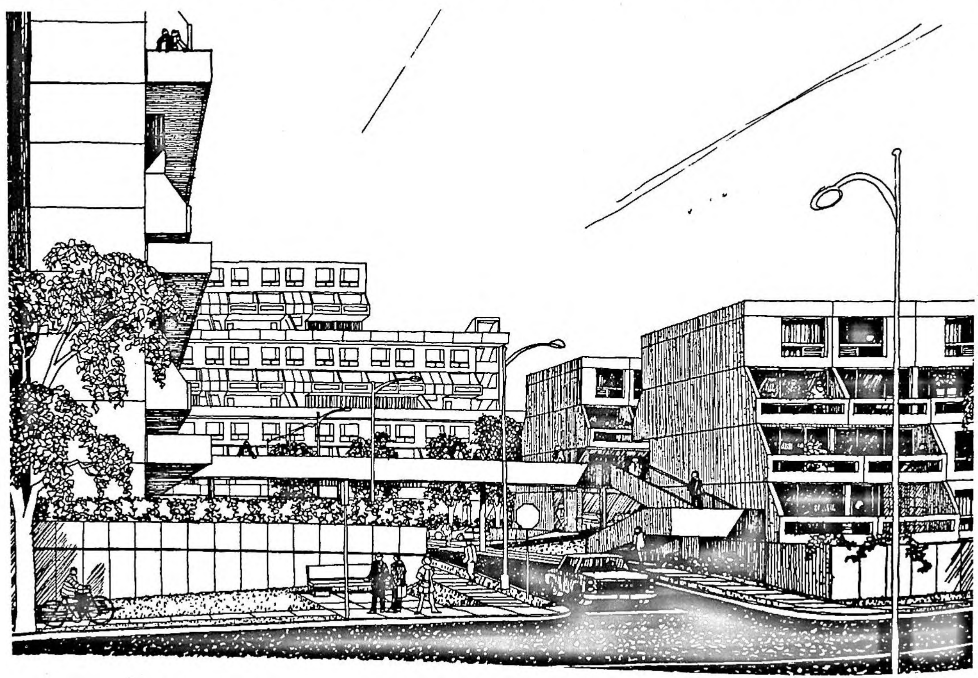
The basic structural system is a series of precast, prefabricated concrete panels and slabs that can be produced at a central plant, trucked to the site, and assembled. Essentially, this system is predicated on large, load-bearing, interior and exterior concrete panels, supplemented by floor and roof panels to create an integral structure. The only onsite work that is contemplated other than normal foundation preparation, is the possible casting of the floor slabs if local conditions make this economical. Standarized, prefabricated metal forms, reinforcing steel assemblies, and assemblies of any required mechanical services to be incorporated in the slabs would be supplied.

The wall panels contain necessary electrical, plumbing and heating-ventilating subsystems, so that only connecting to adjoining units is required onsite. More complete subassemblies, such as bathroom and kitchen walls, complete with fixtures and accessories, and closets and stairways, are also made in concrete at the central factory and shipped to the site for erection.

Design of the exterior panels as four-layered units that include architectural, structural, and finish concrete as well as insulation and the method of construction at the central plant are unusual. The panels are carefully cast one layer at a time in horizontal forms. The first (bottom) layer is the exterior veneer, which may be anything from exposed aggregate to brick and tile; the second layer is a dense mass of concrete, the third layer is expanded polystyrene insulation; and the fourth layer is concrete, which serves as the structural portion of the panel, smooth-finished to become the face of the interior wall.

Such panels are allowed to set sufficiently to be stripped, then stacked vertically in racks to await shipment to the site for immediate erection by crane. Onsite, the alignment of panels is accomplished with adjustable temporary brackets. The wall panels are erected with a 1/2-in. horizontal and vertical spacing between each panel, to allow for movement and provide erection tolerance. The inner side of these joints is grouted, with reinforced steel where necessary, and the outer side is caulked. This forms the needed connection, allowing an air space between the grout and the caulking to permit balancing air pressures and drainage of any condensation.

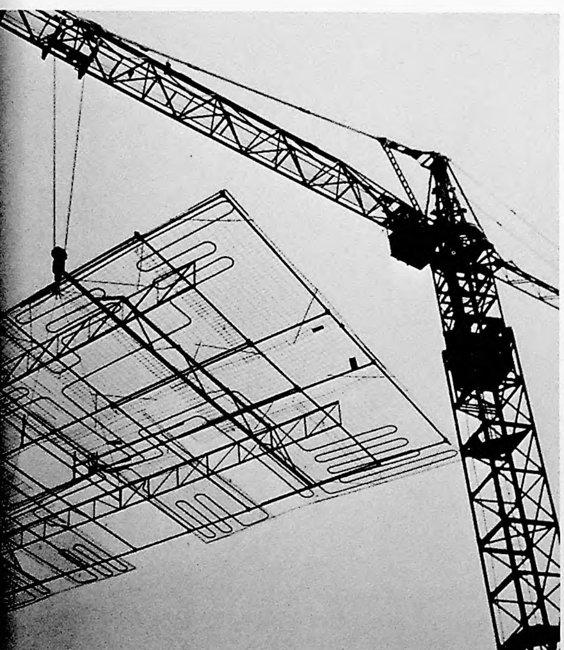
In addition to containing any needed service subassemblies, the panels also incorporate window and door frames and other required openings. Inside faces of any balcony dividers, public stairwalls, and both exterior and interior panels are finished smoothly. Balcony floors, exterior walks, access galleries, and cross-deck connectors may be finished with a variety of treatments. Interior finish includes felt- or rubber-backed



vinyl asbestos flooring and paint or wallcovering on walls and ceilings. Bathrooms have ceramic or other hard tile or plastic enclosure walls at the tub, while all other walls are painted.

The mechanical subsystem is designed with full consideration of the inherent thermal features of the structure, specifically, the high inertia of the concrete panels prevents transmission of any sudden temperature changes. Hence, several methods of heating and cooling are practical and may be installed, depending on locale. These include radiant panels, gas or electric furnaces in combination with an air conditioning coil and remote condenser, or a combination of radiant heating system with a package cooling unit.

Plumbing services are grouped in special technical blocks or panels, which are then stacked one above the other as the building rises to form complete mechanical service cores. Electrical, telephone, and television antenna wiring are included in the panel sections.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2	Density Range	10 TO 150 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLAY DECKS OVER VEHICULAR CIRCULATION; COMMON OPEN SPACES
6	Nonresidential Functions	RECREATION FACILITIES
7	Circulation	PEDESTRIAN & VEHICULAR SEPARATION; CIRCULATION BETWEEN HIGH-RISE AND DECK HOUSES
8	Site Planning Services	CONSULTANTS
9	Community Involvement	MEANINGFUL INVOLVEMENT OF AREA RESIDENTS
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	EFFICIENCY, 1 TO 5 BEDROOMS
13	Design Selection	FROM STANDARD PLANS
14	State of Development	PLANTS OPERATIONAL, SYSTEM DEVELOPED AND MARKETED
15	Community Involvement	MEANINGFUL INVOLVEMENT OF AREA RESIDENTS

BUILDING SUBSYSTEMS

16	Structure	PRECAST CONCRETE PANELS SITE-ERECTED FOR COMPLETE DWELLING UNITS
17	Exterior Elements	BALCONIES; DECK SECTIONS
18	Interior Elements	PRECAST CONCRETE PANEL PARTITIONS
19	Foundations	CONVENTIONAL
20	Comfort Systems	GAS OR ELECTRIC HOT AIR OR RADIANT PANEL HEATING; INTEGRATED OR UNIT COOLING
21	Plumbing	SERVICE LINES INCORPORATED IN WALL PANELS
22	Electrical	CONDUITS CAST IN PANELS
23	Furnishings	BENCHES; PLAY EQUIPMENT FOR BALCONIES AND DECKS

PRODUCTION

24	Offsite Production	WALL & CEILING PANELS; FOUNDATION SLABS; SERVICE SUBSYSTEMS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; ASSEMBLY OF PANELS; ROOFS; UTILITIES CONNECTIONS
27	Labor	UNSKILLED AND SKILLED FOR PLANT AND ONSITE
28	Labor Training Programs	ON-THE-JOB TASK-ORIENTED TRAINING FOR SOME UNSKILLED WORKMEN
29	Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	$19,500 TO $21,500 PER DWELLING UNIT
31	Financing Methods	CONVENTIONAL
32	Useful Life	MECHANICAL EQUIPMENT—15 TO 20 YEARS; APPLIANCES—5 TO 7 YEARS

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	PRODUCTION; CONSTRUCTION; ERECTION; MANAGEMENT; REAL ESTATE; DESIGN
35	External Functions	DESIGN; LAND PLANNING
36	Market Area	70-MILE RADIUS FROM EACH PLANT
37	Delivery Rate	1000 DWELLING UNITS PER YEAR PER PLANT
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	DECK-HOUSE DESIGN WITH RECREATION AREAS; EMBEDDED ELECTRICAL CONDUIT
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES (EXCEPTION OF ELECTRICAL DISTRIBUTION SYSTEM)

Burnett Construction

PROPOSER

Winston A. Burnett Construction Company, New York, New York.

Heavy, insulated bearing walls, 8-in.-thick party walls between dwelling units, thick floor slabs, and interior concrete partitions make up the industrialized construction system proposed, suitable for mass housing (low-rise, high-rise and attached single-family) in urban settings. The system, it is noted, has been in use in Europe for about ten years, has shown considerable savings in project costs, and has recently been adapted to United States practice.

All structural elements used in construction are precast, reinforced concrete and can be erected with a minimum of skilled labor thus offering opportunity for employment of local residents in semiskilled operations. Prefabricated wet-wall construction, which includes most piping (some of which is plastic) also lends itself to employment of semiskilled and unskilled labor.

Basic to the system is the use of an extremely heavy precast bearing wall, which forms both the outer envelope and architectural treatment for the structure, and the principal structural system. This wall consists of an outer face of 2 1/2 in. to 3 in. of concrete, which may be treated in a variety of finishes for architectural appearances; a 2-in. core of foamed plastic insulation; and an 8-in.-thick concrete inner section, which forms the principal bearing element of the structure. An ultimate strength design is used, with joints checked and designed for vertical and horizontal shear.

Party walls between dwelling units are 8 in. thick, uninsulated concrete sections, selected for both safety and sound transmission characteristics. Floors are also of precast slab construction, up to 7 in. thick, and designed to provide flexible-material-filled discontinuities, for further soundproofing values.

Floors and interior walls can be finished in any desired materials—preferably wood, vinyl, ceramic tile, or carpeting. Walls may be painted directly. Interior partitions are 2 1/2-in. to 3-in. precast concrete elements, supported by the bearing walls and floor slabs; stairs and stairwells are of precast concrete.

All units are to be both heated and air conditioned, with tenants expected to pay minimal operating costs for the air conditioning, but no charge for heat. Either electric or gas-fired heating equipment is suitable.

Plumbing consists of a component plumbing system, including fittings, fixtures and preassembled wet walls which can be varied to suit particular designs. This permits use of semiskilled labor, and minimizes errors resulting from field assembly. (Sleeve locations for plumbing are provided in the precast elements, and cannot be varied in the field.) Completely preassembled fiberglass bathroom structures are used.

In electrical systems, all existing electrical standards are followed, with three exceptions: (1) flexible conduit is used wherever acceptable; (2) prefilled conduits are placed wherever load variation is least expected; and (3) a master meter is installed for all building load except lighting.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	5 TO 30 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL AND U.S. POSSESSION CLIMATES
5	Planning Concepts	CLUSTER; COMMON OPEN SPACES
6	Nonresidential Functions	PARKS; PLAYGROUNDS; COMMUNITY, LAUNDRY, STORAGE, & RECREATION FACILITIES
7	Circulation	SEPARATE PROVISION FOR VEHICULAR TRAFFIC; THROUGH STREETS; CUL-DE-SACS; SUPER BLOCK
8	Site Planning Services	
9	Community Involvement	
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	EFFICIENCIES, & 1 TO 4 BEDROOMS
13	Design Selection	
14	State of Development	BUILDING SYSTEM—COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED IN EUROPE
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	CONCRETE STRUCTURAL INTERIOR & EXTERIOR WALL & FLOOR PANELS
17	Exterior Elements	CONCRETE FINISHED WITH EXPOSED AGGREGATE, COLORED TILES, OR BRICK VENEER
18	Interior Elements	CONCRETE PARTITION & CEILING PANELS; CONCRETE STAIR; CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20	Comfort Systems	ELECTRIC OR GAS-FIRED FORCED AIR HEATING; HYDRONIC OPTIONAL; INTEGRATED COOLING
21	Plumbing	PVC & CONVENTIONAL PIPING; INTEGRATED PLUMBING TREE; FIBERGLASS UNITIZED BATHROOM
22	Electrical	CONVENTIONAL; MASTER METER PER BUILDING FOR ALL LOAD EXCEPT LIGHTING
23	Furnishings	

PRODUCTION

24	Offsite Production	WALL, FLOOR, CEILING & PARTITION PANELS; STAIRS & SHAFTS; MECHANICAL SUBSYSTEMS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PANEL ERECTION; INSTALLATION OF SUBSYSTEMS; UTILITY HOOK-UPS
27	Labor	UNSKILLED LABOR FOR PRODUCTION, SITE LANDSCAPING, & INTERIOR PAINTING
28	Labor Training Programs	PROPOSER'S PERSONNEL TO INSTRUCT LOCAL UNSKILLED LABOR
29	Community Involvement	LOCAL CONTRACTORS, UNSKILLED LABOR; RESIDENTS TO SERVICE HVAC UNITS

ECONOMICS

30	Construction Costs	$14.30 PER SQ. FT., 1000 UNITS
31	Financing Methods	
32	Useful Life	TOTAL STRUCTURE—50 YEARS; MECHANICAL SUBSYSTEMS—20 YEARS

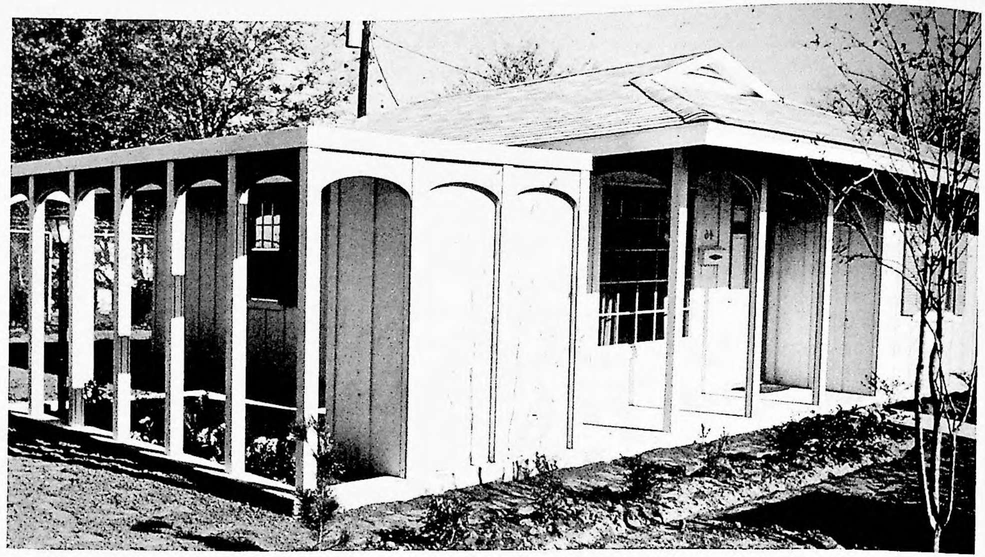
MANAGEMENT

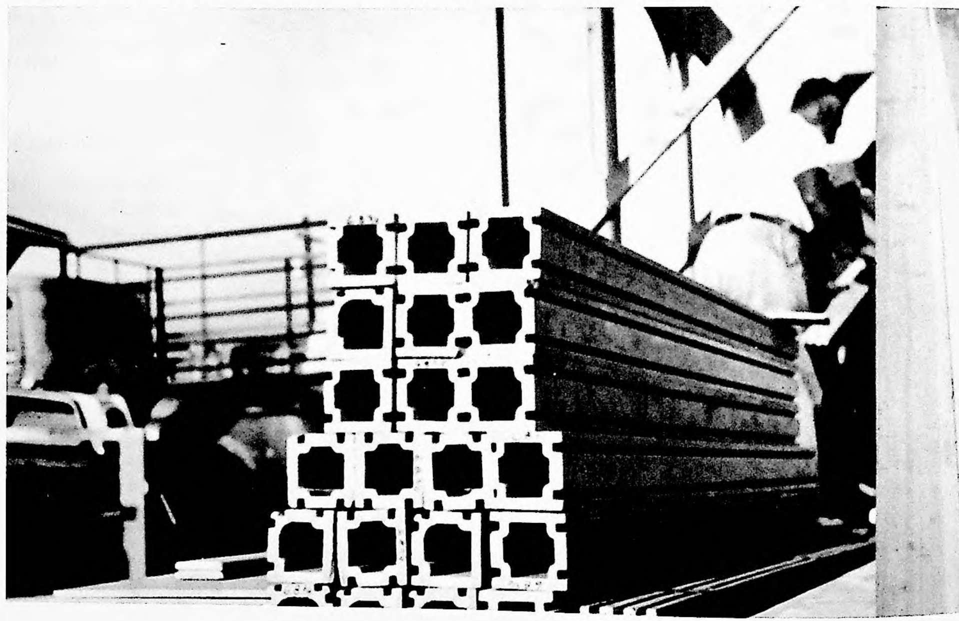
33	Proposer Organization	CORPORATION
34	Internal Functions	GENERAL CONTRACTOR
35	External Functions	
36	Market Area	
37	Delivery Rate	1000 UNITS PER YEAR FOR 5 YEARS
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Certain-Teed





PROPOSER

Certain-Teed Development Corporation, Valley Forge, Pennsylvania; Subsidiary of Certain-Teed Products Corporation, Valley Forge, Pennsylvania.

AFFILIATES

Vilican-Leman and Associates, Site Planners; Edmund M. Morrissey and Associates, Builders.

Modular components of extruded asbestos cement, including wall panels, supporting posts, and other parts, plus conventional wood-framed gabled roofs are the structural elements of the building system proposed. The extruded asbestos cement shapes fit together like pieces of a giant erector set and, because no piece weighs more than 95 pounds, they can be assembled readily by one trained supervisor and three laborers.

While the system offers the advantages of masonry construction in terms of durability, noncombustibility and freedom from attack by vermin and termites, it is expected to deliver significant reduction in the construction time required for conventional masonry, with attendant reduction in costs. A crew can erect the wall system for a three-bedroom, single-story home in just 2 days, with only 2 weeks being required for complete construction of the houses after availability of the foundation slab.

Five shapes of extruded components comprise the system, all made to exacting factory tolerances for assured fit and interchangeability: wall panels, three types of posts (standard, corner, and partition), and sills/heads. Components are erected by first setting a partition post, then two wall panels are fitted into a pair of grooves on the sides of the posts, the panels forming interior and exterior walls; this pattern is repeated the length of the wall. The posts and panels are held in register by a steel rod which runs horizontally through the center of the wall, 2 in. from the top; every other post is fastened to the slab with a steel angle. The basic wall structure is strengthened by a high-shear-strength, weatherproof adhesive which is beaded into posts grooves. This waterproofs the joint, prevents slippage of panels in the grooves, and helps the overall structure develop racking strength to withstand hurricane force winds. Substitution of posts by spandrel wall panels and sills/heads creates opening for windows and doors.

All of the extruded asbestos cement shapes are delivered to the job site in pallets, with their delivery sequence carefully planned so that the top piece from each pallet is the next piece to be used in assembly, thus confusion and delays on the job are eliminated.

The 1 3/4-in. void formed between the wall panels is filled with fiberglass insulation batts for thermal and sound insulation. Electric wiring (or ducting for wiring) may be run between the panels as required, cutouts in the panels being furnished for lead wires and outlets, and a raceway being provided along the top of the walls for electrical distribution.

The walls are topped by a wood plate which is held in place by J-bolts that hook around the steel rod holding the walls and posts in register. Prefabricated wood trusses are nailed to the plate to form the roof system, covered with plywood, and conventionally finished with asphalt shingles.

Floors for the proposed system, usually a slab on ground over conventional concrete grade beams or perimeter footings, are finished with resilient tile; the ceiling is finished with gypsum board. Interior and exterior painting of the extruded asbestos cement is for appearance only, (the components being inherently inert and weatherproof); the acylic latex paint requires only washing every few years.

Prepackaging of mechanical services is proposed, including a bathroom delivered to the site as a unit, a prefabricated kitchen wall, and mechanical core in which is integrated the heating system. Cooling may be added to this core optionally at a later date.

One plant for manufacture of the extruded asbestos cement components is in operation, and shipments now may be made to the northeast, southeast, midwest and southwest parts of the country. A prototype has been erected and is occupied.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN, URBAN RENEWAL, SUBURBAN, RURAL
2	Density Range	5 TO 10 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTER, OPEN SPACES
6	Nonresidential Functions	RECREATION FACILITIES; CONFERENCE ROOMS; COMMERCIAL FACILITIES
7	Circulation	CUL-DE-SAC
8	Site Planning Services	
9	Community Involvement	
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	2 TO 5 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED & BEING MARKETED
15	Community Involvement	USER AND VISITOR REACTION TO PROTOTYPE

BUILDING SUBSYSTEMS

16	Structure	EXTRUDED ASBESTOS CEMENT PANELS & POSTS; ROOF TRUSSES
17	Exterior Elements	
18	Interior Elements	DOUBLE INTERIOR PANELS
19	Foundations	CONVENTIONAL
20	Comfort Systems	HEATING IN MECHANICAL CORE INTEGRATED; OPTIONAL COOLING
21	Plumbing	OPTIONAL PLASTIC PIPE; BATHROOM & KITCHEN WALL INTEGRATED IN CORE UNIT
22	Electrical	CONVENTIONAL ELECTRIC WIRING
23	Furnishings	

PRODUCTION

24	Offsite Production	EXTRUDED ASBESTOS CEMENT COMPONENTS; MECHANICAL CORE
25	Onsite Production	
26	Onsite Construction	FOUNDATION; ERECTION OF COMPONENTS; CORE PLACEMENT; HOOK-UPS
27	Labor	UNSKILLED
28	Labor Training Programs	PLANT INSTRUCTION FOR UNSKILLED AND SEMISKILLED LABOR
29	Community Involvement	LOCAL LABOR IN LOCAL PLANTS

ECONOMICS

30	Construction Costs	$10,000 TO $13,000 PER SINGLE-FAMILY DETACHED
31	Financing Methods	
32	Useful Life	40 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	ALL
35	External Functions	
36	Market Area	
37	Delivery Rate	1,000 UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	PREASSEMBLED MECHANICAL CORE UNITS
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Christiana Western

PROPOSER

Christiana Western Structures, Inc., Subsidiary of Christiana Oil Corporation, Los Angeles, California.

AFFILIATES

B. A. Berkus Associates, Architects & Planners; Mutual Ownership Development Foundation, Community Development; Huntington Harbour Corporation; Christiana Community Builders.

Plywood panels with long-wearing factory-applied polyester resin finish coat, allowing complete wall construction in the shop, are the principal innovative feature of this system. This finish coat, reinforced with fibrous glass, leads to significant life-cycle cost savings, because it does not require repeated painting. It is applied to both interior and exterior panel surfaces and gives the appearance of conventional construction. Approximately half the work required for production of the system is in manufacture of the panels and half for onsite work, including erection and mechanical hookups.

The system includes the fully insulated, nonmodular, stud-wall panel component, made with 3/8-in. plywood sheathing, covered with a 1/32-in. layer of blown fiberglass on both the interior and exterior surfaces. Factory-installed rigid plumbing subsystems and wiring conduits in the walls and flexible horizontal runs in the ceiling require only simple hookup of outside service, appliances, and equipment at the site.

Units are shipped as panels from the factory and field assembled. The production method can provide panels of any length without joints and is suitable for all types of housing up to and including three-story heights. This system, which has been built and marketed for more than 6 years (some 5,000 units have been erected) employs a conventional foundation and floor construction; slab-on-ground or wood-frame floor, with plywood subfloor and vinyl asbestos tile.

This factory-fabricated wall panel framing consists of 2-in. x 4-in. studs 16 in. on center, with top and bottom plates doubled. Joints which exist at wall intersections only, are covered with caulking-compound-coated wood battens. Fiberglass insulation is factory applied in outside walls. Interior walls are framed in the same manner, without insulation. Windows and doors are completely trimmed with hardware installed when the panels leave the shop.

A roof-ceiling component consists of 8-ft.-wide panels produced in any length. A truss frame is jig-built from 2-in. x 10-in. joists and is covered with 3/8-in. plywood sheathing. Interior ceiling finish is acoustical plaster. The fiberglass-film finish applied to interior walls is precolored offwhite and requires no refinishing

for the life of the structure.

Kitchen cabinets are factory assembled, and interior trim is factory cut. Drapery and drapery hardware are provided at all windows and sliding doors. Mechanical systems are produced in core-type units broken down into installation elements to assure easy inspection on-site; installation and interfacing are simple. Unit elements include water supply and drainage systems, venting, fixtures, bath and kitchen modules, heating, ventilating, air conditioning, and ducting. Concealed plumbing is of copper, cast iron, or approved plastic. Ease of maintenance and replacement has been assured. Exterior stairs are specified for multifamily units.

At present a 177-acre production facility at Blythe, California, is in operation. No additional testing of the system is required. Only nominal factory skills are required, and training facilities are maintained at the plant; workers are taught in 2- to 6-week intervals, then licensed for one of several different tasks. The proposer projects a volume production of 6,000 units per year.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	6 TO 25 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	GREENBELT SYSTEM; CLUSTER VILLAGE CONCEPT; HIGH DENSITY WITH OPEN SPACES
6 Nonresidential Functions	MAIN RECREATION AREA; TOT LOTS; CHILD CARE FACILITIES; WOODSHOPS; GYMS
7 Circulation	SEPARATE VEHICULAR TRAFFIC; CUL-DE-SACS; PERIFERAL DRIVING ACCESS & PARKING
8 Site Planning Services	PROPOSER'S SYSTEM DESIGN TEAM
9 Community Involvement	
10 Utilities	CONVENTIONAL; UNDERGROUND

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	BUILDING SYSTEM MARKETED; PRODUCTION PLANT OPERATIONAL
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	PLYWOOD WALL & ROOF PANELS; CONVENTIONAL FLOOR FRAMING; OPTIONAL ROOF TRUSSES
17 Exterior Elements	FIBERGLASS & POLYESTER RESIN FINISH ON EXTERIOR WALLS; STAIRS
18 Interior Elements	WOOD PANEL PARTITION; FIBERGLASS & POLYESTER RESIN FINISH; ACOUSTICAL CEILING
19 Foundations	CONVENTIONAL
20 Comfort Systems	CONVENTIONAL HEATING; INTEGRATED COOLING OPTIONAL
21 Plumbing	KITCHEN & BATH UNIT SERVICE LINES INTEGRATED IN PANEL SYSTEM
22 Electrical	CONVENTIONAL; INTEGRATED IN PANEL SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL, ROOF, & PARTITION PANELS; STAIRS; TRUSSES; CABINETS
25 Onsite Production	
26 Onsite Construction	PANEL ERECTION; FOUNDATION; FLOOR & ROOF FRAMING; UTILITIES HOOK-UP
27 Labor	UNSKILLED & SEMISKILLED FOR PLANT PRODUCTION & CONSTRUCTION/ERECTION
28 Labor Training Programs	2 TO 6 WEEKS WITH PAY FOR ERECTION PROCESS
29 Community Involvement	

ECONOMICS

30 Construction Costs	$8.00 PER SQ. FT., 1,400-SQ.-FT. UNIT—6,000 PER YEAR RATE
31 Financing Methods	CONVENTIONAL
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; PRODUCTION; CONSTRUCTION; ERECTION
35 External Functions	FINANCE; LAND PLANNING; DESIGN CONCEPTS; IMPLEMENTATION
36 Market Area	NATIONAL
37 Delivery Rate	6,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	GENERALLY CONFORM TO NATIONAL MODEL CODES

City Scope Services, Limited

PROPOSER CONSORTIUM

City Scope Services, Limited, Chicago, Illinois
Ellis, Arndt and Truesdell, Inc., Architects, Flint, Michigan
Cunningham-Limp Company, Flint, Michigan

AFFILIATES

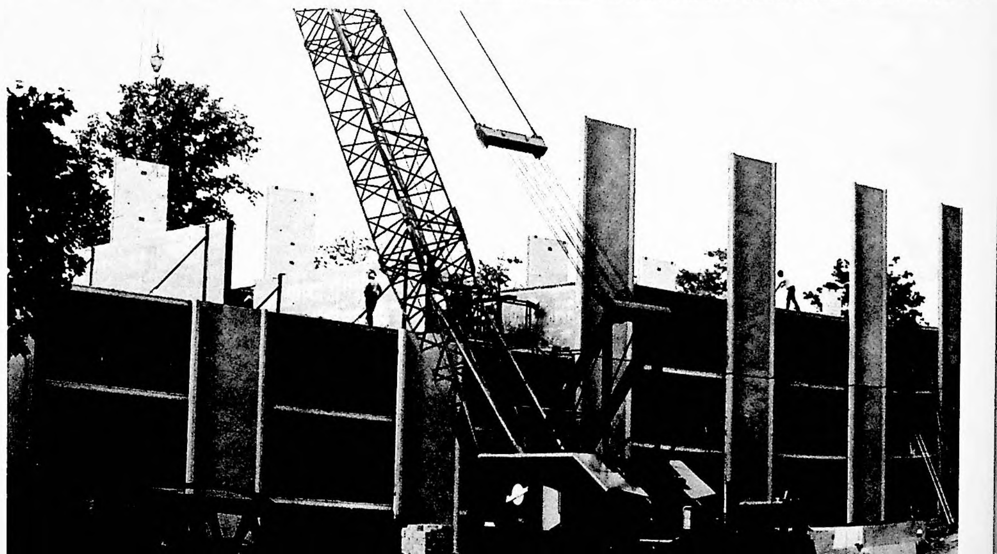
John Miller Electric Company; Flint Plumbing and Heating.

The proposed system, involving the site joining of precast concrete panels, has been proven in completion of a 110-unit project for occupancy by the elderly. The housing is proposed for multifamily occupancy only, but a mix of single persons, married couples, and college students, as well as elderly couples, is recommended for each apartment complex.

Cost control is achieved through off-the-shelf construction techniques using standard materials. The single-unit panels are factory-produced and stocked for easy removal and trucking to site. The prototype housing project for the elderly was constructed of panels produced at a permanent factory site, but it is suggested that a casting factory can be made portable and readily moved from site to site.

All walls, roofs, and floors are precast as individual panel elements and erected at site without framing. The simple welding, onsite, of steel plates that are cast into the panels at the factory ties the structure and permits flexible room arrangement. Inside walls are factory-finished in varied textures of concrete or paint; exterior walls can be left as finished or faced with brick or wood. The slab bearing wall and cored plank deck units are set onsite by crane, situated on foundations designed to site specifications. Conditions will dictate use of caisson, pile, or barge types, with the height of the building a determining factor.

Both plumbing and electrical services are integrated with the building system with raceways cast into panel elements. Cast iron or plastic pipe is designated. Kitchen equipment includes refrigerator, range, and cabinets, and laundry equipment is included. Heat is sup-



plied through individual room units, with electricity as the source of energy. A combination cooling unit is optional; heat (or cooling) distribution is with fan-coil units that are easily and rapidly exchanged. Lighting panels are situated at every floor, and a dual intercom is integrated with the conventional telephone system to provide service to each apartment. Emergency power is supplied from stand-by batteries, if needed.

No large amount of highly skilled labor would be required for producing and installing the system. Local union tradesmen would be employed, men with current skills, and most of the work would be done by the semiskilled. The plan calls for qualifying local labor through training for subsequent programs within respective communities. A self-help program would also be possible, involving exterior site improvements and landscaping.

The proposer acts as representative for a consortium of architects, contractors, consultants, and coordinators. The system, researched and developed for the past 3 years, uses present technology and provides a base for ultimate evolution to a more sophisticated system.

It is felt that the next logical step in the development of a true mass production technique employing this method should be the design of a complete computer analysis program to speed systems and expand capabilities for more thorough analysis. Program requirements would include market evaluation, firm program criteria to initiate new studies of financial feasibility and marketability, logistics of both designing and construction projects as well as cost control, accounting, and future planning.

Summary Information

SITE SYSTEM

1 Site Situation	
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	CONSORTIUM MEMBER
9 Community Involvement	
10 Utilities	SANITARY SEWAGE TREATMENT

BUILDING SYSTEMS

11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY & 1-BEDROOM
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM CURRENTLY MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE PANEL SYSTEM
17 Exterior Elements	
18 Interior Elements	PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	INDIVIDUAL ROOM UNITS
21 Plumbing	INTEGRATED WITH BUILDING SYSTEM IN FACTORY
22 Electrical	INTEGRATED WITH BUILDING SYSTEM IN FACTORY
23 Furnishings	

PRODUCTION

24 Offsite Production	CONCRETE BEARING WALLS; CORED PLANK DECK UNITS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION
27 Labor	SEMISKILLED; SKILLED
28 Labor Training Programs	TRAINING FOR LOCAL PERSONNEL
29 Community Involvement	LOCAL CONTRACTORS, SUBCONTRACTORS, AND MATERIAL SUPPLIERS

ECONOMICS

30 Construction Costs	$7,800 PER UNIT — BASED ON 196 UNITS
31 Financing Methods	
32 Useful Life	50 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; DESIGN; CONSTRUCTION; RESEARCH & DEVELOPMENT
35 External Functions	MECHANICAL SUBSYSTEMS
36 Market Area	
37 Delivery Rate	1,000 DWELLING UNITS FIRST YEAR; 2,000 DWELLING UNITS SECOND YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

The Commodore Corporation

PROPOSER CONSORTIUM

The Commodore Corporation, Omaha, Nebraska
Leo A. Daly Company, Omaha, Nebraska
American Wood Preservers Institute, Washington, D.C.
C.A. Dieman and Associates, Bethesda, Maryland
Donovan, Leisure, Newton and Irvine, New York, New York
Harlan Lee and Associates, Los Angeles, California
Lueder Construction Company, Omaha, Nebraska
N.A.H.B. Research Foundation, Rockville, Maryland
Underwriters Laboratories, Chicago, Illinois

On the basis of considerable design and building experience in the mass production field, the structural concept proposed is one of great simplicity involving module stacking within a frame. The system and subsystems design provides for maximum flexibility and expansion in the arrangement of similar modules within a separate framework. Performance standards guide these producers in the development of modifications to the present system.

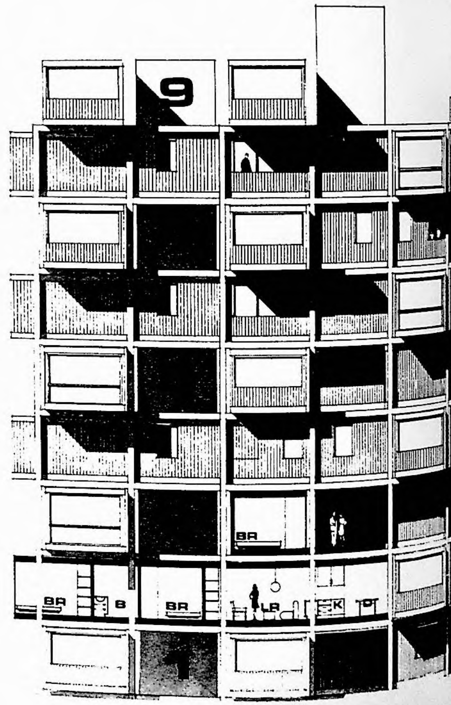
Frame construction is of precast concrete, wood, or steel, depending upon load requirements, and vertical cores for high-rise buildings employ the concrete slipform technique. Cores for low-rise housing are factory-built tilt-up elements, and foundations are spread concrete footings. The frames are erected in grids 14 ft. square with cross beams spaced vertically every 11 ft.

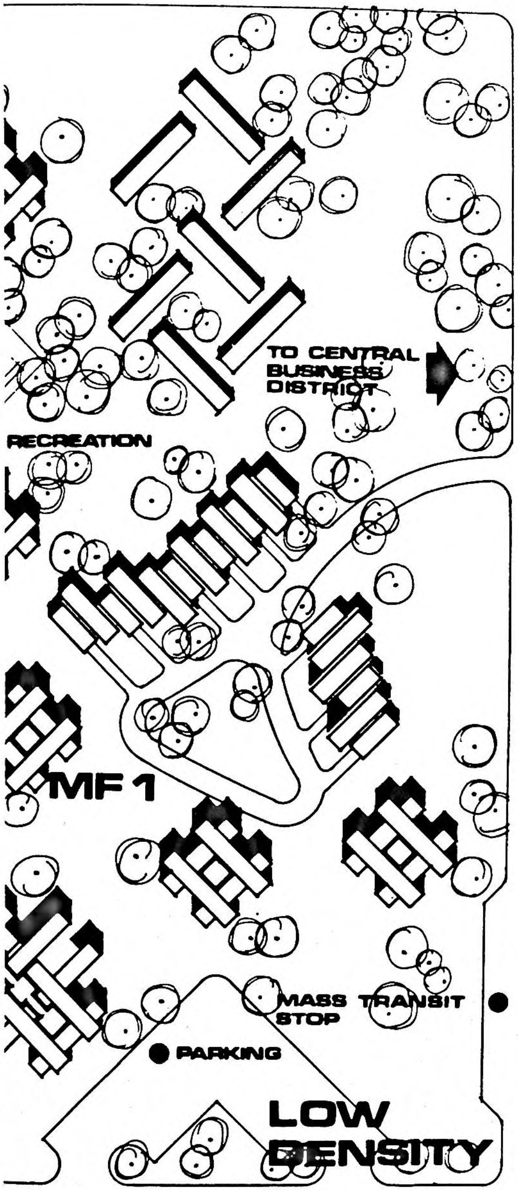
The plant-produced modules for insertion into the frame openings vary in size; they are manufactured in 12-ft. widths, 10 ft. high and range in length from 44 ft. to 60 ft. Their skins are of aluminum, plywood, steel, or hardboard attached to a wood or steel frame. Interiors are plywood or gypsum board walls, with a carpet or vinyl surfaced particleboard subfloor built into the module. Ceiling material is gypsum board. Bow trusses or ceiling joists comprise the roof framing, with galvanized steel or asphalt the exterior roof covering.

Complete bathroom units, laundry facilities, and kitchen subsystems are factory-constructed and built into the module before delivery to the site. Grounded two-wire plastic-covered line is specified for electrical distribution. Heating and cooling subsystems are specified.

The suggested prototype is for construction in the midwest region, but the building technique is adaptable to other areas as well. Five hundred miles from plant is considered an economical transportation range for the fully equipped modules. Immediate volume production of 10,000 units per year is indicated, with a rate of 30,000 units projected for the near future.

Consortium-type management of projects is under direction of the sponsor. Marketing, merchandising, and sales are handled through franchise arrangements and licensing agreements. Semiskilled labor is used for the erection process onsite, with other site activities requiring no special skills.





Summary Information

SITE SYSTEM		
1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2	Density Range	5 TO 10 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTERS; COMMON OPEN SPACES
6	Nonresidential Functions	RECREATION & EDUCATION FACILITIES; COMMUNITY & SHOPPING FACILITIES
7	Circulation	SEPARATE PEDESTRIAN, VEHICULAR & SERVICE CIRCULATION; SUPERBLOCK
8	Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	COMMUNITIES TO PARTICIPATE IN PLANNING
10	Utilities	CONVENTIONAL
BUILDING SYSTEMS		
11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 3 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION FACILITIES IN DESIGN STAGE; BUILDING SYSTEM DEVELOPED & MARKETED
15	Community Involvement	
BUILDING SUBSYSTEMS		
16	Structure	WOOD AND/OR STEEL FRAME VOLUMETRIC MODULES SUPPORTED BY SKELETON FRAMES
17	Exterior Elements	ALUMINUM, PLYWOOD, STEEL OR HARDBOARD FACING
18	Interior Elements	CONVENTIONAL FINISHES; CONCRETE VERTICAL TRANSPORTATION & UTILITIES CORES
19	Foundations	CONVENTIONAL
20	Comfort Systems	
21	Plumbing	
22	Electrical	
23	Furnishings	
PRODUCTION		
24	Offsite Production	VOLUMETRIC MODULES; CONCRETE FRAME MEMBERS; CONCRETE LOW-RISE CORES
25	Onsite Production	CONCRETE HIGH-RISE CORES
26	Onsite Construction	FOUNDATIONS; FRAME ERECTION; VOLUMETRIC MODULE PLACEMENT; UTILITIES HOOK-UP
27	Labor	UNSKILLED AND SEMISKILLED FOR PLANT & SITE CONSTRUCTION
28	Labor Training Programs	PROPOSER TO DEVELOP A NEW TRADE SKILL, "MODULAR HOUSING ERECTOR"
29	Community Involvement	LOCAL LABOR, CONTRACTORS, & SUBCONTRACTORS
ECONOMICS		
30	Construction Costs	$8.20 TO $13.60 PER SQ. FT. (1,000 DWELLING UNITS PER YEAR)
31	Financing Methods	CONVENTIONAL
32	Useful Life	ELECTRICAL—60 YEARS; PLUMBING—40 YEARS; HEATING—25 YEARS; ROOFING—20 YEARS
MANAGEMENT		
33	Proposer Organization	CONSORTIUM
34	Internal Functions	ARCHITECTURAL; MODULE MANUFACTURING; MARKETING; ERECTION, FINANCING
35	External Functions	
36	Market Area	
37	Delivery Rate	10,000 DWELLING UNITS IN 1970; 30,000 DWELLING UNITS IN 1971
38	Consumer Protection	
GENERAL		
39	Major Innovative Concepts	PROGRAM TO DEVELOP A NEW TRADE SKILL, "MODULAR HOUSING ERECTOR"
40	Codes	

Component Building Systems

PROPOSER

Component Building Systems, Ltd., Systems Designers, Chicago, Illinois

AFFILIATES

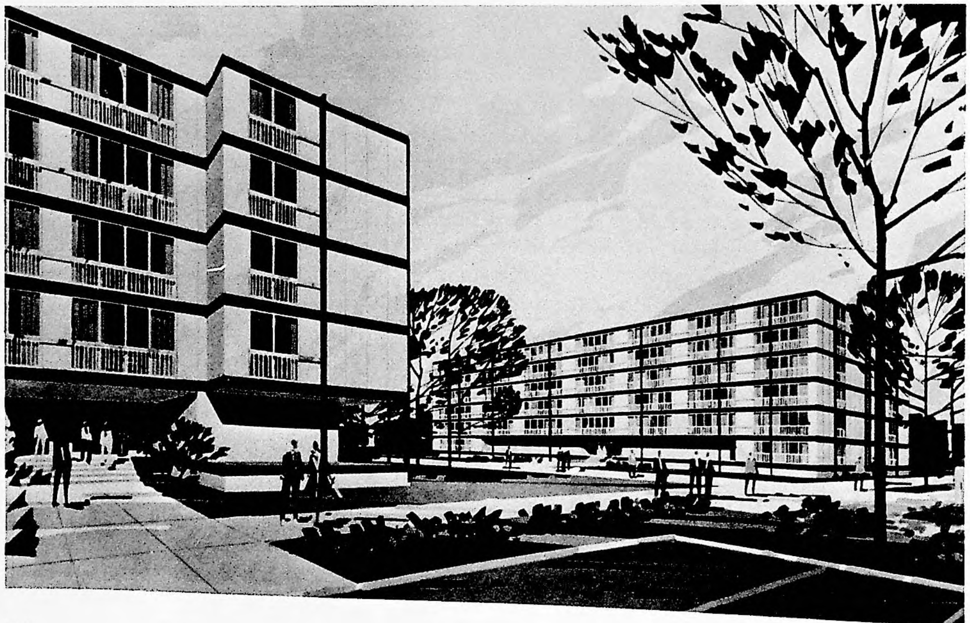
Lods, Depondt and Beauclair, Architects; The Engineers Collaborative, Ltd.; W. E. O'Neil Construction, Inc., General Contractors

Five years of architectural and engineering research and development led to the refinement of this building system concept aimed at durable, economical housing and various other types of buildings, such as educational and health facilities, office buildings, hotels, motels and dormitories. Savings are inherent in factory-fabrication of the structural elements—steel framing and prefinished, insulated panels—and in delivery of complete bathroom and kitchen units for easy installation.

The concept, developed by French architects and engineers, has been tested in a 500-unit apartment and small suburban office building in France. It is an open system with a column-supported structure permitting great flexibility in floor plans, configuration, and number of floors.

The lateral forces are resisted by steel X-braced structural steel bents attached to the structural steel columns. Floor framing consists of structural steel trusses assembled at the site into apartment-sized framing modules, which are crane-lifted into place. Flooring consists of precast tongue-and-groove gypsum plank placed on the framing module before its erection. The roofing can be either conventional multi-ply membrane or metal over insulation. Floor coverings may vary, depending upon individual project economies. The ceiling system consists of prefinished vermiculite tiles with shiplap edges attached to the structure underside by metal clips. Tiles are isolated from the structure by small vermiculite blocks at clip locations.

Exterior walls feature prefinished insulated wall panels, floor-to-ceiling, double glazed sliding doors or standard windows combined with the prefinished insulated panels. The panels are formed of exterior sheetmetal with a laminated or solid insulation core. The interior face is a rigid prefinished facing material, and joint details are double- or single-gasketed and assembled without caulking compounds. Spandrel panels at each floor level are prefinished sheetmetal with insulation backing, and are bracketed on the vertical sides of the floor framing. Interior partitions are pre-



finished panel systems.

Bathrooms and kitchens are completely assembled; central or unit heating elements with gas or electric energy are specified, with air furnace and hydronic baseboard distribution optional. A cooling system completely factory-fabricated, can be integrated with either heating system. Electrical distribution is through runs atop perimeter partitions for flexible cable, or preinstalled below the floor for rigid conduit. After installation, the space at the top of partitions is filled with insulation and covered with a cement asbestos closure, with a prefinished, cove molding.

The construction is adaptable to conventional foundations designed for individual site characteristics. Site work requires a minimum of skilled labor combined with semiskilled and unskilled labor. On-job training for installation of components is proposed, and community groups would be permitted to suggest how they could best participate in the site activity.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1-, 2-, 3 BEDROOM
13 Design Selection	
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED, BUT NOT BEING MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SITE-ERECTED FLOOR PANELS IN COMBINATION WITH STEEL FRAME
17 Exterior Elements	DOUBLE OR SINGLE GASKETED INSULATED EXTERIOR METAL CLAD PANELS
18 Interior Elements	PREFINISHED WALL & CEILING PANELS: COMPLETE KITCHEN & BATH UNITS
19 Foundations	CONVENTIONAL
20 Comfort Systems	OPTIONAL CENTRAL SYSTEM, GAS OR ELECTRIC; HYDRONIC OR BASEBOARD HEATING; COOLING
21 Plumbing	FACTORY FABRICATED BATHROOM & KITCKEN UNITS
22 Electrical	CONVENTIONAL; SUBSYSTEM INTEGRATED WITH BUILDING SYSTEM ONSITE
23 Furnishings	
PRODUCTION	
24 Offsite Production	FRAMING MODULES; FLOOR, WALL & CEILING PANELS
25 Onsite Production	FOUNDATIONS, ASSEMBLY OF COMPONENTS; INSTALLATION OF MECHANICAL SUBSYSTEM UNITS
26 Onsite Construction	
27 Labor	SKILLED; SEMISKILLED; UNSKILLED
28 Labor Training Programs	FIELD LABOR
29 Community Involvement	SELF-HELP; COMMUNITY GROUPS TO SUGGEST HOW THEY COULD BEST PARTICIPATE
ECONOMICS	
30 Construction Costs	$12.50 PER SQ. FT.-100 UNITS (MULTISTORY)
31 Financing Methods	CONVENTIONAL
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	JOINT VENTURE
34 Internal Functions	
35 External Functions	
36 Market Area	NATIONAL
37 Delivery Rate	RESPONSIVE TO DEMAND
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL & LOCAL MODEL CODES

Concrete Industrialized Building System

PROPOSER CONSORTIUM

Portland Cement Association, Skokie, Illinois
National Urban League, Inc.
Ferendino/Grafton/Pancoast, Architects
Flexicore Manufacturers Association
Prestressed Concrete Institute
Dynaspan Producers Association
Spancrete Manufacturers Association
Span-Deck Manufacturers Association
Spiroll Producers Association
National Gypsum Company
American Standard Inc.
Wiremold Company

AFFILIATES

Price Waterhouse and Company, Systems Management Consultant; Northern Trust Company, Financial Consultant; Kirkland, Ellis, Hodson, Chaffetz and Masters, Legal Consultant

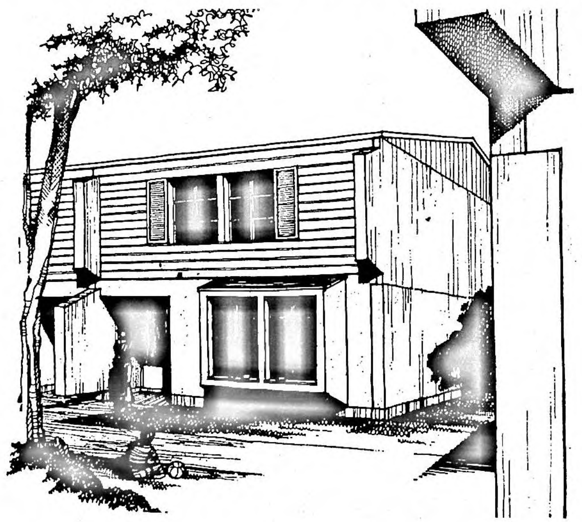
Offered is a concrete industrialized building system as a construction method that can be used now to help meet the nation's housing needs. The system consists essentially of an open-ended, dwelling-sized module, the sides being concrete bearing walls, and the roof and/or floor-ceiling being made up of precast, prestressed hollow-core concrete plank. Both of the components are products presently being manufactured by the concrete industry and therefore are readily available for use.

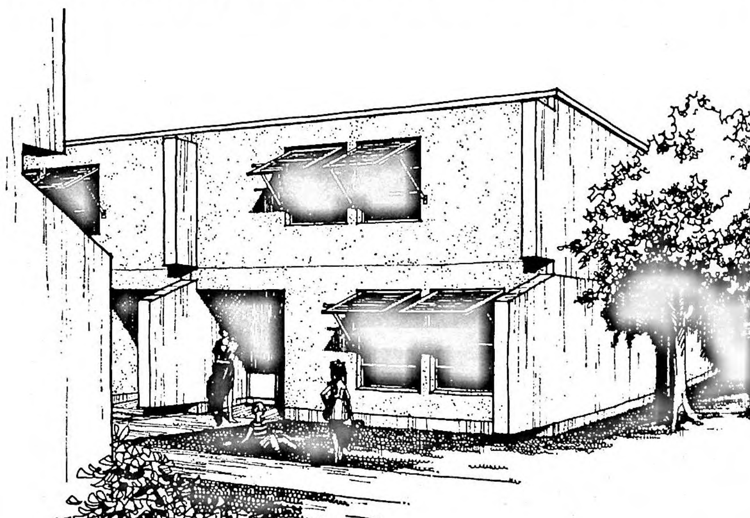
Single-family and multifamily low-rise structures can be constructed from these components, the elements being available in several modular sizes; stacked units are self-supporting up to three stories with the innovative bolted connection providing structural integrity.

The load-bearing hollow-core or solid wall components are usually 8-ft. high and can be precast in single wall-length sections or in shorter sections for ease of transport and erection. Erected on innovative precast concrete foundations or concrete footings, the exterior load-bearing walls are typically 20-ft. apart. Pretensioned hollow-core planks span the open areas between the walls. These precast floor elements are 8-in. thick, in widths ranging from 24 in. to 96 in. and in lengths as required.

The wall and floor-ceiling elements are joined by a four-part bolted connection system which posttensions the entire structural entity and results in a building that is structurally sound. The connection consists of a 6-in. standard bow-tie coiled insert cast into the top surface of the wall element. This mates with a threaded bolt passed through the floor plank into the next wall element above; a center-voided steel plate is cast into the bottom surface of the panel. The connection is completed by a washer and nut. A concrete grout bed between wall and floor elements offers an additional bond and sound barrier. The coiled insert serves as an anchor for the lifting lugs used during crane-erection of the wall sections.

After the basic structure for a dwelling unit is erected and joined, a prefabricated plumbing wall is installed, backed up by modularized kitchen and bathroom units. These are followed by installation of other interior walls, nonbearing partitions, prefabricated stairs and decorative components. The open ends may be closed by whatever styling finish and material selection the architect wishes. This may include conventional 2-in. x 4-in. stud wall construction fabricated in the plant or onsite, with exterior finish being 1/2-in.



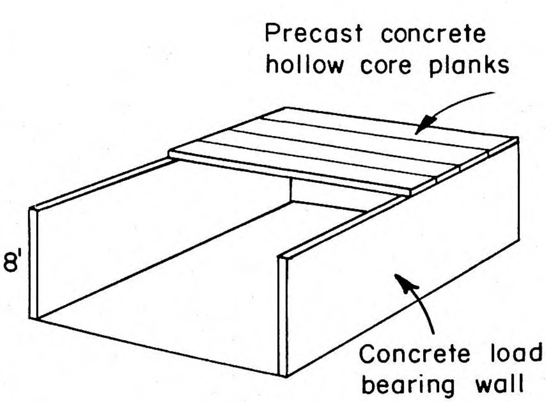


gypsum board clad with 12-in. clapboard. A variation may include precast concrete or decorative concrete masonry. Exterior treatment of the concrete bearing walls may range from exposed aggregates to a textured or colored concrete treatment.

The inside faces of the bearing walls may be painted directly or furred-out, fiberglass-insulated, and finished with gypsum board, the insulating requirement being a function of climatic conditions. The owner-occupant in turn can finish the walls to suit his taste, ranging from painting to application of simulated paneling or other imaginative treatments.

In addition to structural integrity and architectural variety, the use of the precast, concrete components guarantees each dwelling unit with sound reduction and a high degree of fire resistance. The hollow-core construction of the floor planks allows easy integration of mechanical services.

Proposed heating (and optional cooling) is by a gas-fired upflow furnace, with air distribution being via ductwork concealed in passageways and storage areas by dropped ceilings under the concrete planks above. After erection of the structure, wiring will be effected by installation of metal raceways which serve a dual function of electric distribution and decorative baseboard trim.



BASIC STRUCTURAL UNIT

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	RECREATIONAL, EDUCATIONAL, & COMMERCIAL FACILITIES
7 Circulation	SEPARATE VEHICULAR CIRCULATION
8 Site Planning Services	
9 Community Involvement	THROUGH NATIONAL URBAN LEAGUE
10 Utilities	PUBLIC

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	2 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	PRODUCTION PLANT EXISTING; FURTHER DESIGN OF COMPOSITE SYSTEM REQUIRED
15 Community Involvement	THROUGH NATIONAL URBAN LEAGUE

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE STRUCTURAL WALL PANELS; CONCRETE HOLLOW-CORE FLOOR-CEILING PLANKS
17 Exterior Elements	CONCRETE & WOOD STUD END WALLS; BALCONIES; SUN SCREENS
18 Interior Elements	INTERIOR WALLS; STAIRS; DROPPED CEILING; CORE UNITS; PLUMBING WALL
19 Foundations	PRECAST PANELS WITH GROUT LEVELING PAD
20 Comfort Systems	GAS-FIRED UPFLOW FURNACE; OPTIONAL COOLING
21 Plumbing	ENCLOSED PIPING IN "WET" WALL; BATH & KITCHEN CORE UNITS
22 Electrical	WIRING VIA METAL RACEWAYS WHICH SERVE ALSO AS BASEBOARD TRIM
23 Furnishings	

PRODUCTION

24 Offsite Production	CONCRETE WALLS & HOLLOW-CORE PLANKS; WOOD STUD WALLS; CORE UNITS; COMPONENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATION; CONCRETE WALLS & PLANKS; PLACING OF CORE UNITS
27 Labor	CONVENTIONAL
28 Labor Training Programs	BY PROPOSER CONSORTIUM MEMBERS
29 Community Involvement	THROUGH NATIONAL URBAN LEAGUE

ECONOMICS

30 Construction Costs	$12,905 PER UNIT, 1000 UNITS PER YEAR
31 Financing Methods	PROPOSER SUPPLIED; CONVENTIONAL
32 Useful Life	MECHANICAL: 25 YEARS; STRUCTURAL CONCRETE: INDEFINITE

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	OVERALL DESIGN; DEVELOPMENT; PRODUCTION; CONSTRUCTION; MANAGEMENT; MARKETING
35 External Functions	
36 Market Area	NATIONAL
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BOLTED STEEL CONNECTION METHOD FOR CONCRETE COMPONENTS
40 Codes	CONFORMS TO ALL NATIONAL CODES

Creative Buildings

PROPOSER

Creative Buildings, Inc., Urbana, Illinois

AFFILIATES

Walter E. Heller Company, Finance and Construction; Real Estate Research Corporation, Research; Salk, Ward & Salk, Finance; University of Illinois, Housing Research, Technology, and Engineering; Advanced Planning Research, Computer Processing; University of New York at Buffalo, Department of Architecture, Systems Development; Talbott Testing Laboratories; A & H Testing Service.

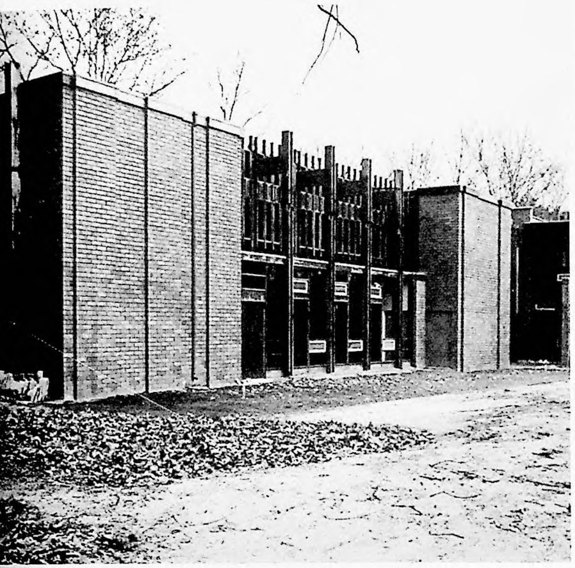
This proposal is for a modular system with no limitations of design and no predetermination of materials. Basically, it employs the 4-in. module extended to a building module of 4 ft. The manufactured volumetric module, in turn, is 12 ft. wide, 60 ft. long, and 12 ft. high, with provision for enlargement of room size by 2-ft. increments. This is accomplished by opening the modules into each other. The system is absolutely flexible for architectural design and material choice. Components are completely factory finished. One- to three-story heights are possible with emphasis on townhouses and garden apartments. High-rise structures up to 20 floors are possible with special framing.

Factory work includes application of a gypsum finish on prefabricated interior nonstructural partitions. Double party walls are specified, and floor and ceiling subsystems are insulated.

All mechanical elements are prepackaged for field installation, including central heating, central cooling, and a ventilating subsystem. Standard stock items are used in the fabrication of these elements. Laundry facilities also are factory produced and shipped ready for installation at the site. Both PVC plastic pipe and copper pipe are indicated for some supply lines and for drain, waste, and venting. Water boiler or air furnace is optional as the primary heating source.

A consortium-type management for projects is proposed, with the proposer retaining central responsibility. The total system uses information retrieval for decision making, with analysis and evaluation placed against performance standards. A detailed plan for the system has been developed, but not yet marketed. Licensing and leasing agreements are favored for merchandising.

Local contractors and local labor will be used insofar as possible with an on-job training program instituted for plant workers. An optional self-help plan involves the occupant in development of foundations, site work, parking construction, grading, landscaping, erection, and interior painting. A separate organization is suggested for fully defining the community needs and to promote self-help in connection with projects.



Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	4 TO 18 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER GROUPING; MASTER PLANNING; COMMON OPEN SPACES
6 Nonresidential Functions	PLAY AREAS; COMMUNITY BUILDING; CENTRAL LAUNDRY FACILITIES
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION
8 Site Planning Services	
9 Community Involvement	SURVEY OF LOCAL NEEDS; MANAGEMENT ORGANIZATION TO PROMOTE SELF-HELP
10 Utilities	CONVENTIONAL; UNDERGROUND ELECTRIC SERVICE; UTILITIES SIZED FOR EXPANSION
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 5 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
15 Community Involvement	OWNER SELECTION OF FINISHES
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULES; SPECIAL FRAMING, HIGH-RISE UP TO 20 STORIES
17 Exterior Elements	
18 Interior Elements	GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL; TO BE DESIGNATED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	HYDRONIC OR FORCED AIR HEATING, COOLING; INTEGRATED WITH BUILDING SYSTEM
21 Plumbing	PVC, COPPER DISTRIBUTION PIPING; PACKAGED KITCHENS & LAUNDRY FACILITIES
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF VOLUMETRIC MODULES; UTILITIES HOOK-UP
27 Labor	SEMISKILLED FOR ENGINEERING & DRAFTING
28 Labor Training Programs	ON-THE-JOB TRAINING FOR PRODUCTION PLANT
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP FOR FOUNDATIONS, SITE WORK, FINISHING
ECONOMICS	
30 Construction Costs	$12.20 to $17.00 PER SQ. FT. EXCLUDING LAND
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURE: 40 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT, FINANCE, PRODUCTION, CONSTRUCTION, MARKETING, PLANNING, DESIGN
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

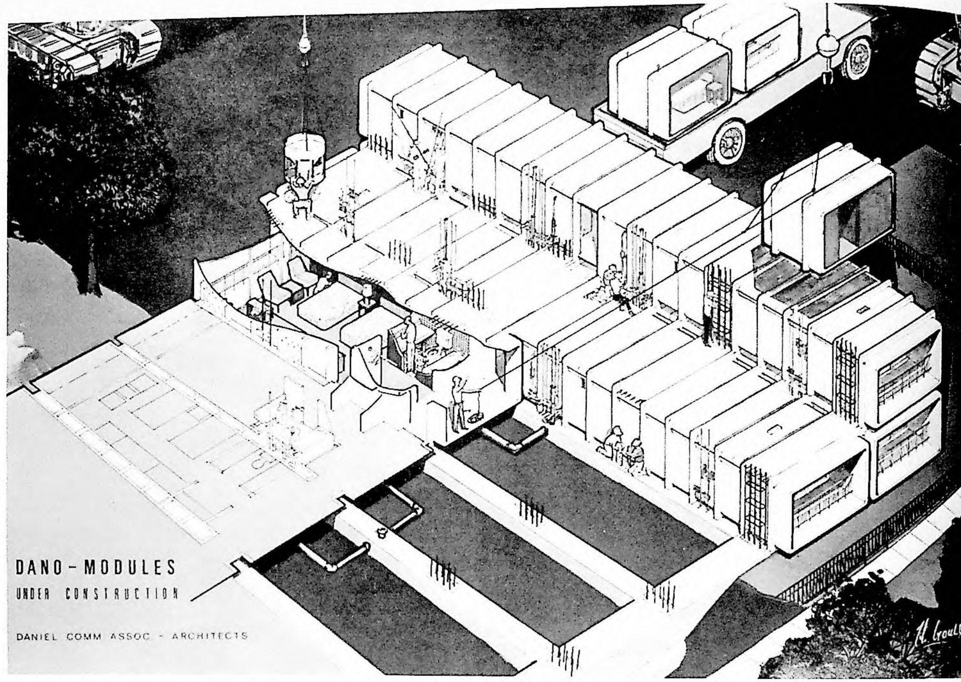
Dano-Modules, Inc.

PROPOSER

Dano-Modules, Inc., Chicago, Illinois

AFFILIATES

M.A. Lombard & Sons Company, Precasters & General Contractors; Sherwin Stenn Engineers Company, Mechanical Engineers; Bernard E. Ury Associates, Inc., Public Relations; Graph Americs, Inc., Computer Services; Raths, Mees & Johnson, Structural Engineers.



Teamed together in this proposal are reinforced concrete volumetric modules (the hardware) and computer-generated design information and building arrangements (the software). The modules may be stacked up to four high as self-supporting building blocks for single-family or multi-family low-rise structures, or they may be stacked, without theoretical limit, by incorporation of a cast-in-place structural concrete frame.

The module essentially is an open-ended rectangular sleeve, with standard inside dimensions of 8 ft. (high) x 8 ft. (long) x 12 ft. (wide). (The 12-ft. dimension may be increased for special uses.) These dimensions were established by recognition of 8 ft. as being standard room height for hotel, motel, apartment, and hospital rooms; the 8-ft. depth was arrived at as the maximum loading permitted without special trucking permit; the 12-ft. module width was believed to be an acceptable room width for most conventional rooms, with combination of modules, of course, permitting lengths in multiples of 8 ft. Equally important, the overall size of the module was determined to be such that it could be easily cast, and, once cast, its resultant weight (6 1/2 tons) could be transported and lifted with conventional equipment.

Trisecting the 8-ft. deep top, bottom, and side walls of the sleeve are 2 ribs (6 in. x 8 in. in cross section) cast monolithically with the walls of the module. As the modules are placed (horizontally or vertically), each pair of ribs butts up to a pair of ribs on an adjoining module and between the ribs is formed a 4-ft. wide chase. These chases, suitably reinforced with bar steel, serve as formwork for casting the concrete structural framework. Thus, with the elimination of conventional formwork, it is expected that construction time will be reduced from 40 to 50 percent.

The chases serve as well for distribution of all mechanical services to the dwelling units, including distribution of heated or chilled air to room registers. Because the chases are accessible, alterations, changes, additions, or replacement of any of these systems becomes possible simply by fishing through the space, without the necessity for tearing out concrete.

Further exploiting the built-in advantage of the chases is the proposer's anticipated use of plumbing trees and powered electrical trees. They will be slipped into the chases (both vertical and horizontal) with a minimum of site time, and hooked into stub-ins from the modules, which will be delivered to the site with these services cast in place.

Walls of the modules are 2 in. to 4 in. thick (being thicker at the coved corners), with the interior surfaces completely finished without need for other wall surfacing. (Later alteration by the owner is accomplished by painting or applying a wall covering.) Exteriors of the modules where exposed (such as the cantilevered portion at the end of a unit in which a balcony might be located) are similarly finished. Ends of the modules may be closed in by a variety of materials such as glass, metal panels, or masonry. The units are completely fireproof, heat insulation is sprayed on, and voids formed by the chases assure individual dwellings of acoustical privacy.

Delivery of the modules to the site will be in a predetermined, numbered order, according to the architect's drawings, so that each goes into place like a building block in the appropriate order, with only hook-up of services and reinforcing and casting of the structural frame being required onsite. The modules themselves may arrive completely ready for living, with built-in equipment, fixtures, and flooring. A complete module or part of one may incorporate both bath and kitchen facilities. In the typical high-rise structure, vertical circulation elements—stairwells and elevator

shafts, for example—will be provided by specially designed and cast modules.

A proposed computer program would provide the generation and printout of both building arrangements and design information so that direct drafting of plans and elevations can be readily accomplished. A second output would be quantities and identities of various components with item cost, cost extension, and total cost so that estimates can be readily arrived at.

Input for the program would consist of the proposed building's specifications and other parameters established by the owner. Stored on disks in the computer would be constraints such as code data and cost information, and this might be augmented by other temporary parameters relating to the specific project.

The proposer states that the modular units for the system may be cast in existing plants, in new plants, or may be produced onsite. Such onsite plants conceivably might be licensed by the proposer to local contractors using local labor.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	PROPOSER
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1, 2, 3 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT, DESIGN STAGE; BUILDING SYSTEM, FURTHER RESEARCH NEEDED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE VOLUMETRIC MODULES, SELF-SUPPORTING UP TO 4 STORIES
17 Exterior Elements	
18 Interior Elements	
19 Foundations	
20 Comfort Systems	CENTRAL HEATING WITH CHASES BETWEEN MODULES AS DUCTS
21 Plumbing	PREFABRICATED TREES IN CHASES; UNIT SERVICES CAST INTO MODULES
22 Electrical	PREFABRICATED WIRING IN CHASES BETWEEN MODULES
23 Furnishings	INTERIORS PRE-FURNISHED
PRODUCTION	
24 Offsite Production	MODULES; PLUMBING TREES; ELECTRICAL TREES
25 Onsite Production	MODULES (POSSIBLE)
26 Onsite Construction	FOUNDATIONS; POURING CONCRETE STRUCTURAL FRAME; STACKING MODULES
27 Labor	SKILLED; UNSKILLED; SEMISKILLED
28 Labor Training Programs	
29 Community Involvement	PLANNING & CONSTRUCTION; LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$9.00 PER SQUARE FT. (BEST RATE)
31 Financing Methods	CONVENTIONAL
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN
35 External Functions	MANAGEMENT; ENGINEERING; PRODUCTION; ERECTION
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	POURING CONCRETE INTO VOIDS BETWEEN MODULES
40 Codes	GENERALLY ADAPTABLE TO ALL NATIONAL MODEL CODES

Delta Building Corp.

PROPOSER

Delta Building Corporation, Virginia Beach, Virginia

AFFILIATES

Talbot & Associates, Engineers & Land Planners; Designed Living, Developer; Porta Aluminum, Inc.

This system contains architectural innovations in space arrangement and materially reduces construction time through prefabrication of subcomponents and site erection around a completely prebuilt mechanical core. Unlike the approach of conventional architectural design, functions of the shelter unit are assigned to general zones; specified are those for activity, privacy, food preparation, sanitary facilities, general storage, mechanical equipment, and outdoor recreation. Thin-wall interior partitions are of the movable, hinged, or folding type, permitting layout variations either during or after construction, with changes easily made by tenants. Built-in furniture, prefinished and totally assembled before installation, is positioned to form movable partitions, saving considerable space over conventional methods.

A wide variety of materials can be used. Component fabrication is factory-conducted offsite except for stair assemblies and other minor elements. An envelope system is employed for enclosure and the prefinished panels, standardized and interchangeable, are made from wood, metal, concrete, or plastic structural frame. Modular prefinished structural panels are prescribed for exterior walls, floor, roof, and load-bearing interior partitions. Floor covering, where required, can be spray- or mop-applied, unless carpeting is used.

The proposer suggests that a radical breakthrough is needed in the foundation subsystem area to effect significant cost savings. He would devote a major portion of his design program to research and development of an improved foundation system.

A ducted, forced warm air system handles heating and cooling requirements, with air-handling units centrally located within the mechanical core. This permits last-minute installation in the construction process; duct runs are minimized; and maintenance and repair are facilitated as well. When practical, ducts are confined to conditioned space to eliminate insulation and vapor-barrier costs.

Standard plumbing layouts are used—piping, plastic tube where permitted, is exposed and surface-mounted to simplify installation and maintenance; and installation of housing components around a mechanical core reduces onsite layout time, fabrication time, and the quantity of piping required. The system calls for prefabricated bathroom components and looks toward future development of complete, self-contained, prewired, and preplumbed kitchen-wall components.

The only cost-reducing feature in the conventional electrical system is to shorten distances between heavy-load areas and the electrical panel in the mechanical core. To reduce onsite supervision and labor, interior lighting could include plug-in fixtures.

A corporate management is suggested, with internal liaison and employment of consultants. Central responsibility would rest in the managing corporation. Trial marketing by location is proposed for this existing system, and Delta indicates that self-help can be made a part of the systems process from total construction to finishing. Unskilled labor can be used from local sources.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN, URBAN RENEWAL, RURAL, SUBURBAN
2	Density Range	
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	
6	Nonresidential Functions	SOCIAL ACTIVITIES
7	Circulation	
8	Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12	Unit Variations	
13	Design Selection	
14	State of Development	BUILDING SYSTEM DEVELOPED & BEING MARKETED; PROTOTYPE CONSTRUCTED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WALL, FLOOR, CEILING PANELS OR FACTORY-FABRICATED MODULES (OPTIONAL MATERIALS)
17	Exterior Elements	WALL PANELS (OPTIONAL MATERIALS); MOVABLE PARTITIONS
18	Interior Elements	MECHANICAL CORE
19	Foundations	CONVENTIONAL
20	Comfort Systems	DWELLING UNIT HEATING SYSTEM; INTEGRATED COOLING OPTIONAL
21	Plumbing	PLASTIC PIPE; SITE-BUILT PLUMBING CORE
22	Electrical	CONVENTIONAL
23	Furnishings	BUILT-IN FURNITURE IN MOVABLE PARTITIONS

PRODUCTION

24	Offsite Production	(OPTIONAL) MODULES, PANELS & MECHANICAL CORE
25	Onsite Production	(OPTIONAL) MODULES, PANELS & MECHANICAL CORE
26	Onsite Construction	FOUNDATION; ASSEMBLY OF COMPONENTS OR MODULES; MECHANICAL HOOK-UPS
27	Labor	UNSKILLED
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS; SELF-HELP

ECONOMICS

30	Construction Costs	$10,000 PER DWELLING UNIT
31	Financing Methods	
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	
35	External Functions	DESIGN, LAND PLANNING
36	Market Area	
37	Delivery Rate	200 DWELLING UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	

Descon/Concordia

PROPOSER

Descon/Concordia Systems Ltd., Montreal, Quebec

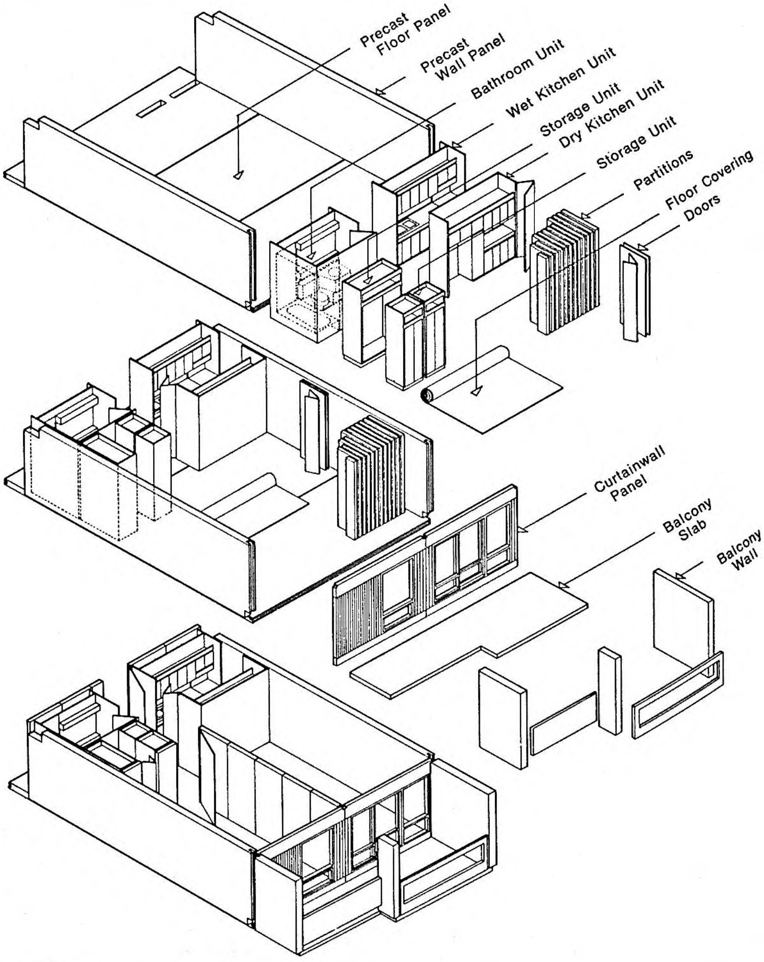
AFFILIATES

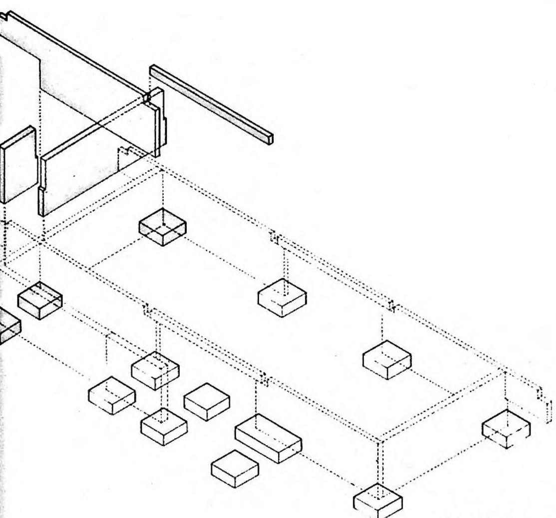
Philip David Bobrow, Architectural Design; Neil Mitchell & Associates, Engineering; Gamze, Korobkin Associates, Engineering; W. A. Dolphin; George E. Buchanan, Jr., Architectural Design; BOSTI-Buffalo Organization for Social and Technological Innovation; Hackett & Associates; Design Systems Inc.; Colin Davidson, Building Systems; Robert Gladstone & Associates; Seymour Glouberman; Shector, Barbacki, Forte & Associates, Consulting Engineers

This proposer combines a management system and a flexible building system which utilizes readily available off-the-shelf components, or components fabricated through existing processes, and existing building and manufacturing processes to produce housing ranging from 2-story townhouses to 22-story high-rise structures.

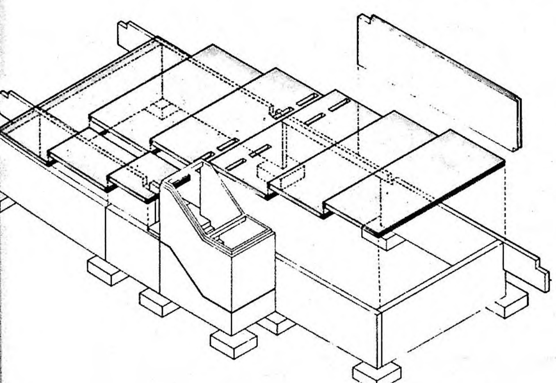
Basic to the building system itself is the use of factory-produced precast reinforced-concrete floor and wall panels which are crane-hoisted and rapidly assembled on the site into a self-supporting structure. These panels may be prestressed or post-tensioned in existing precasting plant facilities, or may be cast onsite. Supplementing these panels as part of the system are nonstructural composite panels with exterior finishes of metal and plastic, integral windows which close room and apartment areas to the weather, and modular interior partitions of metal-stud, gypsum-board construction. These latter two elements will be manufactured in existing plants and designed for interface with the concrete panels.

Five wall panels (a typical size being 27 ft. 4 in. x 8 ft. x 8 in.), four floor-ceiling panels (10 ft. x 21 ft. 4 in. x 5 in.), and a beam are the principal structural elements with which a structure of up to 22 stories may be built. Elevator cores, stairwells, and refuse chutes, assembled onsite from precast concrete elements, complete the component mix required in a typical building. An innovative dry mechanical joint assures speedy assembly of the precast concrete structural panels, while welded mechanical joints tie in the





FOOTINGS + FOUNDATION WALLS



FLOOR SLABS

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN
2	Density Range	20 TO 200 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; LOW TO HIGH DENSITIES; CENTRALIZED SERVICES
6	Nonresidential Functions	RECREATIONAL, SOCIAL & COMMERCIAL FACILITIES
7	Circulation	SEPARATE PEDESTRIAN CIRCULATION; UNDERGROUND PARKING
8	Site Planning Services	BY PROPOSER
9	Community Involvement	ADAPTABLE TO LIFE STYLE OF USER, COMMUNITY PARTICIPATION & ENTREPRENEURSHIP
10	Utilities	SYSTEM STUDIES INCLUDE TOTAL ENERGY PLANT, CENTRAL GARBAGE DISPOSAL, ETC.

BUILDING SYSTEMS

11	Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	LOW-RISE 3 — 5 BEDROOMS; HIGH-RISE, 1 — 4 BEDROOMS
13	Design Selection	FROM STANDARD PLANS
14	State of Development	SYSTEM DESIGN BEING COMPLETED
15	Community Involvement	SYSTEM DESIGNED FOR COMMUNITY INVOLVEMENT AT PROJECT INCEPTION

BUILDING SUBSYSTEMS

16	Structure	PRECAST CONCRETE WALL, FLOOR, & ROOF PANELS; CONCRETE BEAMS
17	Exterior Elements	ALUMINUM OR PLASTIC INFILL PANELS; PRECAST CONCRETE BALCONIES; SUNDECKS
18	Interior Elements	METAL-STUD GYPSUM BOARD AND/OR LIGHTWEIGHT CONCRETE PARTITION
19	Foundations	CONVENTIONAL; DESIGNED FOR SITE CONDITIONS
20	Comfort Systems	OPTIONAL HEATING SYSTEMS; INDIVIDUAL UNIT CONTROLS; FULLY INTEGRATED COOLING
21	Plumbing	PIPING INTEGRATED WITH PANEL, VENTLESS PIPING, OR POSSIBLE PIPELESS PLUMBING WALL
22	Electrical	SURFACE RACEWAY, PARTIALLY OR COMPLETELY FACTORY PREFABRICATED
23	Furnishings	FREE STANDING MODULAR WARDROBES, DRYGOODS STORAGE, PANTRY & LAUNDRY UNITS

PRODUCTION

24	Offsite Production	INTERIOR & EXTERIOR SUBASSEMBLIES; STRUCTURE; WEATHERSCREEN; STORAGE UNITS; ETC.
25	Onsite Production	OPTIONAL PRECAST CONCRETE PANELS; OPTIONAL ASSEMBLY OF COMPONENTS
26	Onsite Construction	ASSEMBLY OF PANELS & COMPONENTS; OPTIONAL FINISHING; SERVICE HOOK-UPS
27	Labor	MINIMUM ONSITE SKILLED LABOR
28	Labor Training Programs	AVAILABLE IN THE FIELD OF CONSTRUCTION MANAGEMENT & MANUFACTURING
29	Community Involvement	SUBCONTRACTORS & LOCAL CONSULTANTS; JOINT VENTURES; FRANCHISES

ECONOMICS

30	Construction Costs	$13,600 PER UNIT IN PLACE IN 1970 AT 1,000 UNITS PER YEAR MINIMUM VOLUME FOR 5 YEARS
31	Financing Methods	PARTIAL CAPITAL INVESTMENT; EQUITY PARTICIPATION
32	Useful Life	ELECTRICAL & PLUMBING — 40 YEARS; ROOFING — 20 YEARS; STRUCTURE — 100 YEARS

MANAGEMENT

33	Proposer Organization	JOINT VENTURE (CORPORATION)
34	Internal Functions	ARCHITECTURAL & ENGINEERING DESIGN; DEVELOPER & PRODUCTION MANAGEMENT
35	External Functions	LOCAL MANUFACTURING RESOURCES; COMMUNITY EQUITY & MANAGEMENT FUNCTIONS
36	Market Area	MONTREAL, BOSTON, NEW JERSEY, NEW YORK, WASHINGTON, CHICAGO, ST. LOUIS
37	Delivery Rate	1,000 UNITS PER YEAR; POTENTIAL OF 50,000 UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	PIPELESS PLUMBING WALL — EXPANDED POLYSTYRENE CARTONS; INFLATABLE DIES
40	Codes	ADAPTABLE TO NATIONAL & UNIFORM BUILDING, PLUMBING & ELECTRICAL CODES

Descon/Concordia (continued)

elevator cores and similar units. Specially designed lifting and bracing devices assure speedy and economical handling of the heavy elements during erection. A unique slab-leveling device assures speedy erection of structure.

Placement of the nonbearing weatherscreen panels and interior partitions is completely independent of erection of the concrete structural elements, so that no time onsite is lost by one crew waiting for another. Units can be closed against the weather as rapidly as the crew can install the weatherscreen units.

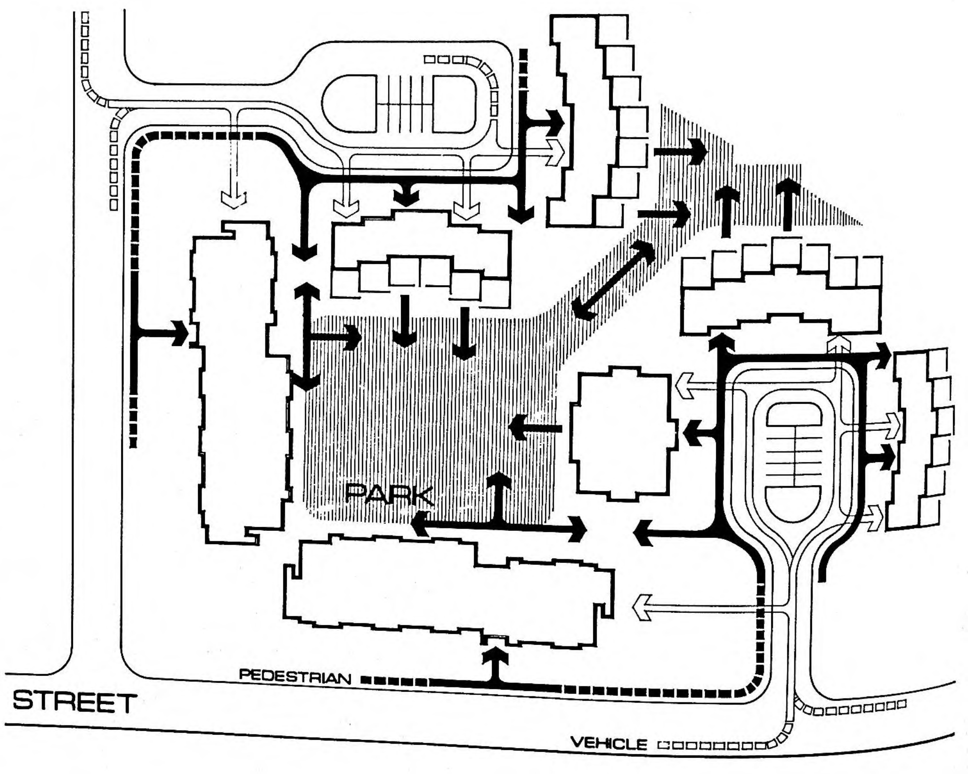
In addition to the weatherscreen panels, which help establish the external appearance of the apartment structure, balconies and sun decks may be employed to add architectural interest to the building and to accommodate occupants' tastes and needs. Both of these reinforced-concrete elements can be added to the building, independent of weatherscreen and structure, after closure has been effected, and take their support from independent foundations and through attachment to the structure by metal brackets, which penetrate the face of the building, curtainwall, or weatherscreen at the joints.

To reduce onsite labor to a minimum, prefinishing of elements has been maximized. For example, ceilings are factory-finished and walls may be dry-finished vinyl or paper veneer with only the structural concrete panels being so covered onsite to match the factory-finished weatherscreen and partitions. Carpeting will be precut to fit the dwelling units and speedily applied onsite. Roof panels, however, will be completely prefinished, with only jointing of the sections being required to effect final weather enclosure of the building.

Foundations for the proposed housing projects will be designed conventionally to meet local soil and topographical conditions – either pads (footings), continuous perimeter footings, or capped wood, concrete, or steel piles. But the substructure above these supports will be precast wall elements.

Extending further the basic concept of utilizing to the fullest degree possible the off-the-shelf hardware presently available to the building industry, is the approach to mechanical services in the building. For example, plumbing may be (1) conventional trees assembled offsite but installed and connected onsite; (2) plumbing trees installed in kitchen and bath panels at the factory and hooked to services onsite; (3) ventless trees of polyvinylchloride, factory-installed, and tied in onsite; or (4) a pipeless plumbing wall, using an expanded polystyrene carton in which piping is formed by inflatable dies. Each plumbing subsystem is designed to interface with structural and interior components. Bathrooms and kitchens are made up of integrated components assembled in a variety of configurations, sizes, and shapes to meet required layouts. Kitchen components consist of wet and dry units. Traditional materials can be used for component fabrication with steel or reinforced fiberglass envisioned in high-volume situations. Factory prewiring, including heavy use of concealed or recessed lighting fixtures is expected, with distribution of wiring being effected

DEVELOPED COURT PARK



through surface raceways in the partitions. Heating and cooling may be through use of conventional units installed in a closet architecturally combined with the balcony on an exterior wall, and distributed from there by forced air. In some areas of the country, electric baseboard heating may be satisfactory.

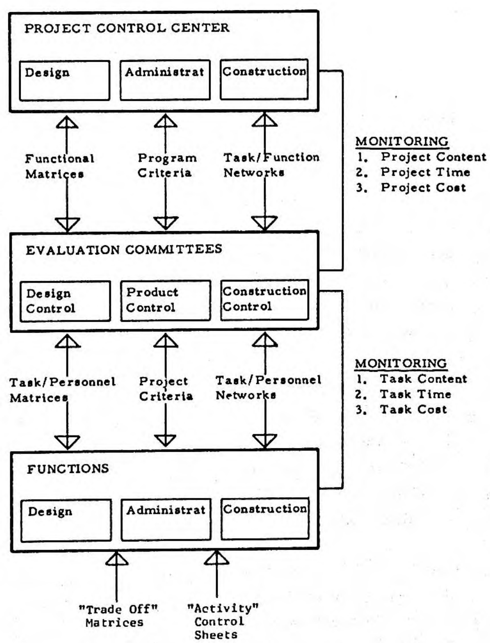
Much of the proposer's management philosophy is directed toward finding solutions for more effective land uses. For example, by elimination of conventional lotting, open space will be "collected" and made more effectively available to all occupants.

In order to select and/or design components, and assemble into suitable units, building forms and site arrangements, the proposer utilizes its own management system. This system, structured to integrate broad interdisciplinary inputs, makes possible a greater optimization of subassemblies into high-quality, more-easily constructed, and lower cost dwelling units.

This system makes possible effective management control of large-volume housing. Delivery of such volume to aggregated markets will be accomplished through the following techniques: (1) Franchising and licensing of the building and management system; (2) Proposer built and owned projects; (3) Proposer built projects for large sponsors; (4) Proposer built projects for private development; and (5) Consulting, training, and education services supplied by the proposer to other companies.

B : ORGANIZATION
B-1 : Management

.6 BASIC MANAGEMENT FLOW



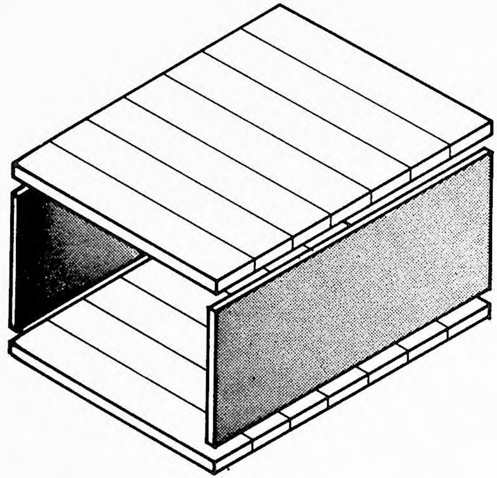
Development Corp. of America

PROPOSER CONSORTIUM

Development Corporation of America, Boston, Massachusetts
San-Vel Concrete Corporation, Littleton, Massachusetts
Stull Associates, Inc., Architects, Boston, Massachusetts

AFFILIATES

Thompson and Lichtner Co., Inc.; R. G. Vanderweil Engineers, Inc.



Aimed primarily at medium- to high-density housing situations (though it is adaptable to single-family detached housing), the module system proposed is a precast concrete-component method, which eliminates erection time as a major constraint. The system is also adaptable to use for various ancillary structures and spaces.

The precast components combine to provide structure, insulated enclosure, doors, windows and surface finish. Wall panels (6 in. to 8 in. thick) provide bearing support for prestressed concrete, hollow-core, extruded concrete floor and roof planks (40 in. wide, 8 in. to 10 in. deep). Connection of these elements, via grouted connections, provides a very rigid box, with a stiff diaphragm. The resulting structure has a very high resistance to both vertical and lateral loading, and has, in addition, a very high fire-resistance rating.

In high-rise structures, shear walls and elevator cores are precast and stacked vertically. Since larger lateral forces are encountered in high-rise construction, a post-tensioning technique is used for continuity—with rods (usually two per wall panel) run continuously from the foundation to the roof, thus clamping floor panels to the bearing walls.

Interior concrete components are lightweight, stressed-skin panels; preassembled components are structurally self-supporting and lifted into place fully finished. Abutting components are joined together mechanically in the field. Exposed concrete surface options include: board and steel form finishes; exposed aggregate, sand blasted and hammered, trowel, broom and etched finishes; and integrally cash brick, ceramic and plastic materials. Interiors are painted, but wall ceiling and floor finishes may be of almost any desired material, applied at the site.

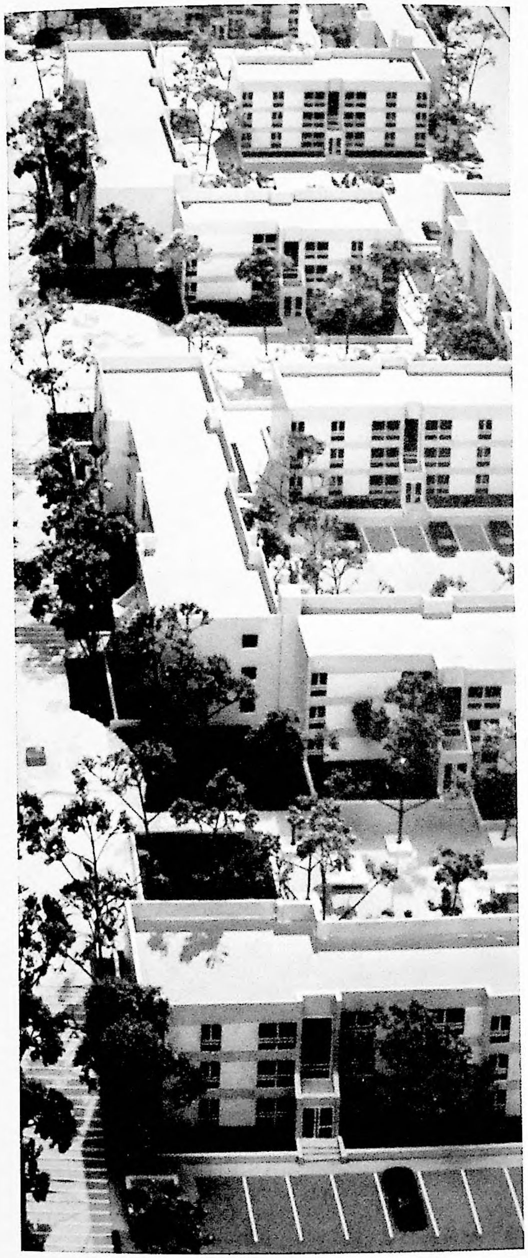
A 4-in. plenum chamber, mechanically built in the field after erection of the panels and planks, provides space for air conditioning and heating distribution and for electrical distribution services.

A core section includes a packaged combination of plumbing, heating, and ventilation systems in a three-dimensional boxed unit and contains (in addition to the mechanical subsystem and electrical load centers) kitchen, bath, and utility room, ready to be lifted into place.

Plumbing lines, in general, will be PVC pipe. An instantaneous electric water-heater is a part of the kitchen equipment. Electrical service is conducted around the rooms of the dwelling unit in a precast raceway in the floor, covered by a cove base.

Community planning is an integral part of the consortium's production/construction planning. The group actively solicits the services of community-based subcontractors and recruits from community labor pools (both skilled and unskilled).

The module system is an end product of the proposer's building systems evaluation, which extends over a 5-year period, and includes several projects already constructed and evaluated. A strong engineering and research staff has been developed, and new technological advances in concrete have been consistently incorporated into operations. Additional services offered by the consortium include project planning, design and production, supervision, and review, with industrial engineering services being provided by consultants.



Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; CLEARED LOT
2 Density Range	40 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY; SUITABLE FOR STABLE WELL-DRAINED SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; ESPECIALLY SUITABLE FOR NORTHERN U.S.
5 Planning Concepts	CLUSTER; SCATTERED LOTS; AIR RIGHTS
6 Nonresidential Functions	HEALTH CLINIC; DAY-CARE, FAMILY GUIDANCE, SOCIAL SERVICE, FACILITIES
7 Circulation	SEPARATE PROVISIONS FOR SERVICE VEHICLE TRAFFIC & PARKING
8 Site Planning Services	SITE MANAGER; PROPOSER INTERNAL PLAN REVIEW & CONTROL
9 Community Involvement	COMMUNICATION BETWEEN PLANNERS & COMMUNITY
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION FACILITIES OPERATIONAL; BUILDING SYSTEM DEVELOPED
15 Community Involvement	COMMUNICATION BETWEEN PLANNERS & COMMUNITY

BUILDING SUBSYSTEMS

16 Structure	SELF-SUPPORTING MODULES (POLYSTYRENE FOAM CORE SANDWICH PANEL); BOLTED JOINING
17 Exterior Elements	CANTILEVERED UPPER UNITS; BALCONIES; PORCHES & EPOXY TERRAZZO PASSAGEWAYS
18 Interior Elements	POLYSTYRENE FOAM-CORE PANEL, VINYL-SURFACED GYPSUM PARTITIONS; HUNG CEILINGS
19 Foundations	CONVENTIONAL; POSTS OR SHORT PILES
20 Comfort Systems	ELECTRIC BASEBOARD OR PANEL HEATING; SEPARATE COOLING UNITS OPTIONAL
21 Plumbing	PVC PIPING; COMPONENTIZED KITCHENS & BATHROOMS; INTEGRATED WITH SUBSYSTEMS;
22 Electrical	CONVENTIONAL; WIRING INTEGRATED IN BUILDING SUBSYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL, FLOOR & ROOF PANELS; STAIRS; ELEVATOR & MECHANICAL CORES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PANEL ERECTION; MECHANICAL INSTALLATION & HOOKUP
27 Labor	SKILLED FOR ERECTION
28 Labor Training Programs	ON-THE-JOB & CLASSROOM TRAINING IN PLANT OPERATION
29 Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS; SELF-HELP; PLANT OPERATION

ECONOMICS

30 Construction Costs	$8,250 TO $14,775 (1 TO 5 BEDROOMS)
31 Financing Methods	LEASEHOLD ARRANGEMENT TO MAINTAIN OWNERSHIP IN COMMUNITY; FHA
32 Useful Life	PRECAST SYSTEM—INDEFINITE; ROOFING—20 YEARS; PLUMBING, ELECTRICAL—100 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	COORDINATION; MARKETING; FINANCING; PRODUCTION; ARCHITECTURAL; SITE PLANNING
35 External Functions	INDUSTRIAL ENGINEERING
36 Market Area	100-MILE RADIUS OF PLANT
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Development International

PROPOSER CONSORTIUM

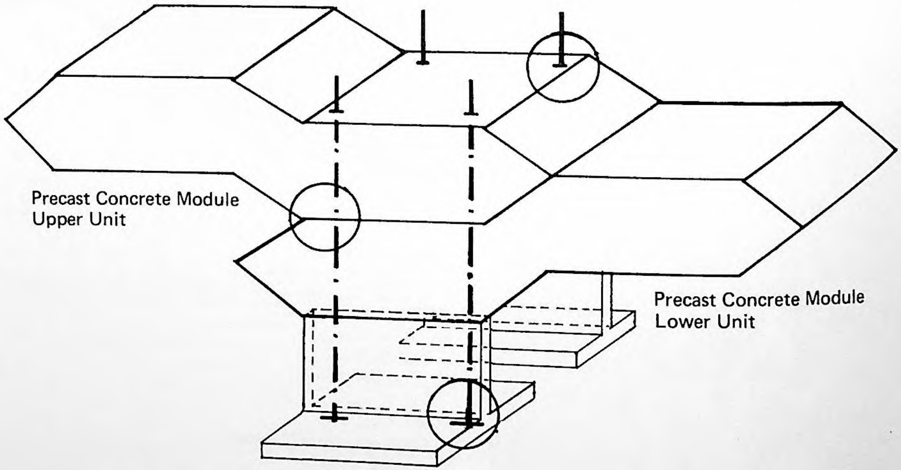
Development International Corporation, San Juan, Puerto Rico
Moshe Safdie and Associates, Architects, Montreal, Canada
Conrad Engineers, New York, New York
T. Y. Lin and Associates, New York, New York

An extension and refinement of the Habitat designs, the system presented is based on a three-dimensional stressed-concrete module that contains a half-story rise within it, to permit assembly into numerous combinations with unique appearance, as well as many advantages.

The concrete modules—fully equipped with all services and finishes—themselves can serve as the structural system for a high-rise or multi-use building; or, with an integrally cast column section, they can become a part of a suspended structure that can give the appearance of a very tall (20-story or more) tree. When the modules are assembled in a configuration to form the structural system without additional support, they are tied together by post-tensioning in both directions to afford a rigid frame tied to foundation areas. The shape of the module, with a bow at the front for special lighting, can be utilized to take best advantage of natural lighting and climatic conditions.

A special feature of the system is its adaptability to very high-density situations—where as many as 300 dwelling units (as in New York City) may be required per acre. Because of the special features of the story-and-a-half configuration of the modules (each apartment, thus, would have an upper and lower section), the units can be stacked to create such desnities without unduly cutting off light and air, or intruding heavily on existing structures in a mid-city location.

The concrete, because of its post-casting characteristic of applying stress to reinforcing cages set before casting, becomes very dense and serves as an effective weather envelope without further treatment. (It may have a number of finishes, including a light sandblasting, for architectural purposes.) Although the



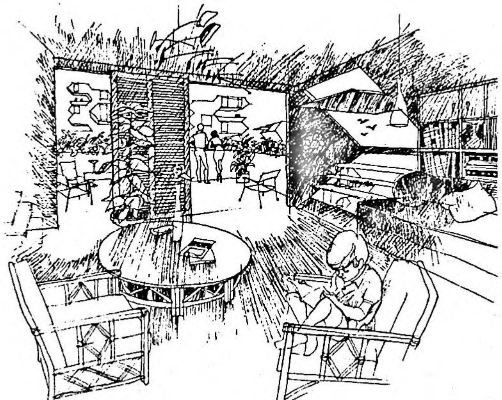
dense concrete provides excellent insulation and fire resistance, insulating characteristics can be further enhanced by adding insulation either in the production line or after erection.

Interior finishes of many materials are possible: floors can be tile; wood parquet, or carpeting is also used. Interior partitions can consist of gypsum board on steel studs, paper honeycomb with exterior wood veneer, paper honeycomb with thin sheet metal, and concrete partitions cast integrally with the module.

Kitchens are prefabricated, with appliances integrated into cabinetry wherever possible; bathrooms utilize gel-coated fiberglass fixtures to minimize maintenance and site work.

Plumbing and piping systems are factory fabricated and installed, but materials used vary with location and local requirements; hot water heaters are supplied with each bathroom assembly. Heating is normally by electric baseboard units, but may also vary depending on the economics of fuel locally available. Through-wall individual units are planned for cooling and ventilating. Electrical, television, and phone distribution systems, as is plumbing, are cast into the concrete modules before delivery to the site.

Foundation systems may be of conventional types, but require careful engineering analysis for each installation, considering the weights and soil types encountered, and the proper distribution of loads from the concrete structure.



Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2 Density Range	24 TO 300 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	HABITAT LAND USE CONCEPT COMBINING RESIDENTIAL, COMMERCIAL & SHOPPING FACILITIES
6 Nonresidential Functions	RECREATIONAL FACILITIES; PLAYGROUND; PUBLIC SPACES; LIBRARIES, THEATER
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION
8 Site Planning Services	
9 Community Involvement	
10 Utilities	UNDERGROUND ELECTRIC SERVICE, ELECTRIC TRANSFORMER VAULT

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
15 Community Involvement	DETERMINATION OF USER NEEDS BY USE OF QUESTIONNAIRES & MODELS

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE SELF-SUPPORTING VOLUMETRIC MODULES, PARTIALLY CANTILEVERED
17 Exterior Elements	
18 Interior Elements	BATHROOM, KITCHEN & HVAC MODULES; PREFABRICATED PARTITIONS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	GAS, OIL OR ELECTRIC CENTRAL HYDRONIC, ELECTRIC BASEBOARD, HEATING SYSTEM
21 Plumbing	DISTRIBUTION LINES, BATHROOM & KITCHEN ASSEMBLY INTEGRATED IN MODULES
22 Electrical	DISTRIBUTION LINES INTEGRATED IN MODULES
23 Furnishings	

PRODUCTION

24 Offsite Production	BUILDING MODULES; MECHANICAL & ELECTRICAL SUBSYSTEMS; KITCHEN & BATHROOM SYSTEMS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF VOLUMETRIC MODULES; UTILITY HOOK-UPS
27 Labor	SKILLED & UNSKILLED AT PRODUCTION PLANT
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	\$10,645 PER UNIT, 1,200 UNITS
31 Financing Methods	CONVENTIONAL
32 Useful Life	TILE—25 YEARS; PLUMBING—25 YEARS

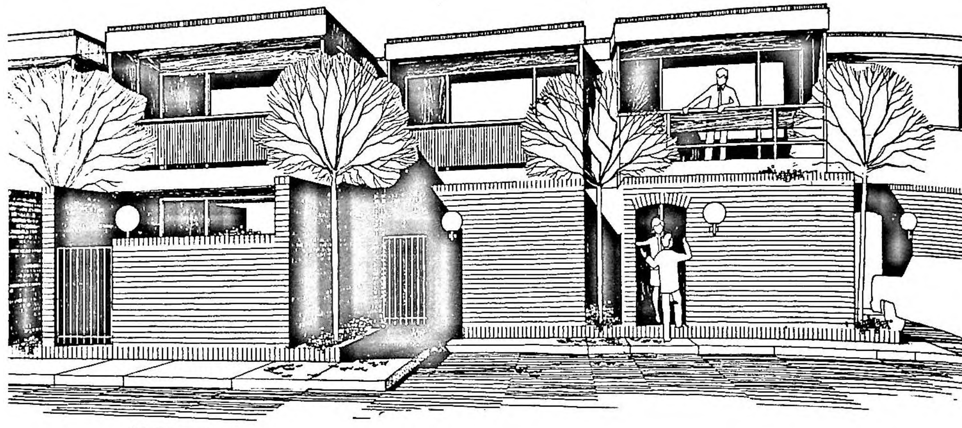
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; PRODUCTION; PROGRAM DEVELOPMENT; ARCHITECTURAL DESIGN; ENGINEERING
35 External Functions	
36 Market Area	
37 Delivery Rate	1,200 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ELECTRICAL SYSTEM IN COMPLIANCE WITH NATIONAL ELECTRICAL CODE

Dierks Forests, Inc.



PROPOSER

Dierks Forests, Incorporated (Division of Weyerhaeuser Company), Tacoma, Washington

AFFILIATES

William Kirby Lockard, Architect; Manes, Brasseale, Hodges, and Associates, Planning Consultants

Steel-framed room-sized modules of wood and other existing building materials are the basic components of the housing system proposed. With these self-supporting enclosures (standard 12 ft. wide x 9 1/2 ft. high), numerous variations in plan can be produced by differing module lengths, and by varying the arrangement in which modules are placed. A subsystem of floor and ceiling fillers spans the space between the parallel units making up a single dwelling, and all are covered by a custom designed, conventionally constructed, gabled roof system.

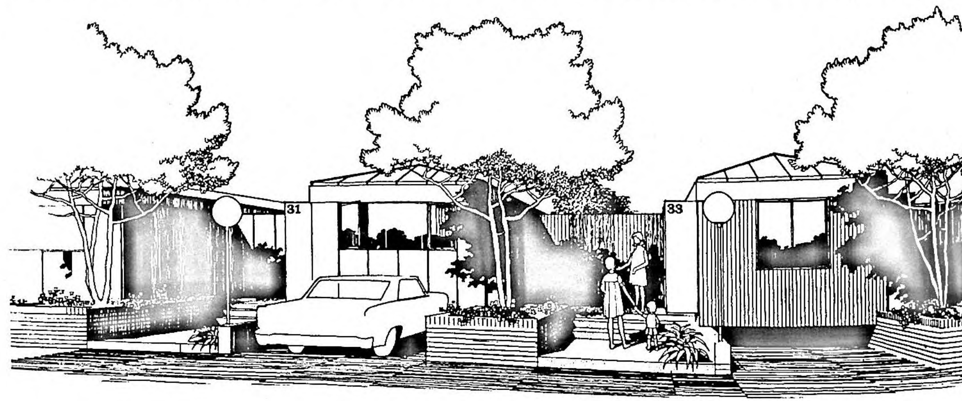
Essentially the modules consist of steel floor framing with floor and ceiling panels, and steel wall studs to which are applied panelized wall sections, door and window sections, and special box units. These latter afford the owner with options including bay windows, bunk beds, storage facilities, desks, dressing tables, and lavatory. They are shipped to the site within the module, but once onsite, appropriate elements are cantilevered out from the exterior wall, furnishing extra space without the need for extra foundations.

The units are trucked to the site and set in place on their foundations. A specially designed system of foundation connections is adaptable to any misalignment of anchor bolts, which may be set in wood posts or in concrete footings or bearing walls. After the units have been joined together in the predetermined floor plan, the roofing system, usually of standard wood trusses and decking, is constructed. Custom designing of this roofing offers the architect or designer the opportunity to match this traditional feature to the type of building being erected. Further options in exterior treatment exist by leaving the wall panels smooth, in a board and batten effect, or by cladding with any other material desired.

Interior wall and ceiling finishes of the modular units are smooth painted hardboard, while floors are hardboard surfaced with resilient tile or carpeting.

The mechanical and electrical subsystems are planned as integral components of the building system. For example, the steel anchors, or sections to which the wall panels are assembled, act as accessible conduits around the perimeter of the modules at floor and ceiling line, through which the wiring may be channeled. The vertical wall studs similarly serve as conduits for leading wiring from attic and ceiling to floor and subfloor spaces. Electric switches and outlets are made to fit into these studs, tapping into the wiring as needed. Wiring is kept to the exterior walls of modules so as not to interfere with the interior partitions, which are designed to be movable and replaceable.

Similarly, lightweight plumbing fixtures, copper supply pipe, and plastic waste pipe are expected to be incorporated in the wall panels. Finally the air distribution system for the conventional forced air heating and cooling system, rather than ductwork, will utilize the plenum space under the subfloor, and deliver conditioned air through registers at strategic places in the floor panels, along the exterior walls. Installation of these systems—electrical, plumbing, and heating/cooling—in the module at the factory rather than on-

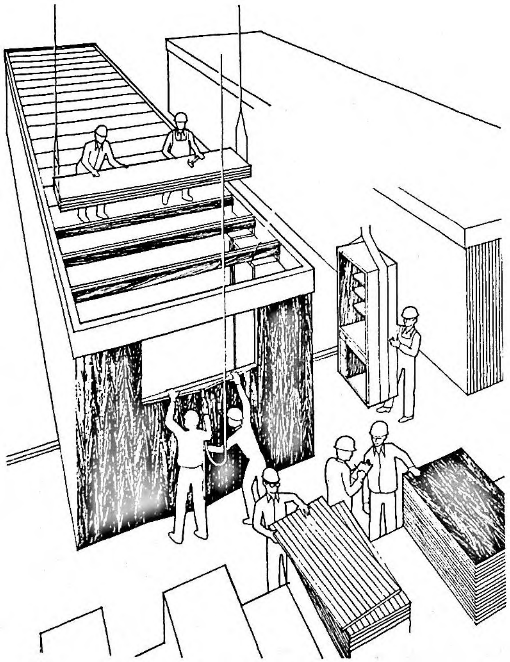


site, will depend on local labor conditions.

No matter how installed, each of the mechanical systems offers an unusual degree of accessibility and potential for removal, modification, alteration, re-use and salvageability. On a larger scale, the same may be said of the entire housing concept—its parts may be shifted, removed, replaced—even by the owner himself and an entire module may be moved intact to another location; the unit being a structural, self-supporting entity.

The system is considered particularly suitable for single-family attached and detached homes. Balancing of income groups within such a development is contemplated through a planning consultant working with a local planning board to help achieve this and other community aims.

Specifically for the lower income groups and for semiskilled and unskilled labor, a training program for site workers is being considered; while the flexibility of the system's components will be used to encourage self-help erection and maintenance and alterations.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN
2	Density Range	8 TO 26 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; COMMON OPEN SPACES; SUPER BLOCK
6	Nonresidential Functions	PARKS; SCHOOLS; CHURCHES; NEIGHBORHOOD CENTER; COMMERCIAL FACILITIES
7	Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; CUL-DE-SACS; COLLECTOR STREETS
8	Site Planning Services	
9	Community Involvement	PLANNING CONSULTANT TO WORK WITH LOCAL PLANNING BOARD & LOCAL GOVERNMENT
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION PLANT, DESIGN STAGE; BUILDING PROTOTYPE TESTING REQUIRED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	STEEL & WOOD FRAME SELF-SUPPORTED VOLUMETRIC MODULES; SEPARATE ROOF ELEMENT
17	Exterior Elements	OPTIONAL BAY WINDOWS; OPTIONAL WOOD OR OTHER FACINGS
18	Interior Elements	OPTIONAL CABINET WALL COMPONENTS; DEMOUNTABLE PARTITIONS
19	Foundations	CONVENTIONAL
20	Comfort Systems	FORCED-AIR HEATING & COOLING, UNDER-FLOOR PLENUM, INTEGRATED WITH BUILDING SYSTEM
21	Plumbing	CONVENTIONAL; PLASTIC WASTE SYSTEM; OPTIONAL PREPLUMBED BATHROOM UNITS
22	Electrical	CONVENTIONAL; WIRING INTEGRATED WITH WALL STRUCTURE
23	Furnishings	OPTIONAL BUILT-IN FURNITURE, STORAGE & CABINET WALL COMPONENTS

PRODUCTION

24	Offsite Production	MODULES; PARTITIONS; STORAGE & FURNITURE WALLS; OPTIONAL MECHANICAL SUBSYSTEMS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; ROOF CONSTRUCTION; MODULE PLACING; FINISHING; UTILITY HOOK-UPS
27	Labor	UNSKILLED AND SKILLED FOR SITE WORK
28	Labor Training Programs	
29	Community Involvement	SITE WORK INCLUDING FOUNDATIONS, ROOF CONSTRUCTION; LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	$16,963 PER UNIT, 500 UNITS PER YEAR; $16,500 PER UNIT, 1,500 UNITS PER YEAR
31	Financing Methods	CONVENTIONAL
32	Useful Life	STRUCTURE—50 YEARS; COMPONENTS—30 YEARS; INTERCHANGEABLE WALLS—6 INTERCHANGES

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	CENTRAL RESPONSIBILITY; GENERAL MANAGEMENT
35	External Functions	ARCHITECTURAL PLANNING AND DESIGN; SITE AND LAND PLANNING
36	Market Area	
37	Delivery Rate	500 TO 1,500 UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	EASE OF ALTERATION OF BUILDING SUBSYSTEMS
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

The Dow Chemical Company

PROPOSER

The Dow Chemical Company, Houston, Texas

AFFILIATES

Rohr Corporation, Structural Fabrication; Daniel Construction Company, Inc.; Geometrics, Inc., Industrial Design; Ronald Beckman, Design Consultant; James G. Miller, Social Behavior; Stratford E. McKenrick, Housing Consultant

Two-step manufacture and delivery of complete modules for low-rise housing, based on a foamed-core, stressed-skin sandwich panel as the key structural unit, make possible numerous savings in the system proposed.

The system also lends itself—in projects of sufficient scale—to use for such ancillary structures as central laundry facilities, social areas, and nurseries. These can either be as separate modules, located according to a general development plan, or as part of a row of structures.

The proposer contemplates manufacture of the panels in sizes of up to 8 ft. high X 60 ft. long in a central manufacturing facility. Then the panels will be shipped by road to regional assembly plants, where they will be assembled into complete modules (fully equipped) for transport to a building site.

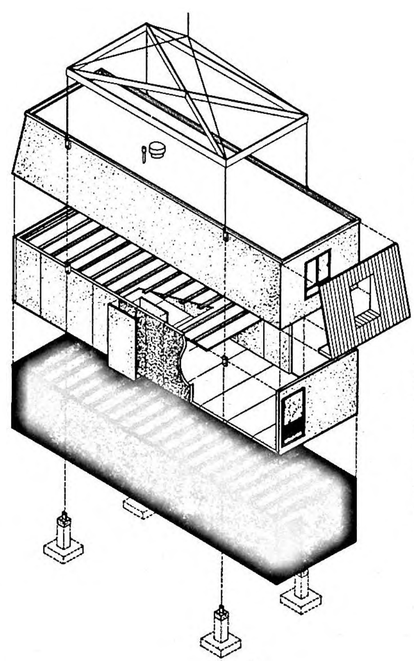
The sandwich panels are composed of plywood skins (or numerous other materials, including metal), enclosing a foamed core that includes complete electrical and other services. The panels offer superior structural and insulative properties and can act as beams if required. Interior layouts or architectural design can be accommodated in the assembly factory, as well as special requirements such as increased heat or air conditioning capacity. All module walls are of this panel construction, with door or window inset as required, making use of recent technological advances in adhesives and joining methods. Because the core of the panels can easily be cut or routed to accommodate electrical and other services, high-speed production of complete and fully equipped wall and floor panels of uniformly high quality is possible.

The panels for both walls and floors are factory-bonded to form an integral monocoque unit that requires no additional reinforcement for shipping and handling. At the site, modules are bolted together to act as a structural box of nine units, with a total depth laterally of 36 ft. in relation to a height of 26 ft. Winds of 120-m.p.h. velocity can be resisted within the structural capability of the system.

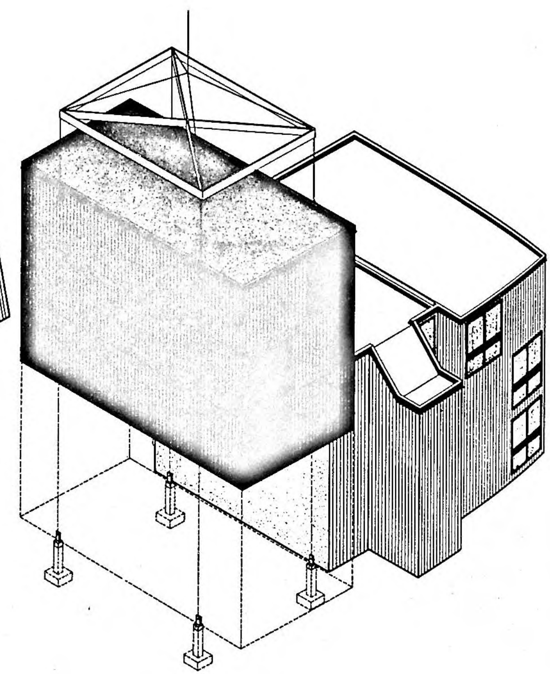
Site work is confined as much as possible to preparing foundations (post or short piles) and placing utilities in long straight runs beneath rows of dwellings. Additionally, considerable attention has been paid to simplifying maintenance—exterior wall surfaces are textured plywood requiring infrequent staining; interior walls are highly damage resistant, due to a resilient washable vinyl-surfaced 5/8-in. gypsum board.

All services supplied to the dwelling units are accommodated in the central service chase: Wet areas (baths and kitchens) are designed to be directly adjacent to such chases, which also provide space for mechanical ventilating systems for these internal areas.

Based on the superior insulative properties of the foam core of the wall panels, electric heating is considered most economical. Heating is by means of electric baseboard or radiant ceiling panel units; ventilation for all exterior rooms is provided by operable sash windows, while interior spaces are individually and



1—STORY HIGHWAY DELIVERED MODULES

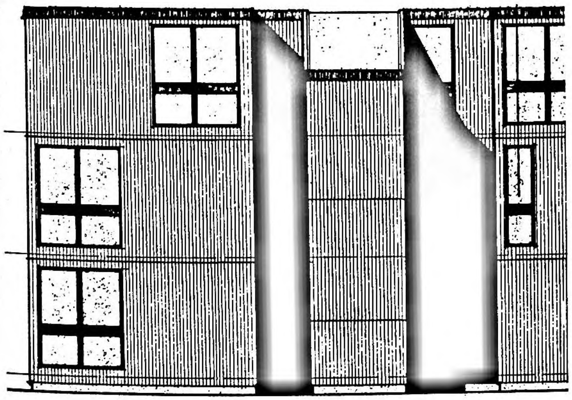


3—STORY AIR DELIVERED MODULES

mechanically ventilated. All ducts are carried in the main vertical service duct for discharge at roof level. If air conditioning is required, unit air conditioners may be installed in knockout panels at either the top or bottom of window panel frames in each room.

All appliances and equipment are commercially available units, assembled into conventionally related bathroom and kitchen assemblies, with necessary plumbing also included in the completed modules as they leave the regional assembly plant.

Though the proposed system of factory production and assembly does not lend itself to self-help, it is planned to locate assembly plants closely adjacent to the housing sites, thus providing jobs and training for prospective residents, if desired.



Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	16 to 180 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER PATTERNS; COMMON OPEN SPACES
6 Nonresidential Functions	PLAYAREAS; SUNDECKS; NURSERY; VOCATIONAL TRAINING SCHOOL; MEDICAL CLINIC
7 Circulation	SEPARATE PEDESTRIAN CIRCULATION; NO THROUGH VEHICULAR TRAFFIC; PEDESTRIAN WALKWAYS
8 Site Planning Services	PROPOSER'S SYSTEM DESIGN TEAM OF AFFILIATES, LOCAL ARCHITECT & BUILDER
9 Community Involvement	USE OF LOCAL PLANNING AGENCIES: STUDY OF RESIDENT NEEDS & CHARACTERISTICS
10 Utilities	

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE; POSSIBLE HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 to 4 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS, WITH OPTIONS
14 State of Development	BUILDING SYSTEM REQUIRES DEVELOPMENT; PRODUCTION FACILITIES, DESIGN STAGE
15 Community Involvement	EVALUATION OF TENANT SATISFACTION; STUDY OF RESIDENT NEEDS

BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTING VOLUMETRIC MODULES (STYROFOAM CORE SANDWICH PANEL); BOLTED JOINING
17 Exterior Elements	CANTILEVERED UPPER UNITS; BALCONIES; PORCHES & EPOXY TERRAZZO PASSAGEWAYS
18 Interior Elements	STYROFOAM-CORE PANEL, VINYL-SURFACED GYPSUM PARTITIONS; HUNG CEILINGS
19 Foundations	CONVENTIONAL; POSTS OR SHORT PILES
20 Comfort Systems	ELECTRIC BASEBOARD OR PANEL HEATING; SEPARATE COOLING UNITS OPTIONAL
21 Plumbing	PVC PIPING; COMPONENTIZED KITCHENS & BATHROOMS; INTEGRATED WITH SUBSYSTEMS
22 Electrical	CONVENTIONAL; WIRING INTEGRATED IN BUILDING SUBSYSTEM
23 Furnishings	

PRODUCTION	
24 Offsite Production	PANELS; HVAC, PLUMBING, & ELECTRICAL COMPONENTS; COMPONENT & MODULE ASSEMBLY
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING & JOINING MODULES; UTILITIES HOOK-UPS
27 Labor	UNSKILLED, SEMISKILLED & SKILLED LABOR FOR PLANT PRODUCTION & SITE CONSTRUCTION
28 Labor Training Programs	TRAINING OF LOCAL LABOR FOR FACTORY & ON SITE PRODUCTION & ASSEMBLY
29 Community Involvement	LOCAL LABOR, CONTRACTORS & SUBCONTRACTORS

ECONOMICS	
30 Construction Costs	$12,640 (AVERAGE) PER DWELLING
31 Financing Methods	CONVENTIONAL; FHA, & PROPOSER SUPPLIED
32 Useful Life	BUILDING—50 YEARS; ROOF MEMBRANE—20 YEARS (MINIMUM)

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL RESPONSIBILITY; FINANCIAL; MARKETING; MANAGEMENT; PANEL PRODUCTION
35 External Functions	DESIGN; MODULE PRODUCTION; SITE CONSTRUCTION; MECHANICAL COMPONENTS
36 Market Area	100-MILE SHIPPING RADIUS FROM 10 ASSEMBLY PLANT LOCATIONS
37 Delivery Rate	1,000 (MINIMUM) TO 1,500 (OPTIMUM) UNITS PER YEAR
38 Consumer Protection	

GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM, PANEL CONSTRUCTION; PRODUCTION TECHNOLOGY
40 Codes	GENERALLY ADAPTABLE TO ALL NATIONAL MODEL CODES

Dow Chemical Company

PROPOSER

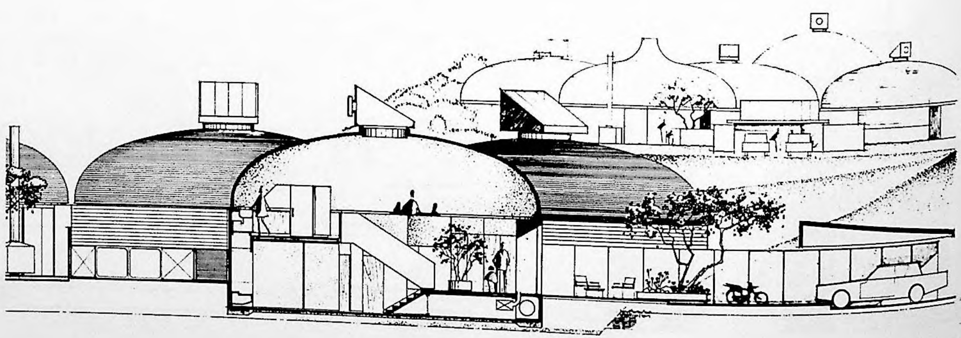
The Dow Chemical Company, Midland, Michigan.

AFFILIATES

Daniel Construction Company, Inc., Constructor; Rohr Corporation, Manufacturer; Tarapata, MacMahon, Paulsen Associates, Inc., Architect–Planner; Stratford E. McKenrick, Housing Consultant; James G. Miller, Behavioral Sciences Consultant; Research and Design Institute, Socio-Physical Design Consultant.

A concept that combines unusual side bearing walls, which become a part of the furniture and conveniences of the home, with a spun plastic dome enables the proposer to build single-family and multifamily homes of unusual design in clustered developments. The structural system is well suited to construction of ancillary structures—in which either the shell alone can form the entire structure, or a combination of the support modules and shells can be used. Single dwellings are in reality an increment of a hexagonal matrix or module, thus permitting group housing to evolve in an organized fashion, depending on particular site conditions.

Construction begins with a grid of public utilities (sewer, water, and power), stubbed off at the intersection of dwelling units, and then hexagonal reinforced concrete slabs are cast. Factory-built structural wall components then are placed to form the periphery of a typical dwelling unit. Six of these components become the complete outside wall of the dwelling. These components are built of relatively conventional wood framing with stressed-skin sandwich panels constructed of foam cores and plywood and/or other material for outside facing. Wall sections are tall, three-dimensional components, which contain within them necessary piping, wiring, and space for closets and shelves. The wall sections extend through from the first story of a multilevel structure so that their tops can serve for such purposes as countertops in bathroom or kitchen, or as storage space and window seats. The wall components when assembled are designed to serve as a structural chassis which will accept all elements needed for the



functioning of the household: bathroom fixtures, heating units, kitchen equipment and appliances, and storage space. These service elements can either be added to (or slipped into) the chassis in the factory, or can be installed in the field.

Once the necessary mechanical hook-ups are made to the existing utilities, modular, prefabricated interior wall panels are put in place to form the lower-level rooms. Next follows installation of prefabricated stressed-skin floor panels which are supported on the exterior wall components and on interior bearing walls, which also form a hexagonal assembly in the center of the unit and enclose a stair core area.

The dwelling is now ready for final enclosure, which is a spirally-generated plastic roof shell. It can either be generated on the site and lifted onto the dwelling, or could be generated, under certain conditions, from within the dwelling. The double-curved shell structure contains a plastic cellular core of steel-wire-reinforced 4-in. thick extruded polystyrene to which has been bonded an exterior covering of fiberglass-reinforced rigid polyvinyl chloride sheet (.035 inches thick) and an interior surface of fiberglass covered with 1/4-in.-thick layer of cement-based decorative spray coating to harmonize with interior decor.

The basic dwelling unit is conceived as a split-level arrangement with separated private spaces on the lower level and open, family living spaces on the upper level. The building is entered at an intermediate level, a family deck, which can serve as a recreation room or a play area. Half a flight up—enclosed by the unencumbered form of the shell—is the principal living space, including dining and kitchen space divided by low partitions. Three bedrooms (with a possible fourth), bath and laundry unit comprise the lower level. The 3-ft. increments of the modular wall components provide recesses for factory-installed clothes closets, dressers, and window openings; in the bath, the module is opened up to an 8-ft. recess to accommodate a premolded bathtub, sink, and water closet. Enclosed space within the dwelling totals 1,800 square feet.

Lighting in the shell area is indirect, with lights mounted above the cabinets formed by the top of the support modules wall components, directed into the shell itself. On lower levels, lighting may be by conventional ceiling on wall-mounted fixtures.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL; ESPECIALLY SUITABLE FOR SELECTIVE RENEWAL
2 Density Range	12 DWELLING UNITS PER ACRE; STUDY POSSIBILITIES OF OTHER DENSITIES
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; SMALL, COMPACT COLONIES; HEXAGONAL PLANNING MATRIX
6 Nonresidential Functions	ENVIRONMENT OF LIFETIME LEARNING, EXERCISE, & ENTERTAINMENT
7 Circulation	SUPERBLOCK; CURVILINEAR, ANGULAR INTERSECTING STREETS; CUL-DE-SACS
8 Site Planning Services	PROPOSER ORGANIZATION'S SITE PLANNER, CENTRAL STAFF, & LOCAL REPRESENTATIVE
9 Community Involvement	SURVEYS OF USER NEEDS & PREFERENCES, RESIDENT & COMMUNITY ATTITUDES
10 Utilities	UNDERGROUND UTILITIES GRID, CENTRAL STUB-OFF POINTS AT INTERSECTION OF 3 UNITS

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED; STUDY POSSIBILITY OF TWO-UNIT HOUSES
12 Unit Variations	1, 3, & 4 BEDROOMS; STUDY POSSIBILITY OF EFFICIENCY APARTMENTS
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	BUILDING SYSTEM & PRODUCTION FACILITIES-DESIGN STAGE
15 Community Involvement	SURVEYS & EVALUATIONS OF RESIDENTS ATTITUDES TOWARDS HOUSING FEATURES

BUILDING SUBSYSTEMS

16 Structure	WOOD-FRAME & STRESSED-SKIN WALL PANELS; REINFORCED POLYSTYRENE FOAM DOME
17 Exterior Elements	WOOD OR METAL SIDING & CORNER CLOSURE PANELS; PVC DOME COVERING; SKYLIGHT
18 Interior Elements	GYPSUM, WOOD, OR METAL PARTITIONS; STAIR UNITS; KITCHEN & BATH ISLAND MODULES
19 Foundations	HEXAGONAL CONCRETE SLAB, PLASTIC FOAM INSULATION ALONG PERIMETER
20 Comfort Systems	GAS FORCED AIR HEATING; COOLING OPTIONAL; INTEGRATED IN WALL COMPONENTS
21 Plumbing	PLUMBING & WASTE DISPOSAL SYSTEMS INTEGRATED WITH WALL COMPONENTS; FIBERGLASS TUB
22 Electrical	WIREWAYS INTEGRATED WITH WALL COMPONENT; RACEWAYS INTEGRATED WITH PARTITIONS
23 Furnishings	ACCESSORY COMPONENTS, DRESSERS, SHELVES, INTEGRATED WITH WALL & ISLAND COMPONENTS

PRODUCTION

24 Offsite Production	WALL & ISLAND COMPONENTS; FLOOR PANELS; PARTITIONS
25 Onsite Production	OPTIONAL GENERATION OF DOME SHELL
26 Onsite Construction	FOUNDATIONS; PLACEMENT OF COMPONENTS; OPTIONAL GENERATION OF SHELL
27 Labor	UNSKILLED & SEMISKILLED ONSITE; MINIMUM SKILL FOR MANUFACTURING
28 Labor Training Programs	TRAINING LOCAL UNEMPLOYED FOR ASSEMBLY & CONSTRUCTION; ON-JOB TRADE SKILLS
29 Community Involvement	LOCAL CONTRACTORS, SUPPLIERS, & DEVELOPERS

ECONOMICS

30 Construction Costs	$10.81 PER SQ. FT. ($20,106 PER DWELLING UNIT) FOR 1,860 SQ. FT. UNIT
31 Financing Methods	INTERIM PROPOSER SUPPLIED & CONVENTIONAL; LONG-TERM CONVENTIONAL
32 Useful Life	STRUCTURE—50 YEARS; PVC OUTER MEMBRANE OF DOME SHELL—20 YEARS

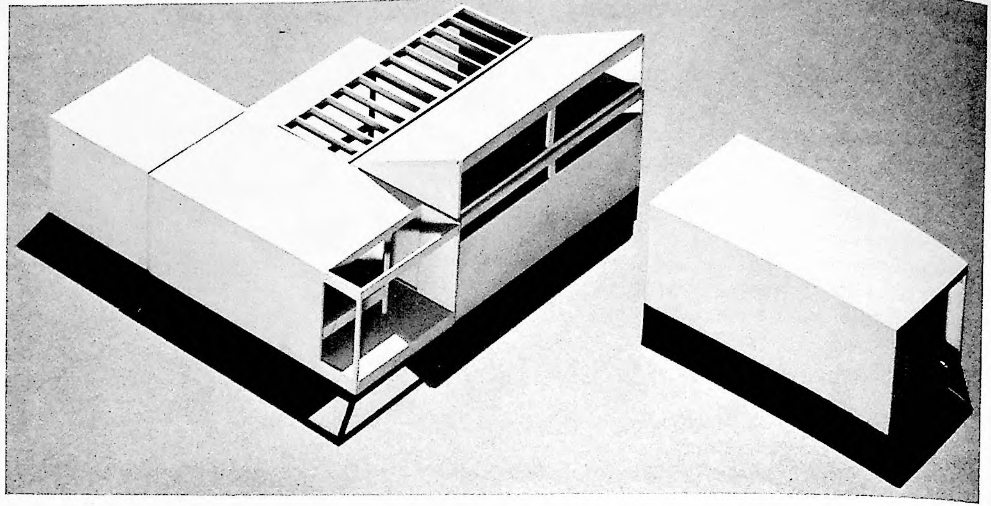
MANAGEMENT

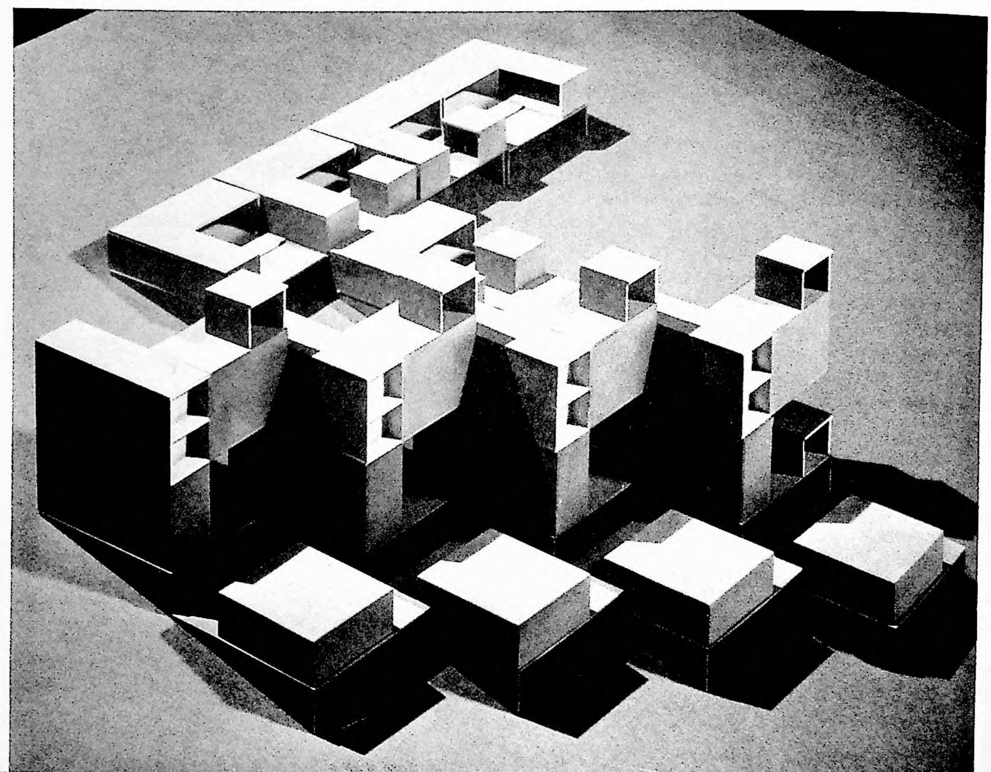
33 Proposer Organization	CORPORATION (PROPOSES TO FORM ASSOCIATION FOR VOLUME PRODUCTION)
34 Internal Functions	MANAGEMENT; PLANNING; DESIGN, TEST & EVALUATION; PRODUCTION; FRANCHISING
35 External Functions	MARKETING & ENVIRONMENTAL CONSULTING; FRANCHISERS FOR DOME GENERATION
36 Market Area	NATIONAL; CENTRALLY LOCATED MANUFACTURING PLANTS
37 Delivery Rate	1,500 DWELLING UNITS PER YEAR, BEST RATE
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM; HEXAGONAL SITE MATRIX; UTILITIES GRID
40 Codes	ADAPTABLE TO ALL MODEL CODES

Electro-Mechanical Corporation





PROPOSER

Electro-Mechanical Corporation, Sayre, Pennsylvania

The housing system proposed is built around a room-sized module made of steel framing members and sandwich panels. Modules are stacked like blocks to form single-family detached and attached houses or multifamily low-rise apartment projects up to three stories high. The module, which is designated the basic closure system by the proposer, may be assembled in the field from the framing members and panels, or it may be delivered to the site assembled for placement.

Augmenting the basic closure system are three subsystems which comprise the total housing unit, ready for occupancy: (1) interior systems consisting of core assembly and storage and space division elements; (2) exterior extension systems for adding architectural variety and conveniences, such as porch, deck, room expansion, fence, exterior storage, and skylight; and (3) mechanical and electric systems, integrated with the modules or delivered to the site prepackaged, ready for installation.

Layout of the completed housing units, particularly in single-family attached and multifamily structures, contemplates inward orientation of the individual units, permitting their bounding on one or more sides by other units, but with generous provision for private, public, and semipublic open spaces within these bounds. In addition to the many options which the exterior extension systems offer the owner or occupant initially, these same systems permit growth and change of the units in later years, at the user's option, by adding or subtracting any of the elements of the four building subsystems. Further involvement of the user and the community is encouraged through employment of semiskilled and unskilled help in erection of the units, and through self-help interior completion of the dwelling units.

Framing members for the modules—columns, beams and base frame under-carriage—are roll-formed and welded square, tubular steel sections. The panels have cores of expanded perlite and impregnated mineral fiberboard, prefinished hardboard or plywood. Requirements for sound and thermal insulation, integral with the core construction, may be varied by varying core thickness and this thickness may be varied further to accommodate consumer preferences in terms of thinner or thicker wall finishes.

Manufacture of the wall, roof and floor panels, which are basically similar (with the exception of an elastrometric finish for roof panels, for example), is to be on automated production lines. Window and door elements also can be incorporated in the wall panels in the plant.

The room-sized modules are structurally self-supporting, with live loads in the living areas calculated at 40 psf, roof loads at 60 psf, and wind loadings of 5 psf being accommodated.

Foundations for the system are conventional cast-in-place concrete—either slab-on-ground, or piers and spread footings for sloping or rolling terrain. In the latter case, modules are tied to a neutral floor frame every 12 feet.

Whether the basic closure module of the proposed system is to be field assembled, or delivered as a module ready for placement, may depend upon resolution of certain constraints. The proposer anticipates that the greatest efficiency will result from large components assembled at the factory. A volume production rate of more than 16,000 dwelling units per year is feasible.

If factory assembled, the proposed system would include completely prefabricated, prepackaged bathroom, kitchen, and laundry facilities, as well as prewired and preplumbed modules. A prepackaged, field-installed, electric, forced air heating/cooling system is proposed, with distribution of the heated or chilled air via plenum and insulated ductwork.

Summary Information

SITE SYSTEM

1 Site Situation	
2 Density Range	4 TO 50 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; PRIVATE, SEMIPRIVATE & COMMON OPEN SPACES
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	CONVENTIONAL; INDIVIDUAL FUEL SYSTEMS FOR EACH BUILDING

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE; FUTURE HIGH-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT, DESIGN STAGE; SYSTEM DESIGN REQUIRES DEVELOPMENT
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STEEL FRAME SELF-SUPPORTED VOLUMETRIC MODULES; OPTIONAL STEEL FRAME WITH PANELS
17 Exterior Elements	OPTIONAL PORCH, DECK, SKYLIGHT ROOF, & ROOM EXTENSION UNITS
18 Interior Elements	BATHROOM, KITCHEN, & LAUNDRY CORE; PARTITIONS; STORAGE SYSTEMS; STAIRS
19 Foundations	CONVENTIONAL
20 Comfort Systems	ELECTRIC FORCED AIR HEATING; INTEGRATED COOLING
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEMS
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEMS
23 Furnishings	

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES; HVAC PACKAGES; BATHROOM-KITCHEN-LAUNDRY CORE UNITS; PANELS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF VOLUMETRIC MODULES, HVAC PACKAGES, CORES, PANELS
27 Labor	UNSKILLED & SEMISKILLED FOR ONSITE ERECTION
28 Labor Training Programs	
29 Community Involvement	SELF-HELP FOR ON-SITE ERECTION & COMPLETION; LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	$8.00 TO $10.00 PER SQ.FT.
31 Financing Methods	
32 Useful Life	COMPLETE DWELLING UNIT—40 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	
35 External Functions	
36 Market Area	
37 Delivery Rate	1,000 TO 16,640 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	PLANT OR FIELD ASSEMBLY OF MODULE ELEMENTS
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Emerson & Company

PROPOSER CONSORTIUM

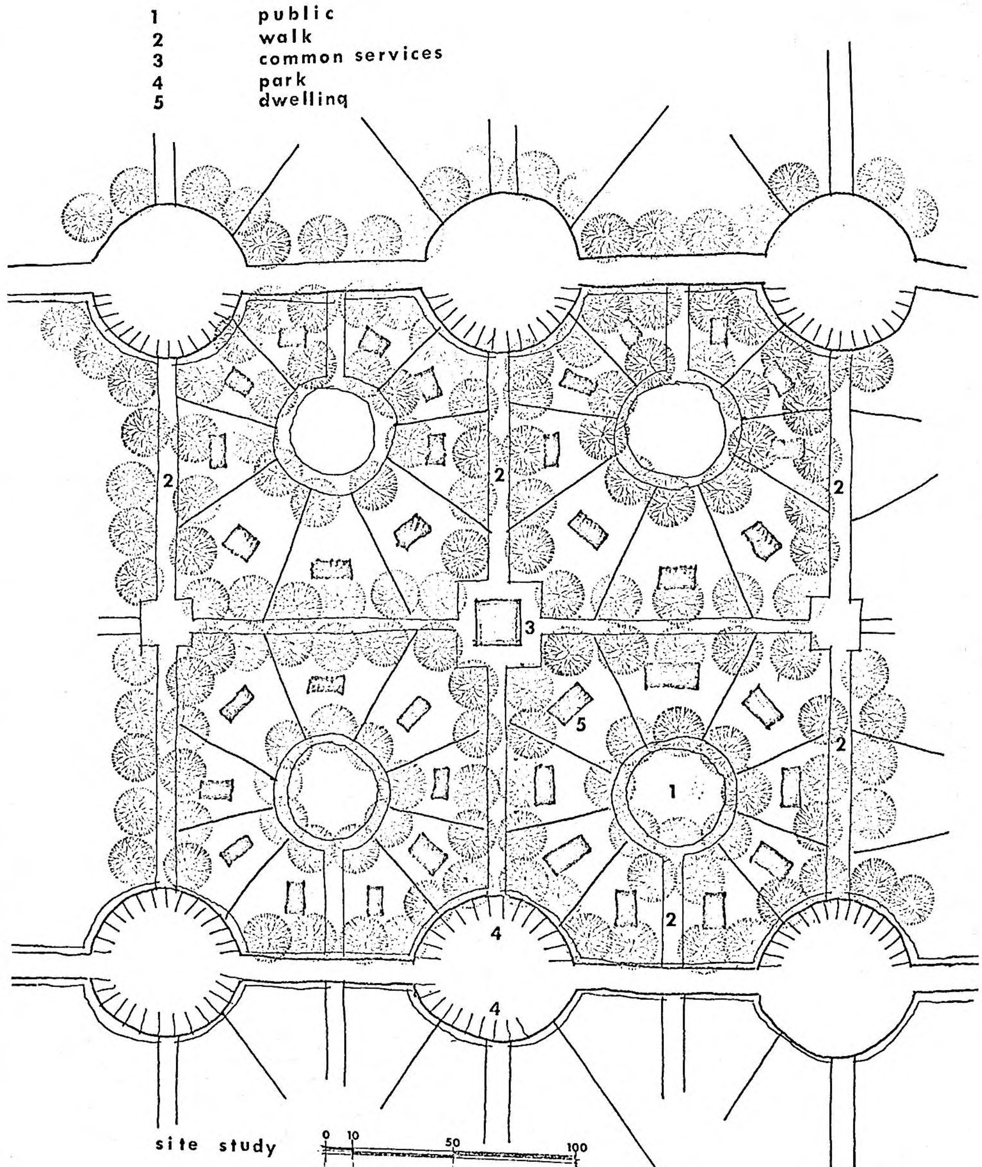
Emerson & Company, San Antonio, Texas
EMCO Developers, Inc., San Antonio, Texas
Urban Systems Institute, San Antonio, Texas
Russ Securities Corporation, San Antonio, Texas

Uniting at the site, with a minimum of construction time, two basic systems which comprise a total dwelling unit, is the concept which underlies this housing proposal. The two systems are the living system (the structural shell of the house) and the utility system, including all mechanical subsystems and unitized bath and kitchen facilities.

For the living system, the proposer has selected prefabricated and preassembled component parts, mainly interior and exterior wall panels, commercially available. The proven acceptance, performance, economy factors, productibility and adaptability of these housing elements governed this choice. The panels will be assembeld into three-, four- and five-bedroom housing units to satisfy a variety of architectural considerations and to allow for sufficient variations to assure consumer acceptance.

Typically, the component panels are built up of conventional building materials around a structural steel framing and incorporate both thermal insulation and vapor barrier treatment. Exterior walls are finished and ready with veneering as designated by the architect. Interior walls are finished ready for painting. Window and door frames are built into the panels, and sash and doors are prehung at the factory ready for use.

The utility system is a separate module, completely assembled at the factory and ready for use upon hookup at the site with central services. Although the typical floor plans which form part of the proposal show the modules sited within the shell, the proposer states that the module might conceivably be attached to the outside of the living system. Being a self-contained unit, the utility system may be serviced or even replaced without disturbing the living system. Furthermore, the self-supporting units lend themselves to future expansion of housing projects, since they may

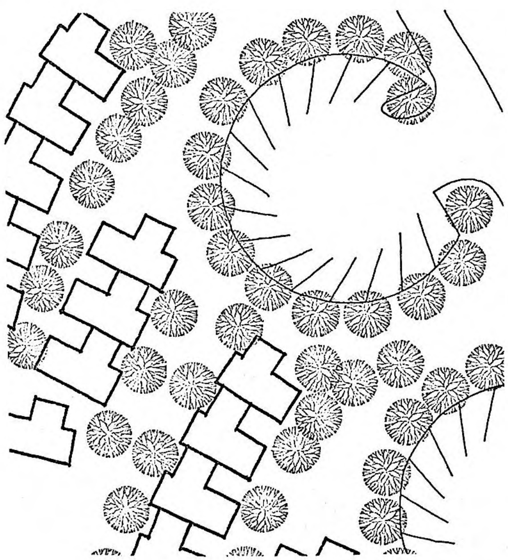


be stacked vertically or horizontally, such stacking being desirable to concentrate all services within a given area of a project.

Foundations for the proposed housing system may be conventional slab-on-ground, pier and beam, or post-tensioned members. Once the foundations are ready, the living system shell and its matching utility system are expected to be erected quickly, with only a limited amount of skilled labor being required to close the units to weather.

In addition to single-family units on scattered sites, also proposed is a staged development for sites closer to existing community facilities, ranging from one to several block areas, on which substandard single-family units may stand. The exercise of air rights, temporary housing, fostering of cooperation among existing owners, and centralization of utilities are among the concepts which would be applied to bringing such a development to a successful fruition.

The proposer contemplates establishing minimum training courses for use of unskilled and semiskilled labor, both in the plant and onsite. Self-help completion painting of the housing units is expected to offer potential owners a 4 to 5 percent savings on total construction costs.



Summary Information

SITE SYSTEM

1	Site Situation	SUBURBAN, URBAN RENEWAL
2	Density Range	4 TO 35 DWELLING UNITS PER ACRE
3	Topography	FLAT TO 6% GRADIENT PREFERRED
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	
6	Nonresidential Functions	
7	Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION
8	Site Planning Services	
9	Community Involvement	USER NEED CONSIDERATIONS FOR REGION OF SELECTED SITE
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	3, 4, & 5 BEDROOMS
13	Design Selection	BUILDING SYSTEM DEVELOPED AND MARKETED WITH COMMERCIALLY AVAILABLE COMPONENTS
14	State of Development	USER NEED STUDY OF PROTOTYPE
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	COMPONENT PANELS WITH STRUCTURAL STEEL FRAME
17	Exterior Elements	CONVENTIONAL FINISHES
18	Interior Elements	CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL SLAB—ON—GROUND, PIER & BEAM, OR POST-TENSIONED MEMBERS
20	Comfort Systems	SEPARATE FACTOY-ASSEMBLED UTILITY MODULE
21	Plumbing	SEPARATE FACTORY-ASSEMBLED UTILITY MODULE
22	Electrical	SEPARATE FACTORY-ASSEMBLED UTILITY MODULE
23	Furnishings	

PRODUCTION

24	Offsite Production	UTILITY SYSTEM MODULE; BUILDING SYSTEM COMPONENTS
25	Onsite Production	
26	Onsite Construction	ASSEMBLY OF STRUCTURAL SHELL; PLACEMENT OF UTILITY SYSTEM MODULE
27	Labor	
28	Labor Training Programs	PROGRAMS FOR ONSITE & PLANT INSTRUCTION FOR UNSKILLED & SEMISKILLED
29	Community Involvement	COORDINATE WITH COMMUNITY LEADERS; SELF-HELP

ECONOMICS

30	Construction Costs	$11.00 PER SQ. FT.; $15,000 PER (1,700 SQ. FT.) UNIT
31	Financing Methods	CONVENTIONAL
32	Useful Life	50 YEARS

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	MANAGEMENT
35	External Functions	CONSTRUCTION; ERECTION
36	Market Area	SOUTHWEST; AGRICULTURAL SOUTH; MIDWEST
37	Delivery Rate	
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	TWO-SYSTEM DWELLING UNIT (LIVING SYSTEM & UTILITY SYSTEM)
40	Codes	MODIFICATION OF PLUMBING CODE

FCE-Dillon, Inc.

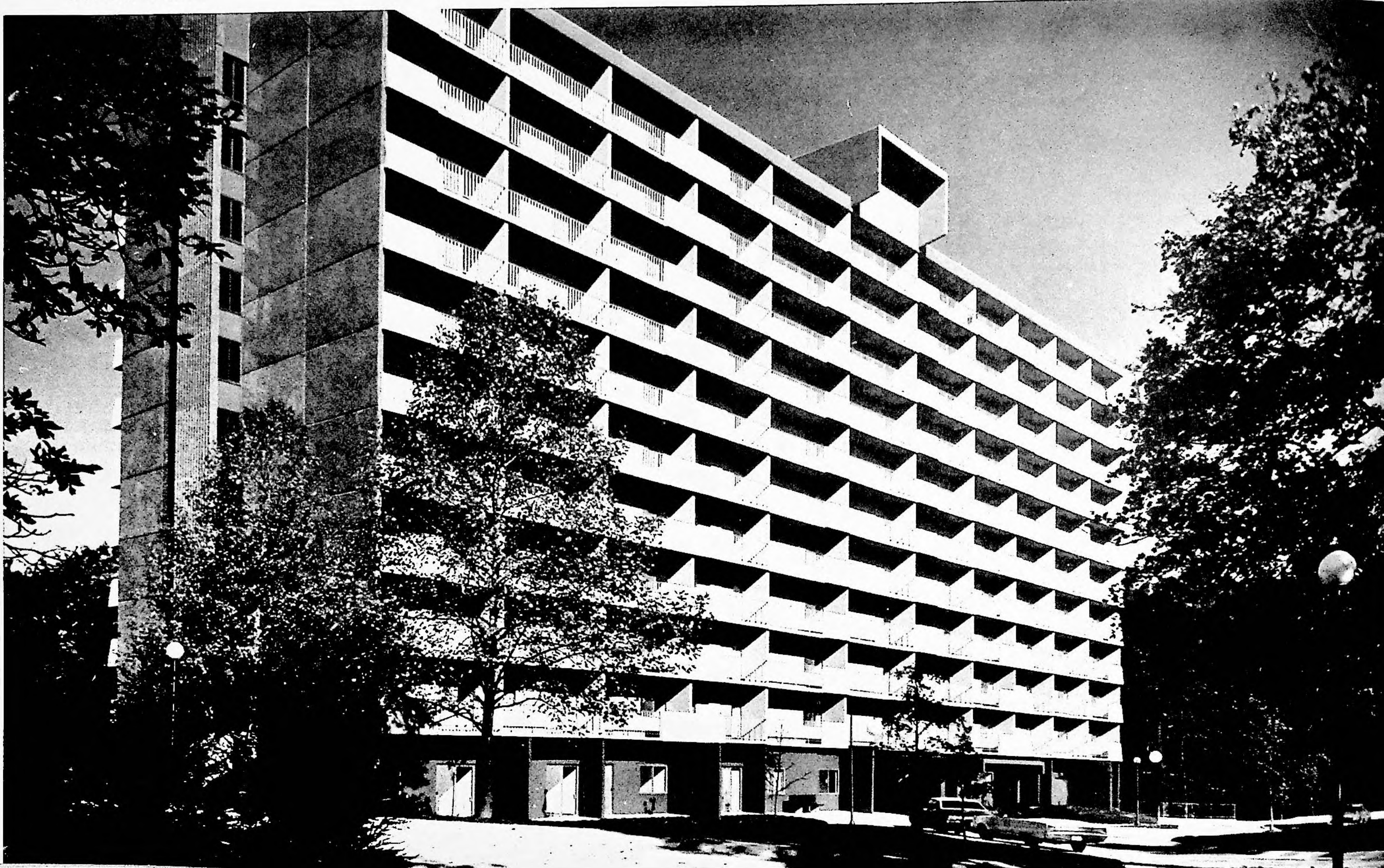
PROPOSER CONSORTIUM

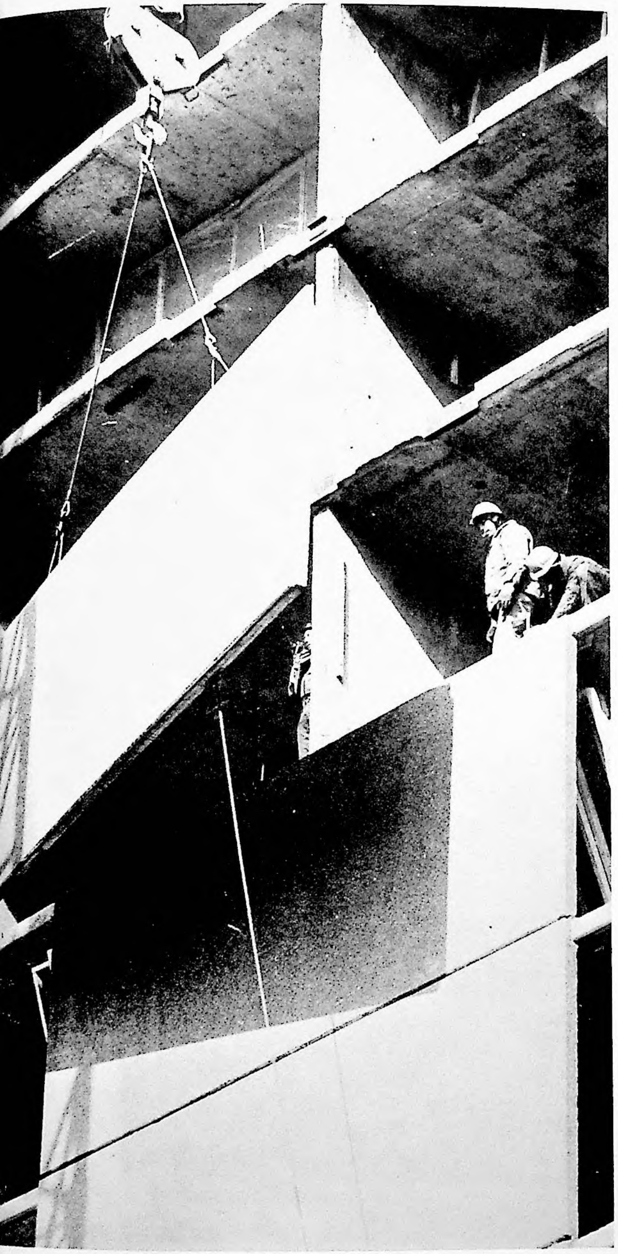
Thomas J. Dillon & Company, Inc., Builder-Developer, Akron, Ohio
Forest City Enterprises, Inc., Builder, Retailer, Land Developer, Cleveland, Ohio
Top Roc Corporation, Manufacturer;
Barbitta-James and Associates, Architects;
Shelter Systems, Inc., Architects and Engineers.

A flexible, panelized building scheme is proposed that uses concrete for floors and bearing walls, with wood for infill exterior walls, partitions, and roofs, and offers considerable variety for all types of housing. The system is equally usable for ancillary structures such as laundry rooms, communal rooms, and garages.

Major advantage claimed for the system is the use of materials and components that are easily available, and whose technology is well known, both in the factory and in the field. The concrete bearing walls themselves offer many advantages both from an architectural and structural viewpoint. Numerous surface treatments can be applied, and walls can be placed as jutting units to screen adjacent areas (as in townhouse arrangements), and the post-tensioned floor slabs add great structural strength. Wood infills can also be used for architectural variety and for most of the necessary openings for windows and doors (though the concrete walls can also accommodate openings), and offer fire, thermal, and sound barriers.

The simplest soil bearing systems can be used for foundations—either footings, spread footings, or piling are suitable. Bearing walls are precast, reinforced concrete, 8 in. thick and either 24 ft. or 34 ft. in length. Load-bearing wood endwalls serve a dual purpose—acting as closure walls and as support for wood roof trusses, with their construction of 2-in. x 4-in. lumber with 2-in. x 10-in. chords at bottom. Exterior sheath-





Summary Information

SITE SYSTEM

1 Site Situation	URBAN, SUBURBAN; URBAN RENEWAL
2 Density Range	4 TO 70 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO SLOPES UP TO 12 DEGREES & TO ALL NORMAL SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; USE OF AIR RIGHTS OVER SHOPPING CENTERS
6 Nonresidential Functions	RECREATIONAL, LIBRARY, COMMUNITY, CRAFTS, & SHOPPING FACILITIES
7 Circulation	PEDESTRIAN WALKS & PATHS; SEPARATE SERVICE VEHICULAR TRAFFIC
8 Site Planning Services	CONSORTIUM MEMBER
9 Community Involvement	COORDINATION WITH NEIGHBORHOOD CITIZENS' GROUPS
10 Utilities	CONVENTIONAL; ELECTRICAL SERVICES PREFERABLY UNDERGROUND

BUILDING SYSTEMS

11 Housing Types	SINGLE FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	BUILDING SYSTEM DEVELOPED & MARKETED; DISTRIBUTION CHANNELS ESTABLISHED
15 Community Involvement	COORDINATION WITH NEIGHBORHOOD CITIZENS' GROUP

BUILDING SUBSYSTEMS

16 Structure	CONCRETE WALL & FLOOR PANELS; WOOD-FRAME ENDWALLS & ROOF TRUSSES; ROOF SECTIONS
17 Exterior Elements	WOOD FRAME INFILL PANELS
18 Interior Elements	WOOD FRAME PARTITIONS; STAIRS & CLOSETS; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL
20 Comfort Systems	WARM AIR HEATING OR HEATPUMP OPTIONAL FUEL; DISTRIBUTION INTEGRATED IN PANELS
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM PANELS
22 Electrical	CONVENTIONAL INTEGRATED IN PANEL SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	CONCRETE & WOOD FRAME PANELS; ROOF COMPONENTS; BATHROOM & KITCHEN UNITS
25 Onsite Production	CONCRETE WALL AND FLOOR PANELS WHEN ECONOMICAL
26 Onsite Construction	FOUNDATIONS; PANEL AND COMPONENT ERECTION; UTILITY CONNECTIONS
27 Labor	SKILLED WORKERS FOR PLANT PRODUCTION
28 Labor Training Programs	APPRENTICE TRAINING PROGRAMS FOR ALL BUILDING TRADES BY PROPOSER
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP

ECONOMICS

30 Construction Costs	$14,000, 2-BEDROOM TOWNHOUSE UNIT, 1,000 UNITS PER YEAR
31 Financing Methods	CONVENTIONAL
32 Useful Life	CONCRETE PANELS—LIFETIME; SIDING—10 TO 15 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; LAND DEVELOPMENT; DESIGN; PRODUCTION; CONSTRUCTION & ERECTION
35 External Functions	
36 Market Area	250-MILE RADIUS OF PLANTS
37 Delivery Rate	600 TO 6,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

ing is glued in place to insure structural rigidity.

Much attention has been paid to exterior finish and maintenance. Aluminum, wood, or other siding can be used, windows are aluminum framed and can be washed from the inside, varied materials can be used for roof finishes, and the concrete endwalls require no maintenance. Interior partitions are covered with gypsum board, finished to suit the desire of the occupant.

Partition walls are factory built and contain all electrical services and plumbing. Bathroom and lavatory facilities, also factory built, include a fiberglass tub-shower unit. The mudroom and laundry area in single-family units contains all necessary plumbing and electrical outlets. The kitchen, including cabinets, is factory installed and includes all appliances and other appurtenances.

A variety of floor coverings can be used, though the basic coverings are vinyl asbestos tile, hardwood flooring, or carpeting—all for installation at jobsite. Ceiling can be painted, acoustical, sprayed plaster, or acoustical tile, and dropped ceilings are also possible.

Basic heating is by forced warm air, with duct space provided above hung ceilings; field plumbing connections are limited to the two wet walls—bathroom and kitchen, with either copper or plastic piping. Although wiring is normally done at the factory, it can be done onsite in the open strip in the partitions, if required.

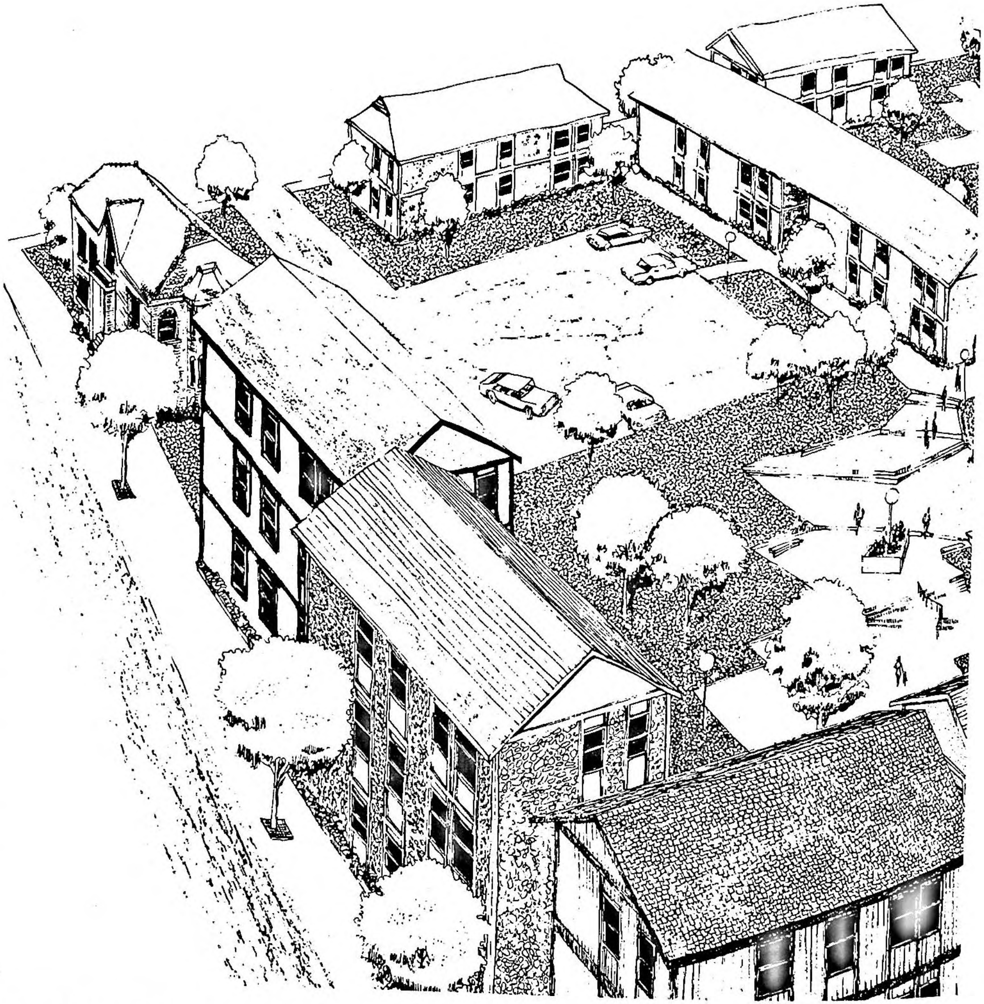
The program has been designed to provide a considerable range of housing types and unit arrangements to provide planners with maximum freedom to organize and develop the total potential of a site. The use of such housing structures in air-rights space—as over shopping center parking areas—is now being explored by the proposer, who already develops and owns numerous centers throughout the country. The proposer indicates a volume production capability of from 600 to 6,000 units per year.

A subsidiary system, already in use by the consortium's members, is a completely factory-built system of modules shipped to the site and assembled into various types of housing units. Like most such systems, it is based on a wood platform-frame (2-in. x 4-in. studs, 16 in. on center) with conventional exterior and interior covering, trussed roofs, insulation, and completely factory-installed electrical, plumbing, and heating-air conditioning systems. This system is offered as an immediately usable method for obtaining fast, efficient, and economical housing on a smaller scale.

Module System

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12 Unit Variations	
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	BUILDING SYSTEM DEVELOPED & BEING MARKETED
15 Community Involvement	COORDINATION WITH NEIGHBORHOOD CITIZENS GROUPS
BUILDING SUBSYSTEMS	
16 Structure	WOOD PLATFORM-FRAME MODULES; ROOF TRUSSES
17 Exterior Elements	CONVENTIONAL FINISHES INTEGRATED IN MODULES
18 Interior Elements	CONVENTIONAL FINISHES INTEGRATED IN MODULES
19 Foundations	CONVENTIONAL
20 Comfort Systems	HEATING & COOLING SYSTEMS INTEGRATED IN MODULE
21 Plumbing	INTEGRATED IN MODULE
22 Electrical	INTEGRATED IN MODULE
23 Furnishings	
PRODUCTION	
24 Offsite Production	COMPLETE WOOD-FRAME MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATION; PLACING OF MODULES; UTILITY HOOK-UPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	

Fidelity Homes



PROPOSER

Fidelity Homes of America, Inc., Nashville, Tennessee

AFFILIATES

Storr's Wood Products, Inc., System Fabricators, Incorporated; Dyna-Tex, Incorporated; Lake Park Company; Gresham and Smith Architects; L. W. Buie

Particleboard sandwich panels are the basic elements of the building system proposed. The panels consist of two layers of particleboard separated by furring strips, nailed together to form room-high wall sections which are supplied in four standard widths, ranging from 15 in. to 5 ft. The tongue-and-groove panels may be assembled into a variety of floor plans, mostly for single-family attached and detached homes, and for two- and three-story multifamily structures.

Erection of the panels is accomplished manually, with low-skilled labor, making self-help possible. The system's ease of erection is reflected also in ease of modification by the user. Interior partitions can readily be rearranged, and exterior panels may be opened up to permit expansion or addition of more space. To develop this potential for self-help further, the proposer contemplates offering a kit of partitions to the tenant.

The housing afforded by the panelized system may be conventional in appearance—the architect having the option of cladding the exterior of the panels with brick or siding—or the particleboard surface may be exposed to the weather, with grooving, recessed panels and other forms of texturing affording an architecturally pleasing appearance. Although particleboard wall panels are the basic components of the system, other particleboard elements, including ceiling and floor panels, may be furnished.

The basic shell for the system is completed by a gabled-roof system, traditional in appearance, and may be accomplished through use of standard, prefabricated trusses. Foundations for the houses are conventional cast-in-place concrete—slab-on-ground, or on sloping ground, bearing walls and interior spread footings, spanned by joists or floor panels of conventional or particleboard construction.

The particleboards which make up the panels are manufactured from scrap or low-grade wood stock, impregnated with phenolicurea resin, combined under a combination of pressure and high-frequency dielectric heating. The resultant product, known as flat patten particleboard, can be produced up to 3 in. thick, in sheets up to 8 ft. x 24 ft., and offers excellent sound and thermal insulating characteristics, which can be varied in accord with requirements by varying the ingredients. Since the particleboard can be worked with conventional carpentry tools and equipment, it is suited to high-speed production and shaping in the plant; and yet it may be modified or adjusted in the field, if required, including direct nailing to support shelves or other accessories.

The basic load-bearing panel, approximately 2 1/2 in. to 5 in. thick has a 1 1/2-in. to 3-in. board on the outside, a 1/2 in. to 3/4-in. board inside, and is joined by automatic nailing machines through the furring strips which separate the two surfaces. This operation also clinches the nails on both sides to give the sandwich strength and racking resistance. Factory wiring of the panels, using the void between skins and including outlets and switches, is proposed, as is preplumbing with lightweight plastic pipe.

Openings for windows and doors are set into the panels at the factory and may include glazing of windows and hanging of doors, so that site work is reduced to a minimum. The vertical delineation formed between panels as they are mated by the tongue-and-grooved joint is concealed by a plastic molding which is affixed to the female side of the wall panel. Other interior trim such as baseboard and ceiling molding may be conventional woodworking, or may be furnished in molded plastic. Interior finishes may range from factory-introduced pigmentation of the particles themselves, to primed surfaces, painting, unfinished surfaces, or decorative materials added (often by self-help) either by nailing or by adhesives.

Kitchen and bathroom facilities for the structures are modularized, with back-up of these services to a common partition allowing for single junction of water, electricity and drainage lines to the structure's central service lines. These modules are completely prepackaged and ready for use upon installation and hook-up.

Offsite plants for production of the panels are proposed, with shipments being economically feasible within a 500-mile radius.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER BLOCK; COMMON OPEN SPACES
6 Nonresidential Functions	PLAY AREAS
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION; PEDESTRIAN WALKS WITHIN BLOCKS
8 Site Planning Services	PROPOSER'S REPRESENTATIVES TO AID LOCAL SPONSORING GROUPS
9 Community Involvement	LOCALLY FORMED SPONSORING GROUPS INVOLVED IN PLANNING
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTI-FAMILY LOW-RISE; POTENTIAL HIGH-RISE
12 Unit Variations	
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEM: PROTOTYPE CONSTRUCTED; PRODUCTION FACILITIES: DESIGN STAGE
15 Community Involvement	LOCALLY FORMED SPONSORING GROUPS INVOLVED IN PLANNING

BUILDING SUBSYSTEMS

16 Structure	PARTICLEBOARD SANDWICH WALL & FLOOR PANELS; WOOD TRUSS OR BOX BEAM ROOF SYSTEM
17 Exterior Elements	TEXTURED, PREFINISHED OR UNFINISHED WALL SURFACES; OPTIONAL SIDING
18 Interior Elements	PANEL PARTITIONS; PLASTIC PANEL JOINT MOULDING; MOLDED TRIM
19 Foundations	CONVENTIONAL
20 Comfort Systems	FORCED AIR OR ELECTRIC BASEBOARD HEATING; INTEGRATED WITH BUILDING SUBSYSTEM
21 Plumbing	CONVENTIONAL; INTEGRATED IN KITCHEN & BATH MODULES
22 Electrical	INTEGRATED IN KITCHEN & BATHROOM MODULES & IN WALL PANELS
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL & FLOOR PANELS; ROOF TRUSSES; KITCHEN & BATHROOM MODULES; PACKAGED HEATING
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; COMPONENT ERECTION; MODULE PLACEMENT; FINISHES; UTILITIES HOOK-UPS
27 Labor	SEMI-SKILLED & UNSKILLED FOR PLANT PRODUCTION; UNSKILLED FOR SITE CONSTRUCTION
28 Labor Training Programs	PROVIDED WITH INITIAL UNITS
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP IN SITE ERECTION & IN PLANT

ECONOMICS

30 Construction Costs	$8,000 TO $10,600 PER UNIT, 1,000 UNITS PER YEAR
31 Financing Methods	CONVENTIONAL
32 Useful Life	HOUSING UNIT—40 TO 50 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	OVERALL MANAGEMENT; INVESTMENT & DEVELOPMENT
35 External Functions	MANUFACTURE; FABRICATION; DESIGN, ENGINEERING & TESTING; PRODUCTION OF MODULES
36 Market Area	500-MILE RADIUS OF PANEL-FABRICATED PLANTS
37 Delivery Rate	260 TO 1,000 UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	USE OF PARTICLE BOARD MANUFACTURED FROM LOW GRADE WOOD STOCK
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Five Point Housing Consortium

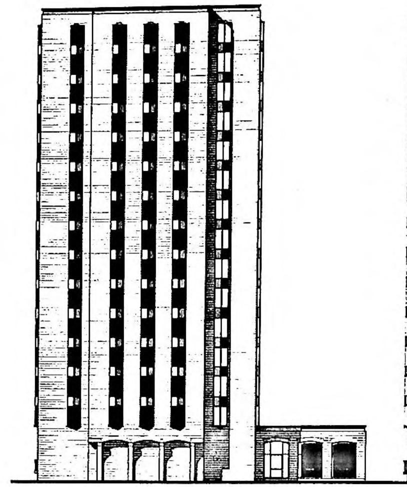
PROPOSER CONSORTIUM

Five Points Housing Consortium, San Diego, California
Kenneth E. Anderson, AIA, Architect
A.J. Blaylock & Associates, Engineers
Neilsen Construction Company, General Contractors
Hazard Products Inc., Concrete Products Manufacturers
Commercial Facilities, Inc., Real Estate Facilities Developers

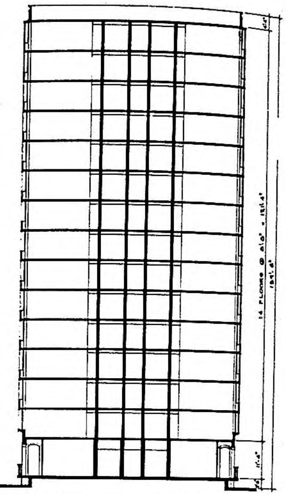
Lightweight concrete blocks and precast-concrete, flat-slab floor and roof decks are the modular components of the multifamily dwelling system proposed. Delivered to the site, prepackaged by numbers and sizes in accordance with CPM (critical path method) schedules, and cross-referenced to the masons' detail sheets, modules can be assembled into high-rise self-supporting apartment buildings at a reduction in construction time when compared to conventional masonry construction.

In essence, two factors contribute to construction-time savings: the use of precast (rather than cast-in-place) floor slabs, and the sequential scheduling of construction crafts in erecting the modular (and auxiliary) building elements. The reinforced, precast flat slabs are typically 13 ft. 4 in. x 22 ft. and afford clear spans of 20 ft. between the supporting concrete block walls below. In construction terms, this means that once a slab has been crane-placed, the area below, being free of the framework and shoring required for cast-in-place concrete, is immediately ready for mechanical and finishing trades. Precise CPM scheduling keeps the two major operations—placement of flat slabs and erection of load-bearing concrete block walls—separated both in time and space. While the masons build up walls at one end of the building, the erection crews are placing and attaching slab to walls build the previous day at the other end of the building.

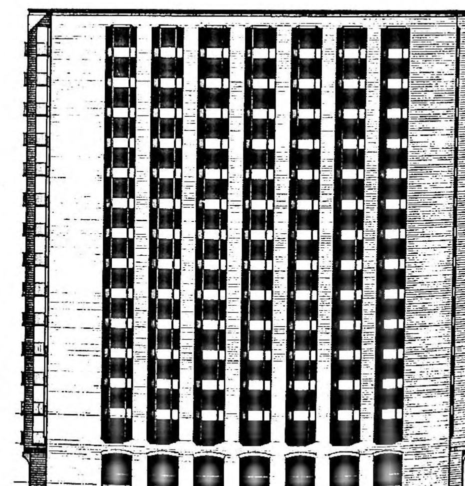
The structural system represented by the block-and-slab combination is capable of producing a 15-story building without skeletal frame, in full compliance with local and uniform codes. The many lineal feet of connection between the slabs and the bearing walls result in loadings that tend to be small and nearly



SOUTH END ELEVATION



TYPICAL CROSS SECTION



WEST SIDE ELEVATION

uniform.

The structures built using this system may conform to a variety of architectural treatments offered by the texture of the block itself and the larger texture implicit in the openings in the building, including fenestration and balconies. This architectural freedom extends to the interiors, where a latitude of room and partition arrangement exists due to the clear span between block walls offered by the precast floor slabs.

The inside walls, finished with a smooth, thin coat of plaster, may be painted as desired, possibly as a self-help project by the occupant. Ceilings may also be painted, the concrete underside of the slab coming from the forms smooth, ready for finish.

The relatively few nonbearing walls required to set off spaces within apartment units will be built of lightweight steel studs and conventional gypsum board. Windows will be redwood-framed with aluminum sash.

Heating for the apartments is expected to be a gas-fired, central hot water system, with distribution by baseboard units or individual fan-coil units—the latter being capable of air conditioning employing a central supply of chilled water, also gas generated. Hot water would be supplied by a primary circulating system of heated water which would effect direct heat exchange with storage units within each apartment.

Prefabricated kitchen units will be incorporated into the apartments, and, depending upon feasibility studies, unitized bathrooms may be utilized. Innovations under consideration, such as Sovent plumbing, and use of adhesives in layup of concrete block, rather than conventional mortar, similarly will be governed by feasibility studies.

A 120-volt, 3-phase, 4-wire electrical system is planned for the individual housing unit, with multiple receptacle raceways, exposed at the baseboard, being installed for distribution and for both TV and telephone leads with optimal extensions for high-level outputs.

The proposer offers plans for utilization of his modular system of construction chiefly for housing of the elderly and the handicapped, in moderate- and low-income groups.

A plant for production of the basic modules is built and operational; the building system is fully developed and is being marketed.

Summary Information

SITE SYSTEM

1 Site Situation	40 TO 80 DWELLING UNITS PER ACRE
2 Density Range	GRADIENTS OF LESS THAN 25%
3 Topography	ADAPTABLE TO ALL NATIONAL CLIMATES
4 Climate	COMMON OPEN SPACES
5 Planning Concepts	RECREATION FACILITIES; SNACK BAR; LIBRARY
6 Nonresidential Functions	SEPARATE PEDESTRIAN & VEHICULAR & SERVICE CIRCULATION
7 Circulation	PROPOSER'S CONSULTANTS WORK WITH CITY PLANNERS
8 Site Planning Services	
9 Community Involvement	CONVENTIONAL
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	FLEXIBLE
13 Design Selection	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
14 State of Development	
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	CONCRETE UNIT MASONRY FOR LOAD-BEARING WALLS; PRECAST CONCRETE FLOOR & ROOF SLABS
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	CONVENTIONAL
19 Foundations	CENTRAL HEATING & COOLING SYSTEM FOR BUILDING
20 Comfort Systems	BATHROOMS FACTORY FABRICATED FOR FIELD INSTALLATION, "SOVENT" PLUMBING
21 Plumbing	OPTIMUM USE OF FACTORY PREWIRED EQUIPMENT
22 Electrical	CARPETING
23 Furnishings	

PRODUCTION

24 Offsite Production	MODULAR COMPONENTS
25 Onsite Production	ASSEMBLY OF BUILDING COMPONENTS
26 Onsite Construction	UNSKILLED
27 Labor	
28 Labor Training Programs	SELF-HELP LABOR
29 Community Involvement	

ECONOMICS

30 Construction Costs	$16.60 PER SQ. FT. MULTIFAMILY HIGH-RISE
31 Financing Methods	50 YEARS — TOTAL STRUCTURE
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	ALL
35 External Functions	
36 Market Area	100 TO 1,000 UNITS PER YEAR
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	"SOVENT" PLUMBING; ADHESIVES IN LAYUP OF CONCRETE BLOCK
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Foamcor, Inc.

PROPOSER

Foamcor, Inc., Benica, California

This proposal centers on the use of 8-ft. x 4-ft. x 3-in. polyurethane-foam building panels employed for floor, wall, and ceiling elements. The system is adaptable for construction of relocatable units, add-on rooms, mountain cabins, and professional offices, in addition to single-family dwellings and multiple-unit structures. The prefinished panels are factory-fabricated and trucked to the site, but experience illustrates the feasibility of establishing onsite plants for producing the panels, plants that can readily be relocated from job to job.

The manufacturing process employs prefinished exterior and interior veneers bonded into a structural sandwich with the introduction of the foam. Froth-foam injection techniques bond all parts into load-bearing sections. The product can be cut, drilled, nailed, sawed, and otherwise shaped as easily as can plywood. The foam fill provides adequate insulating qualities, and because of the load-bearing nature of the panel, considerable cost is saved through elimination of framing lumber required in conventional dwelling construction. Panels are joined by steel key-locking devices.

Availability of raw materials locally determines the location of fabricating plants, and the product cost is determined on a delivered basis, both as to materials produced at the plant location and those shipped from other areas.

Exterior finishes are determined by consumer preference, cost, and material availability. The system has utilized aluminum bonded to wood, patterned aluminum, hardboard, Douglas fir, redwood, and cedar siding. Development of a sectionalized floor system is being considered.

Heating, air conditioning, and water heaters are supplied by subcontractors. Plumbing and fuel supply systems are incorporated in the utility walls of the utility-core unit. Innovative in the electrical system is the presetting of switches, boxes, and raceways in the wall at the factory; these are then foamed in place. Heating is supplied by electrical wall units.

The proposer would draw from his own consortium and from local project consortia to develop design criteria for each project as dictated by local need. Site planning begins with the local consortium, involving real estate, financial, and planning groups. This foam panel production system is operational now on the basis of an output of 100 dwelling units per year. The proposer is planning an expansion soon to a rate of 1,100 units annually. Skilled labor is used in the production facility, semiskilled and untrained labor onsite for assembly.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN, URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	PROPOSER ORGANIZATION ASSISTED BY LOCAL ADVISORY CONSORTIA
9 Community Involvement	ADVISORY CONSORTIA OF COMMUNITY REAL ESTATE, FINANCIAL, ETC., TALENTS
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	3 & 4 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	LOCAL ADVISORY CONSORTIA

BUILDING SUBSYSTEMS

16 Structure	POLYURETHANE CORE SANDWICH WALL, FLOOR, ROOF PANELS; ROOF TRUSSES & BEAMS
17 Exterior Elements	SIMULATED STUCCO; PATTERNED ALUMINUM OR CONVENTIONAL WOOD SIDING
18 Interior Elements	POLYURETHANE CORE, GYPSUM OR WOOD PARTITIONS; WOOD OR ALUMINUM WALL FINISHES
19 Foundations	CONVENTIONAL
20 Comfort Systems	ELECTRIC WALL UNIT HEATING; OPTIONAL INTEGRATED HEATING, COOLING UNIT
21 Plumbing	CONVENTIONAL; UTILITY CORE; INTEGRATED IN BUILDING SUBSYSTEMS
22 Electrical	CONVENTIONAL; SWITCHES, BOXES, RACEWAYS INTEGRATED IN BUILDING SUBSYSTEMS
23 Furnishings	

PRODUCTION

24 Offsite Production	SANDWICH PANELS; TRUSSES & BEAMS; UTILITY CORE WALLS
25 Onsite Production	OPTIONAL ONSITE FACTORIES FOR PRODUCTION OF PANELS, TRUSSES & BEAMS
26 Onsite Construction	FOUNDATIONS; PANEL ERECTION; PLACING OF UTILITY CORE WALLS; UTILITIES HOOK-UPS
27 Labor	UNSKILLED FOR SITE ERECTION; SKILLED FOR PRODUCTION PLANT
28 Labor Training Programs	LOCAL LABOR TO BE TRAINED BY PROPOSER
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP LABOR

ECONOMICS

30 Construction Costs	$12,040 PER UNIT, 1,000 UNITS PER YEAR
31 Financing Methods	PRIVATE SOURCES, LENDING INSTITUTIONS, OR PUBLIC STOCK ISSUE
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	GENERAL MANAGEMENT; CENTRAL RESPONSIBILITY; PRODUCTION; ERECTION; FINANCE
35 External Functions	
36 Market Area	
37 Delivery Rate	100 TO 1,100 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

General Electric

PROPOSER

The General Electric Company, Philadelphia, Pennsylvania.

AFFILIATES

Hugh Gibbs, FAIA, and Donald Gibbs, AIA, Architects; Candeub, Fleissig and Associates, Planning and Community Development Consultants; Foundation for Cooperative Housing.

Emphasis on components and finished subassemblies that can be incorporated into complete single-family attached and detached and multifamily low-rise structures, plus a number of internal innovations, forms the basis of this housing system. The combination of components or subassemblies, rather than three-dimensional modules, was selected after careful study of practicalities of transport, factory-assembly possibilities, and transportation difficulties. Use of components and subassemblies permits many variations in appearance and interior arrangements. Sections for a dwelling can be shipped from factory to jobsite without conflict with most highway load-size and weight restrictions.

Innovations include: A stressed-skin, plywood-reinforced, sandwich-type floor panel (which also forms the ceiling in multistory applications); use of cast plaster finish for walls and ceilings to obviate as many onsite finishing operations as possible; a central chase to carry all utilities; and use of steel instead of wood studding.

Keys to flexibility onsite are the use of factory-built glazed sections which offer architectural freedom zones and the inherent strength of the stressed-skin floor sections which permits attachment of cast-plaster ceilings. Overhangs on the second floor of a two-story structure provide variety in appearance, as well as additional space. Exterior appearance can also be varied by factory application of various types and finishes of plywood, board-and-batten, polyvinyl-fluoride coating over plywood, and other surfacing materials.

The structural system, in which wood can be used as an alternative to steel studding, depending on availability and local conditions, is similar to standard frame construction. At the builder's option, it can be installed over a basement, a slab, or crawl space. Steel was selected for the framing because of easy availability, because strength can be increased by a simple change in gauge, and because metal lends itself readily to automated fabrication. However, there is also considerable use of wood in the floor panels, prefabricated roof trusses and sheathing, plywood exterior siding, exterior and interior doors, and wood stair treads and risers carried on wood stringers.

Basic subassembly is the floor panel, made up of plywood top and bottom, with a wood frame, and filled with a cellular, phenolic-impregnated paper-honeycomb core. Partial filling of all cores with sand (or polyurethane foam) absorbs sound and impact energy.

The cast plaster used for ceilings and sidewalls is basically a 1/2-in.-thick, unreinforced gypsum plaster, cast in a flat-bed and attached to the studs or floor panels by imbedded metal lath and straps. Plaster thickness for ceiling can be increased, where required for additional fire resistance, by addition of vermiculite additives and by use of air-entraining agents. Sections of up to 8 ft. x 30 ft. have been cast and handled in the factory and onsite, without damage or special problems. Onsite finishing operations are held to a minimum. Much interior trim has been eliminated; its main use is at floor-to-wall connections.

The mechanical distribution systems are located in a central chase, which includes air ducts, hot and cold water, drains, vents, gas flue, and electrical load connections. Heating, ventilating, and air conditioning

systems are designed as a part of the building, rather than as independent items. Insulation, depending on location of the project, can vary from simply vapor barriers to fiberglass and polyurethane foam.

Plumbing, also factory fabricated and installed, makes use of performance-rated plastic piping throughout, though copper can be substituted if desired. A single-stack venting system can adequately handle all the fixtures, and standard bathroom fixtures are factory tested and included in the subassemblies.

Electrical systems are designed as an integral part of the delivered structure. Electrical hardware is fabricated as a harness, including mounting boxes, cover plates, and intermodular connectors, and is then inserted during the assembly process. Connectors at interfacing ends of the structure provide for continuity with adjoining sections.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN, SUBURBAN; RURAL
2 Density Range	12 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; GREENBELT
6 Nonresidential Functions	RECREATIONAL FACILITIES
7 Circulation	SEPARATE PEDESTRIAN AND VEHICULAR TRAFFIC
8 Site Planning Services	CONSULTANT
9 Community Involvement	INTERVIEWS WITH LOCAL PEOPLE TO DETERMINE NEEDS
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE; POSSIBLE HIGH-RISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION PLANT & BUILDING SYSTEM DEVELOPED & PROTOTYPE CONSTRUCTED
15 Community Involvement	INTERVIEWS WITH LOCAL PEOPLE TO DETERMINE LIVING HABITS

BUILDING SUBSYSTEMS

16 Structure	STEEL (OPTIONAL WOOD) FRAME WALL ASSEMBLIES; STRESSED-SKIN PLYWOOD FLOOR & ROOF PANELS
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	PAINTED CAST-PLASTER CEILINGS AND PARTITIONS; PLYWOOD SUBFLOOR
19 Foundations	CONVENTIONAL
20 Comfort Systems	INDIVIDUAL HEATING SYSTEM FOR UNITS; FUEL OPTIONAL; CENTRAL CHASE DISTRIBUTION
21 Plumbing	SINGLE-STACK VENT; CENTRAL CHASE DISTRIBUTION; INTEGRATED WITH BUILDING SUBSYSTEMS
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEMS
23 Furnishings	

PRODUCTION

24 Offsite Production	HOUSING COMPONENTS; SUBSYSTEMS; MECHANICAL SERVICE SYSTEMS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ASSEMBLY AND ERECTION OF COMPONENTS; UTILITY CONNECTIONS
27 Labor	SKILLED, SEMISKILLED & UNSKILLED FOR PLANT & ONSITE CONSTRUCTION
28 Labor Training Programs	TRAINING OF LOCAL BUILDERS BY PROPOSER
29 Community Involvement	CONTRACTORS; LABORERS

ECONOMICS

30 Construction Costs	
31 Financing Methods	CONVENTIONAL
32 Useful Life	CONVENTIONAL

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; PRODUCTION; CONSTRUCTION; ERECTION
35 External Functions	DESIGN; LAND PLANNING
36 Market Area	400-MILE RADIUS OF PLANT
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	PRECAST PLASTER WALL; STRESSED-SKIN FLOOR PANEL; UTILITY DISTRIBUTION SYSTEM
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Gypsum Panel Systems

PROPOSER

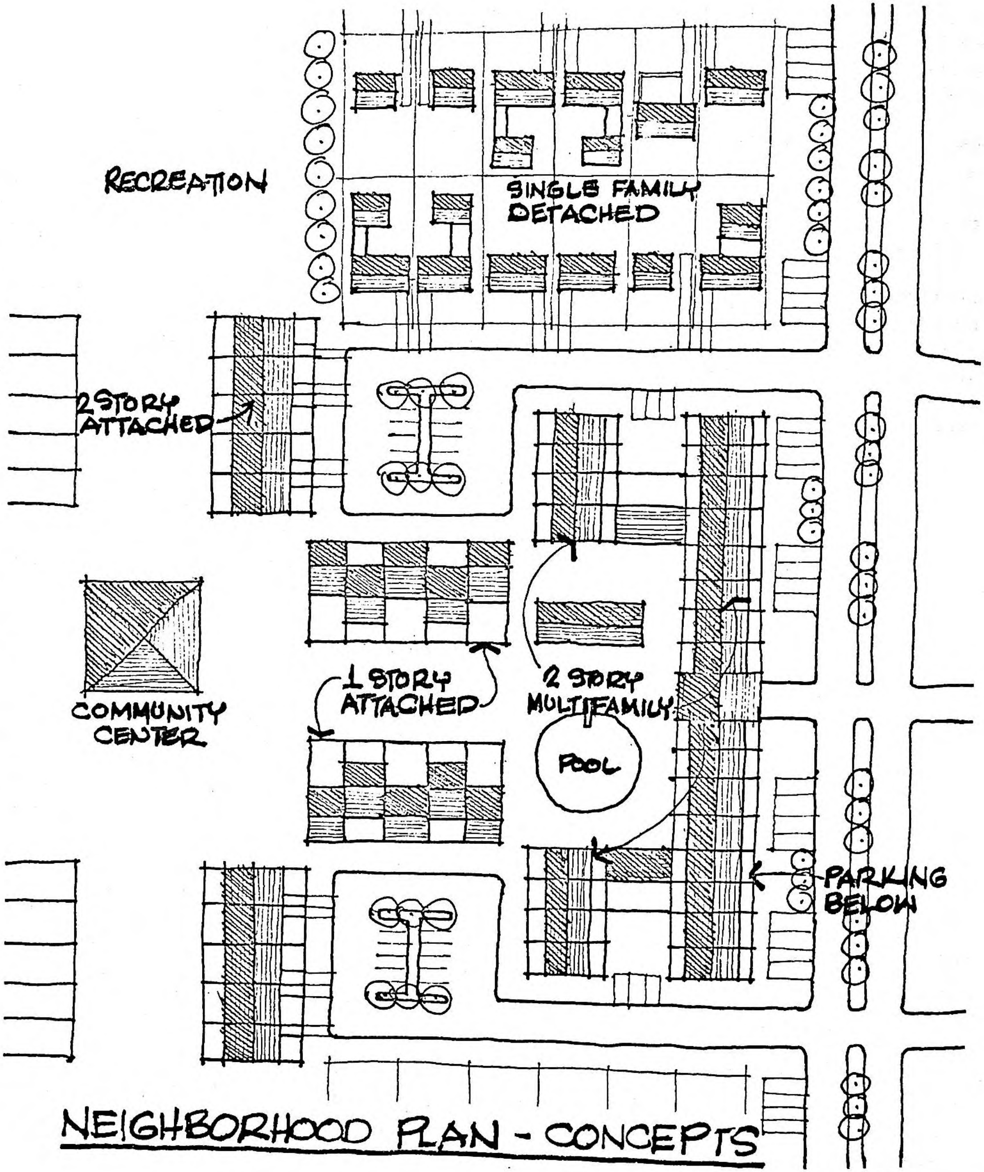
Gypsum Panel Systems, Houston, Texas, Kendrick/Gate Associates, Architects; H. A. Lott, Inc., Contractor

Flexibility is the keyword in this modular load-bearing gypsum panel system. Economies are realized through rapid factory output of components formed from readily available gypsum board; it is estimated a four-man crew can complete one housing unit every 15 days at a minimum 200-unit per year rate, including fabrication of all modular components.

A use emphasis is placed on temporary housing for persons displaced in rehabilitation areas, although the system lends itself to providing single-family attached and detached, and multifamily low-rise types. Architecturally, flexible open-plan variations are offered, and tenants are able to make partition adjustments to rearrange space within certain limits.

The basic structural element is a modular, load-bearing 4-ft. x 8-ft. x 2 5/8-in. gypsum board wall panel with 1 5/8 in. thick, 6 in. wide gypsum board splines at edge and center. Roof panels, also gypsum board, measure 2 ft. x 8 ft. x 2 in. and carry 1-in. x 6-in. gypsum board ribs at edge and center. Tests are proposed on wall panels 4 ft. x 10 ft. x 2 5/8 in. Structural spanning beams at 4 ft. on center bear at wall panel junctions, and panels placed at right angles to the bearing walls provide lateral bracing. There is a two-story height limit.

Roof panels attach directly to beams at 4 ft. on center and wall panels are nailed to base channels, which, in turn, are anchored to the floor system. Flat or sloping roof styles are optional. Exterior finishes can be varied, with stucco over metal lath presently available; synthetic coatings will be tested for exterior application. Thermal insulation is introduced between the outer layers of gypsum board when required. Interiors feature painted walls and ceilings, resilient floor coverings, and exposed ceiling beams. Slab-on-ground foundations, with grade beams or perimeter types optional, are specified.

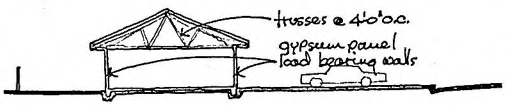


To hold costs at the lowest possible level, the basic unit includes only plumbing fixtures, kitchen cabinets and certain built-in appliances; additional built-ins will be offered for installation during construction or later. Electrical wiring in panels is of the nonmetallic sheathed cable type, with rigid conduit specified for placement in concrete or below-grade. Wiring and outlets in panels are factory-installed; plumbing assemblies are fabricated, and plastic pipe is proposed for all but hot water lines.

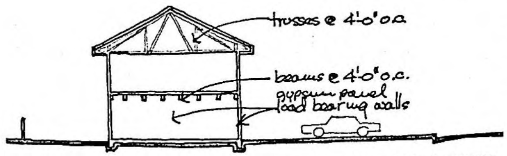
An innovative bathroom finish calls for a special waterproof coating applied to gypsum board panels for the walls and ceiling subsystem, with a fiberglass shower/tub assembly. An integrated, conventional heating-cooling system is specified, with the energy source either gas or electricity. In rental or condominium complexes, central heating-cooling plants are suggested, with air handling equipment for each unit.

Panels can be mass produced in remote areas, or onsite with minimum capital investment, and little skilled labor would be required either for plant output or unit erection. A panel-fabricating factory is located onsite where 50 or more dwelling units are to be erected; otherwise panels are shipped from permanent production facilities.

A feature of the plan is to job-train local labor, including tenants, for site preparation and erection of dwellings, supplementing that training with instruction manuals. The proposer has arranged for community involvement in the planning process and will subcontract unit erection work to local firms, providing technical assistance from the central corporation.



SINGLE FAMILY 1 STORY DETACHED



SINGLE FAMILY 2 STORY DETACHED

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	4 TO 30 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATURAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	OUTDOOR POOL; COMMUNITY CENTER; SHOPPING/SERVICE FACILITIES
7 Circulation	SEPARATE PEDESTRIAN CIRCULATION; PRIMARY & SECONDARY ARTERIES; CUL-DE-SACS
8 Site Planning Services	ARCHITECT-PLANNER WITH PROPOSER ORGANIZATION
9 Community Involvement	MARKET & USER SURVEYS
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTI-FAMILY LOW-RISE
12 Unit Variations	2 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEMS: DESIGN STAGE; PRODUCTION PLANT: DESIGN STAGE
15 Community Involvement	USER SURVEYS; PROTOTYPE TESTING WITH INDIGNIOUS USERS

BUILDING SUBSYSTEMS

16 Structure	GYPSUM-BOARD WALL & ROOF PANELS; FLOOR & ROOF BEAMS; TRUSSES FOR SLOPED ROOFS
17 Exterior Elements	WALLS—STUCCO OVER METAL LATH OR SYNTHETIC COATINGS
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS OR ELECTRIC HEATING-COOLING SYSTEM FOR BUILDING OR INDIVIDUAL UNIT
21 Plumbing	PLASTIC PIPING AS APPROVED FOR COLD WATER SUPPLY & FOR DRAINAGE; PREASSEMBLED
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEMS
23 Furnishings	

PRODUCTION

24 Offsite Production	PANELS; PLUMBING ASSEMBLIES; ROOF TRUSSES OR BEAMS
25 Onsite Production	OPTIONAL PANEL FABRICATION ON SITES OF 50 OR MORE UNITS
26 Onsite Construction	FOUNDATIONS; ERECTION OF PANELS & ROOF ELEMENTS; FINISHES
27 Labor	UNSKILLED & SEMI-SKILLED FOR PLANT FABRICATION; SKILLED FOR UTILITY HOOK-UPS
28 Labor Training Programs	ON-THE-JOB TRAINING FOR ONSITE LABOR INCLUDING TENANT SELF-HELP
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP LABOR

ECONOMICS

30 Construction Costs	$8.963 TO $13,282 PER UNIT
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURAL & ELECTRICAL SYSTEMS—30 YEARS; MECHANICAL SYSTEM—15YEARS

MANAGEMENT

33 Proposer Organization	JOINT VENTURE
34 Internal Functions	MANAGEMENT; FINANCE; DESIGN AND ENGINEERING; COST ESTIMATING, CONSTRUCTION
35 External Functions	PRODUCTION OF GYPSUM BOARD MATERIALS
36 Market Area	
37 Delivery Rate	200 DWELLING UNITS PER YEAR, MINIMUM
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO NATIONAL MODEL CODES

HA-FE-BI-RI

PROPOSER CONSORTIUM

HA-FE-BI-RI, Stamford, Connecticut
Housing Advisory and Building Service
Architectural Products
Victor H. Bisharat
F. D. Rich Company, Inc.

This proposal involves an existing system of cast-in-place load-bearing reinforced concrete structures. The method has been confined to the building of high-rise apartments but is readily adaptable to low-rise buildings as well. Practical height limitation is 30 stories or 280 ft. The system has been tested by the consortium in the Puerto Rico market.

The unusual feature, developed by the proposer is use of precision-made steel formwork in rectangular tunnel sections for in-place casting of structural concrete. The forms are fabricated in one- or two-room widths and conventional ceiling height. Some economies are gained through rapid site placement of concrete after the steel forms have been positioned by tower crane. The forms are insulated with 2-in. or 3-in. polyurethane, which retains heat generated by the curing concrete. This further reduces construction time, lowering support time of the frames from several days to only 13 hours. Electric heating pads are also employed for winter work.

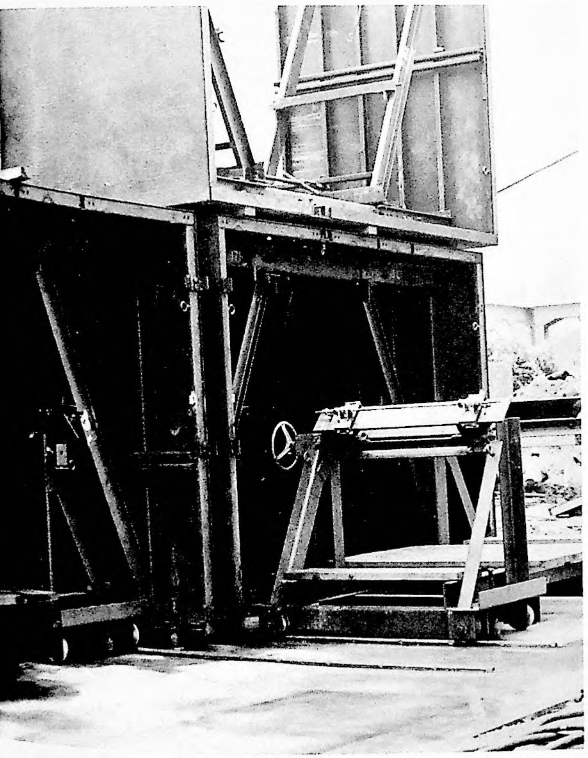
Partition walls, staircases, and plumbing subsystems are prefabricated, practically eliminating the need for skilled tradesmen onsite. Emphasis is placed on the reduction of overall labor costs through the use of factory production methods onsite. Local materials and local labor are used to a large extent.

In design, the system frees the architect from modular restrictions through almost limitless component variations. Dimensions can be changed from floor to floor through form adjustment onsite.

Structurally, the monolithic shear-wall technique employed offers hurricane and earthquake resistance and requires no fitting, patching, or grouting. Cured wall and ceiling surfaces are ready for paint, wallcovering, or texture treatment, and all interior work—partitions, cabinetry, stairs, and trim lends itself to controlled dimensioning.

Bathroom and kitchen modules are not part of this system, but such modules can be incorporated easily because of the precise nature of the system itself. Pipes, conduits, and utility boxes are fastened to the forms and cast in the concrete walls and slabs. All duct openings are framed out without weakening the basic structure. Conventional foundations are specified and location can be on a wide variety of soil conditions.

The proposal describes a self-help feature, employment of apprentices for the installation of trim, cabinets, floor tile, and electrical and plumbing fixtures; local contractors, subcontractors and labor would be employed, stressing use of neighborhood manpower. An on-job training program is mentioned.



Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	WITHIN CONSORTIUM
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY HIGH-RISE; ADAPTABLE TO MULTIFAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	SYSTEM DEVELOPED & MARKETED (PUERTO RICO)
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	CAST-IN-PLACE LOAD BEARING REINFORCED CONCRETE
17 Exterior Elements	NONSTRUCTURAL EXTERIOR WALLS
18 Interior Elements	PARTITIONS; STAIRCASES
19 Foundations	CONVENTIONAL
20 Comfort Systems	INTEGRATED IN BUILDING SYSTEM; MODULAR MECHANICAL COMPONENTS CAN BE ADAPTED
21 Plumbing	INTEGRATED IN BUILDING SYSTEM; MODULAR MECHANICAL COMPONENTS CAN BE ADAPTED
22 Electrical	INTEGRATED IN BUILDING SYSTEM; MODULAR MECHANICAL COMPONENTS CAN BE ADAPTED
23 Furnishings	
PRODUCTION	
24 Offsite Production	PREFABRICATED PARTITION WALLS, STAIRCASES, PLUMBING SUBSYSTEM
25 Onsite Production	
26 Onsite Construction	ERECTION OF FORMS & PLACING OF CONCRETE
27 Labor	UNSKILLED & SEMISKILLED
28 Labor Training Programs	TRAINING FOR IN-PLACE CONSTRUCTION
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP
ECONOMICS	
30 Construction Costs	
31 Financing Methods	CONVENTIONAL
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	400 DWELLING UNITS PER YEAR—MINIMUM; NO MAXIMUM LIMIT
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	STEEL FRAMEWORK FOR CASTING IN-PLACE STRUCTURAL CONCRETE
40 Codes	

Roger Halle

PROPOSER

Roger Halle, Research Architect, Pound Ridge, New York

AFFILIATES

Wm. F. Pedersen & Associates, Architects; Severud-Perrone-Sturm-Conlin-Bandel, Structural Engineers; Fred Fischer Engineering, Structural Engineers; Jaros, Baum & Bolles, Mechanical Engineers; McKee-Berger-Mansueto, Inc., Construction Cost Consultants.

Dividing the building process into three parts—steel structure, enclosure elements, and mechanical services—this proposal results in a simple, flexible, complete system. The small number of conveniently sized modular components can be mass-produced in the factory, easily distributed, chosen from design tables and catalog, and readily transported to sites, where they can be variously arranged, as desired, and rapidly assembled, largely by unskilled labor. The system is adaptable not only to all types of housing, but also for community-use buildings, schools, and offices, up to, in its present stage of development, four stories in height.

Because of its flexible, component nature, the system is well suited to a variety of marketing means, and for use either by small local builders, with local labor and community real estate, financial or legal interests, in accordance with conventional practices, or by large developers, and for modest individual buildings, as well as for large programs.

The key feature of the system is its patented central joint. This is a separate structural element that joins beams and columns and is a universal joint for construction. It greatly simplifies procedures and substantially reduces the number of different parts needed to achieve a wide range of building plans.

The system is based upon center-line dimensioning and standard depth of beams and width of beams and columns, the 3-ft., 4-in. horizontal planning grid, and a 7-ft., 1/4-in. vertical module. All components—beams and columns, wall, floor, and roof panels, window and door elements, and stair units—relate to these basic dimensions.

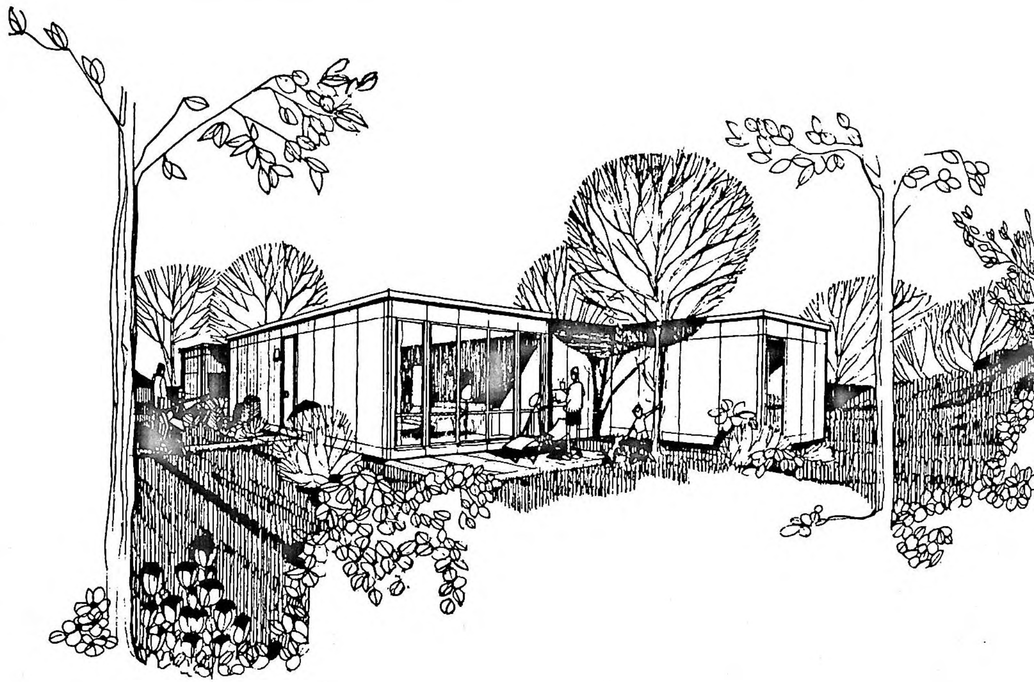
The principal structural components consist of lightweight open-web steel beams of standard depth and width, square-tube columns the same width as the beams, and the central joint. Two men, with screwdriver and wrench, can rapidly assemble the entire structural frame, without heavy or costly equipment. Only one size bolt is used, and the parts are so designed that they cannot be fit together incorrectly. All horizontal joints are capable of lateral adjustment to correct any dimensional field errors.

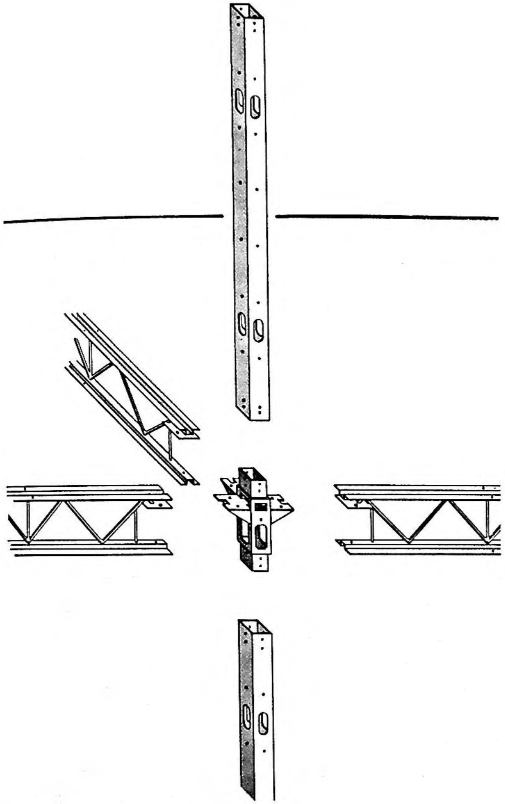
The enclosure elements apply directly to the structure, with exterior and interior wall panels secured with simple attachment devices in a pattern of prepunched holes in the structure. If desired, they can be removed, replaced, and reused elsewhere. These panels can be of many materials—plywood, board materials, metal or plastic—and thus can be of many colors and textures and achieve a wide variety of appearances.

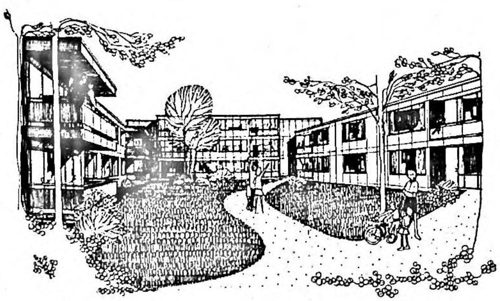
A universal floor and roof panel is used. The hollow steel structure and walls allow space for desired thermal or acoustic insulation, and for ready passage of electrical and small-size plumbing lines. The space provided by the open-web beams in the roof structure can be used for the same purposes, and also for ducts.

Lighting fixtures of many types can be used, with fixtures and outlets incorporated in the standard panels. Also, heating and air-conditioning equipment and bathroom and kitchen units can be accommodated within the planning grids and readily installed at the sites.

Foundations can be of any conventional types, and the structure erected on any terrain or contours.







Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN; RURAL
2	Density Range	VARIES
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	FLEXIBLE SYSTEM ALLOWS VARIETY OF PLANNING CONCEPTS
6	Nonresidential Functions	COMMUNITY-USE BUILDINGS, SCHOOLS, OFFICES, ETC.
7	Circulation	FLEXIBLE SYSTEM ALLOWS FOR VARIETY OF CIRCULATION PATTERNS OR SPACES
8	Site Planning Services	PROFESSIONAL SERVICES
9	Community Involvement	LOCAL PROFESSIONALS & BUSINESSES CAN PARTICIPATE
10	Utilities	CONVENTIONAL OR INNOVATIVE

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE (FUTURE)
12	Unit Variations	FLEXIBLE, LIMITED ONLY BY PLANNING GRID
13	Design Selection	FLEXIBLE, LIMITED ONLY BY PLANNING GRID
14	State of Development	BUILDING SYSTEM BASIC DESIGN & ENGINEERING COMPLETED; PROTOTYPE CONSTRUCTED
15	Community Involvement	COMMUNITY CAN BE INVOLVED IN PLANNING & DESIGN PROCESS

BUILDING SUBSYSTEMS

16	Structure	INTEGRATED MODULAR, STEEL FRAME, WITH PATENTED UNIVERSAL JOINT
17	Exterior Elements	MODULAR WALL & ROOF PANELS; MODULAR WINDOW & DOOR UNITS
18	Interior Elements	MODULAR WALL, PARTITION, FLOOR AND CEILING PANELS; DOOR UNITS
19	Foundations	CONVENTIONAL
20	Comfort Systems	CONVENTIONAL OR INNOVATIVE, INTEGRATED WITH BUILDING SYSTEM
21	Plumbing	CONVENTIONAL OR INNOVATIVE; SERVICES INTEGRATED WITH BUILDING SYSTEM
22	Electrical	CONTINUOUS-HOLLOW STRUCTURE USEABLE FOR PASSAGE OF WIRING
23	Furnishings	

PRODUCTION

24	Offsite Production	STRUCTURAL & ENCLOSURE COMPONENTS; MECHANICAL UNITS
25	Onsite Production	
26	Onsite Construction	FOUNDATION; BUILDING ASSEMBLY; ROOFING; MECHANICAL INSTALLATIONS
27	Labor	IN FACTORY, SKILLED; ONSITE, LARGELY UNSKILLED
28	Labor Training Programs	SPECIAL TRAINING FOR ONSITE WORK ESSENTIALLY UNNECESSARY
29	Community Involvement	LOCAL BUILDERS CAN PARTICIPATE; SELF-HELP ASSEMBLY POSSIBLE

ECONOMICS

30	Construction Costs	PROJECTED SAVINGS OVER CONVENTIONAL CONSTRUCTION
31	Financing Methods	CONVENTIONAL OR INNOVATIVE
32	Useful Life	SAME AS CONVENTIONAL CONSTRUCTION

MANAGEMENT

33	Proposer Organization	PROFESSIONAL
34	Internal Functions	CENTRAL RESPONSIBILITY, DESIGN
35	External Functions	SALES, PRODUCTION, CONSTRUCTION
36	Market Area	UNLIMITED
37	Delivery Rate	UNLIMITED
38	Consumer Protection	MANUFACTURER & CONTRACTOR GUARANTEES

GENERAL

39	Major Innovative Concepts	BUILDING SYSTEM: UNIVERSAL STRUCTURAL JOINT, UNIVERSAL FLOOR & ROOF PANEL
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Hanover Modular Homes

PROPOSERS

Hanover Modular Homes, International, Inc., College Station, Texas

Cerf-Sanford-Ross, Inc., Architects-Engineers-Consultants, College Station, Texas

Steel pipe is used to frame the volumetric modules, which are moved to the site completed, ready for occupancy, and are joined together to form the single- and multifamily dwelling units of this system. The modules, which are room-wide, and in lengths of 28 ft., 40 ft. and 52 ft., in varying combinations, may be stacked two high to form conventional-appearing detached or attached houses, even to a peaked roof. Only the connection of utilities is required at the site; all other work is done in the factory at a significant savings in labor.

Basic to the system is the use of 1¼-in. diameter corrosion-resistant black pipe to make up the structural framework. Made up in jigs, computer programmed, and automatically welded, the steel pipelengths are assembled into room-sized volumetric shapes, to which are fastened flooring, external siding, interior walls, ceiling, and roof in a highly unitized, assembly-line method which saves 75 percent in labor costs. Although the steel pipe costs more per linear foot than other material might, savings result because fewer linear feet are necessary due to the pipe's greater structural strength.

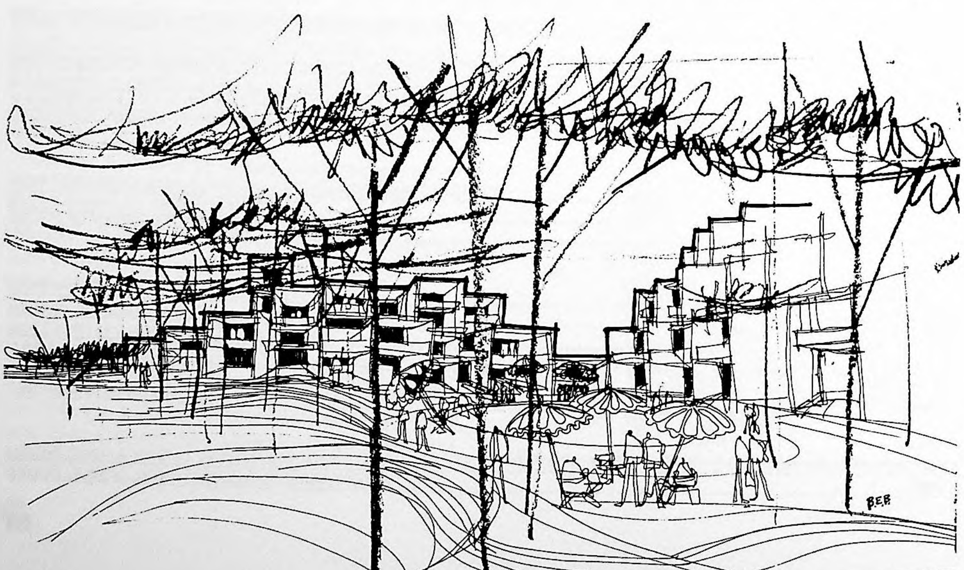
A special feature of the proposer's high-speed assembly of cladding and other components to the pipe frame is the snap sleeve. This is a split circular sleeve of plastic Cycolac which, when snapped over the 1¼-in. pipe, grips it with a tenacity equivalent to nailing, and can provide a holding capacity of about 60 lb. Six of these snaps, bonded by high-strength adhesive to the other dimensions of a section of wall or floor panel, are used to "snap" or fasten each panel securely to the pipe frame.

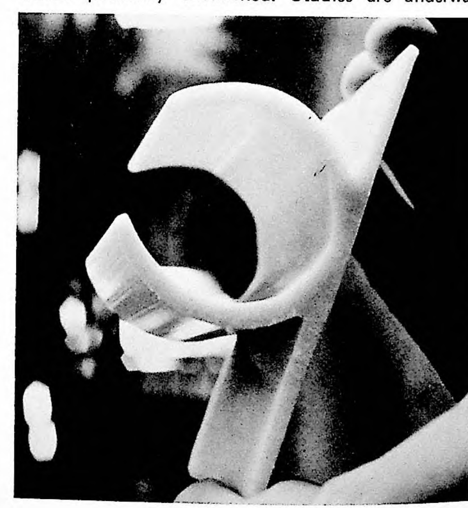
Standard exterior siding for the modules is roughtex cedar plywood, but prefinished siding, painted siding, or brick veneer may be specified. Interior walls typically are mahogany-type 4-ft. X 8-ft. paneling. Subflooring for the modules is built up with 1-in. X 4-in. furring strips snapped to the frame, 3/8 in. of mineral wool insulation, and 5/8 in. of plywood or particleboard. This is subsequently finished with vinyl tile or carpeting.

The ceiling is suspended acoustical tile throughout, with the roof deck (also snapped to the gabled framework) being 3/8-in. plywood, sprayed-in insulation, and 5-ply built-up roofing. Interior trim, built-in kitchen cabinetry, and bathroom fixtures are included in the house's purchase price and are factory-installed.

Also included is electric baseboard heating, with central air conditioning being an option. All mechanical services, including possible use of wiring harnesses to reduce costs further, is to be accomplished on the factory assembly line. Wiring will be nonmetallic flexible cable or conduit, and will be hooked up to the lighting equipment. Galvanized steel and copper tubing for hot and cold water supply, and PVC plastic and cast iron draining lines are used for built-in plumbing.

Foundations for the pipe-framed modules may be piles or perimeter grade beams for the 2-story developments presently envisioned. Studies are underway,

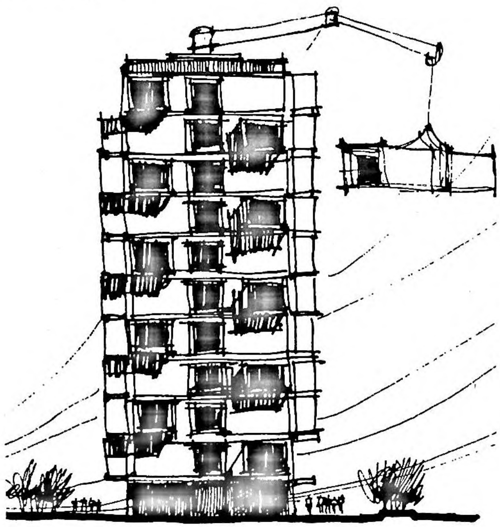




however, to use the modules in niches or slots of high-rise structural frames, the foundations of which would be custom-designed for the loading anticipated.

Because of the computerized, highly rationalized approach to modular manufacture through which the proposer anticipates delivering quality housing at substantial savings, he does not envision, or even encourage, any potential for self-help or local labor—especially in the plant, or during site erection. But after the modules have been placed and joined and utilities hooked up, the proposer acknowledges that modification might be possible by the occupant. It is suggested that the community (or a group of inhabitants) might establish a "parts" store at which could be purchased walls, windows, and perhaps even entire bedroom kits for additions.

Another potential for such community involvement exists in the possible organization of incorporated community action groups to set up local plants for production of the modules. The proposer sees the need for 50 module production plants across the country, ideally within a 200-mile shipping radius of the sites; although more sophisticated shipping and handling techniques and better highways could increase that rather arbitrary limit. One plant for module manufacture already is in existence.



Summary Information

SITE SYSTEM	
1 Site Situation	URBAN, URBAN RENEWAL, SUBURBAN, RURAL
2 Density Range	1,703 PERSONS PER GROSS ACRE
3 Topography	
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	INWARD TURNING CONCEPTS WITH NEIGHBORHOOD CELLS, COMMON OPEN SPACES
6 Nonresidential Functions	CIVIC CENTER; PARK
7 Circulation	CUL-DE-SAC
8 Site Planning Services	
9 Community Involvement	ENVIRONMENTAL DEVELOPMENT
10 Utilities	

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION FACILITIES—BUILT & OPERATIONAL; ADDITIONAL PLANTS PROPOSED
15 Community Involvement	ADAPTABLE TO OCCUPANTS DESIRES

BUILDING SUBSYSTEMS	
16 Structure	STEEL PIPE-FRAME SYSTEM; SNAP-ON WALL, FLOOR & CEILING PANELS
17 Exterior Elements	ROUGHTEX CEDAR PLYWOOD SIDING OR CONVENTIONAL FINISH SIDING
18 Interior Elements	MAHOGANY PANEL; PLYWOOD OR PARTICLEBOARD SUBFLOOR; VINYL TILE; ACOUSTICAL CEILING
19 Foundations	CONVENTIONAL
20 Comfort Systems	ELECTRIC BASEBOARD HEATING; CENTRAL AIR CONDITIONING OPTIONAL
21 Plumbing	BATH & KITCHEN FIXTURES FACTORY INSTALLED: PVC & CAST IRON PIPE FOR DRAINAGE
22 Electrical	WIRING PREPACKAGED
23 Furnishings	

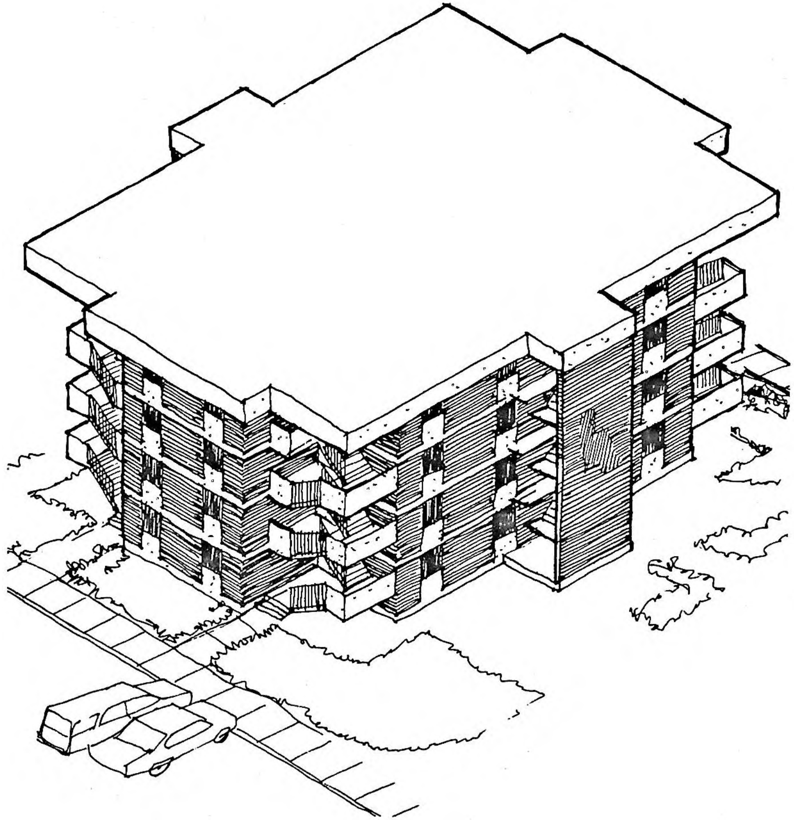
PRODUCTION	
24 Offsite Production	FRAME & OTHER MODULAR COMPONENTS
25 Onsite Production	ADAPTABLE TO ONSITE PRODUCTION PLANTS
26 Onsite Construction	FOUNDATIONS; COMPONENT ASSEMBLY; UTILITY INSTALLATIONS & HOOKUPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	DEVELOPMENT OF FRANCHISED COMMUNITY CORP. FOR ONSITE PRODUCTION PLANT

ECONOMICS	
30 Construction Costs	$5.21 PER SQ. FT.
31 Financing Methods	
32 Useful Life	50% LONGER THAN AVERAGE RESIDENCE

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	
35 External Functions	
36 Market Area	200-MILE RADIUS
37 Delivery Rate	
38 Consumer Protection	

GENERAL	
39 Major Innovative Concepts	FRAMING SYSTEM, CIRCULAR PLASTIC SLEEVE FOR JOINING
40 Codes	NATIONAL ELECTRIC CODE; MATERIALS AND EQUIPMENT—UNDERWRITER'S LABORATORY

Harrell-Hutton-Wrighton and Associates



PROPOSER

Harrell-Hutton-Wrighton and Associates, Hickory, North Carolina

Wood-framed, conventionally designed, factory-completed modules, are the basis for this proposal. A center hall, created by use of spacer plates and some framing, permits considerable variation in interior arrangement.

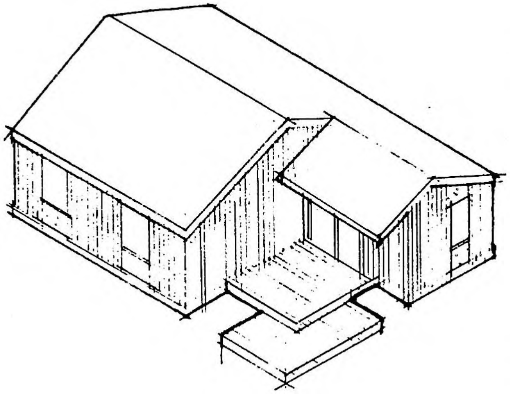
Basic module size (to facilitate road transportation) is 12 ft. wide, with lengths of 14 ft. and 28 ft.—thus making possible variation on final assembly by interposing modules of different lengths.

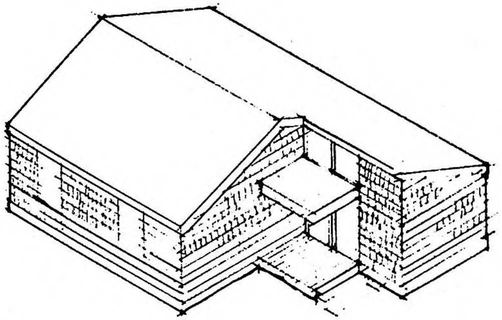
Each module is designed to be individually self-supporting, and to support stacked modules up to and included three stories in height without superstructure, depending for structural support on flat panel, stress-skin plywood floor and ceiling systems, and truss-braced wood stud exterior walls. Exterior walls—built as a truss structure with the plywood sheathing—are based on 2-in. x 4-in. framing, with final exterior finishes of plywood, shake shingles, or veneers that may be installed either in plant, or in the field.

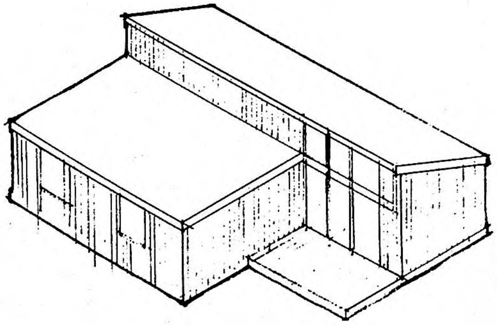
The roof structure makes use of trussed rafters, 1/2-in. plywood sheathing, and felt and shingles on sloped roofs or slag-surfaced built-up roofing on flat decks. In low-rise structures, module ceiling construction is 3/8-in. plywood panels top and bottom, glue-laminated to a 2-in. x 4-in. framing, spaced 16 in. on center. All floors are 5/8-in. exterior grade plywood top panel, and 3/8-in. exterior grade plywood bottom panel, glue-laminated to 2-in. x 6-in. framing lumber (also 16-in. on center).

In general, thermal insulation is mineral wool (with installed resistance factors of R-19 in attic spaces, R-11 at exterior and party walls, and R-13 at floor spaces adjacent to the exterior. Interior finish materials include vinyl sheet flooring, gypsum board walls and ceilings.

Basically, two methods of heating are considered: either a warm-air duct system from a central source; or electric radiant heat in ceilings. Either system is planned as a sub-element which would be preassembled and factory installed to the degree practical. The individual forced air system includes a furnace with preassembled ducts installed in the hall ceiling spacer unit, acting as a plenum, with flexible-tubing ducts to serve the modules. The furnace itself is located in a closet adjacent to the exterior wall, with direct air return.







Summary Information

SITE SYSTEM

1	Site Situation	URBAN, SUBURBAN
2	Density Range	8 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; ESPECIALLY SUITABLE TO SOUTHEASTERN STATES
5	Planning Concepts	
6	Nonresidential Functions	RECREATIONAL, SOCIAL & COMMERCIAL FACILITIES
7	Circulation	
8	Site Planning Services	BY PROPOSER
9	Community Involvement	
10	Utilities	UNDERGROUND ELECTRICAL SERVICE

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE; ADAPTABLE TO HIGH-RISE
12	Unit Variations	1 TO 3 BEDROOMS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION FACILITY & BUILDING SYSTEM IN DESIGN STAGE
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WOOD FRAME MODULES, SELF-SUPPORTING BELOW 3 STORIES — SKELETON FRAME FOR HIGH-RISE
17	Exterior Elements	
18	Interior Elements	HIGH-RISE STAIR TOWER; ELEVATOR; CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL
20	Comfort Systems	CENTRAL HEATING INTEGRATED WITH BUILDING SUBSYSTEM; SEPARATE COOLING SYSTEM
21	Plumbing	INTEGRATED WITH BUILDING SYBSYSTEM; PLASTIC PIPE
22	Electrical	FACTORY FABRICATED FOR FIELD INSTALLATION; INTEGRATED WITH BUILDING SUBSYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	MODULES INCLUDING MECHANICAL, ELECTRICAL, AND PLUMBING SYBSYSTEMS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS, ERECTION OF MODULES, FRAME FOR HIGH-RISE
27	Labor	SEMISKILLED AND UNSKILLED; MINIMUM NUMBER OF SKILLED WORKERS
28	Labor Training Programs	TRAINING MINORITIES IN REAL ESTATE & SALESMANSHIP
29	Community Involvement	TENANT INVOLVEMENT IN MAINTENANCE & REPAIR; LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	$16,250 FOR PROTOTYPE
31	Financing Methods	CONVENTIONAL
32	Useful Life	STRUCTURE — 50 YEARS

MANAGEMENT

33	Proposer Organization	FRANCHISE ORGANIZATION
34	Internal Functions	DESIGN; RESEARCH; MANUFACTURING
35	External Functions	CONSTRUCTION; PLANT DESIGN; ADVERTISING
36	Market Area	
37	Delivery Rate	18 MODULES (4 1/2 DWELLING UNITS) PER DAY
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Hercules, Inc.

PROPOSER

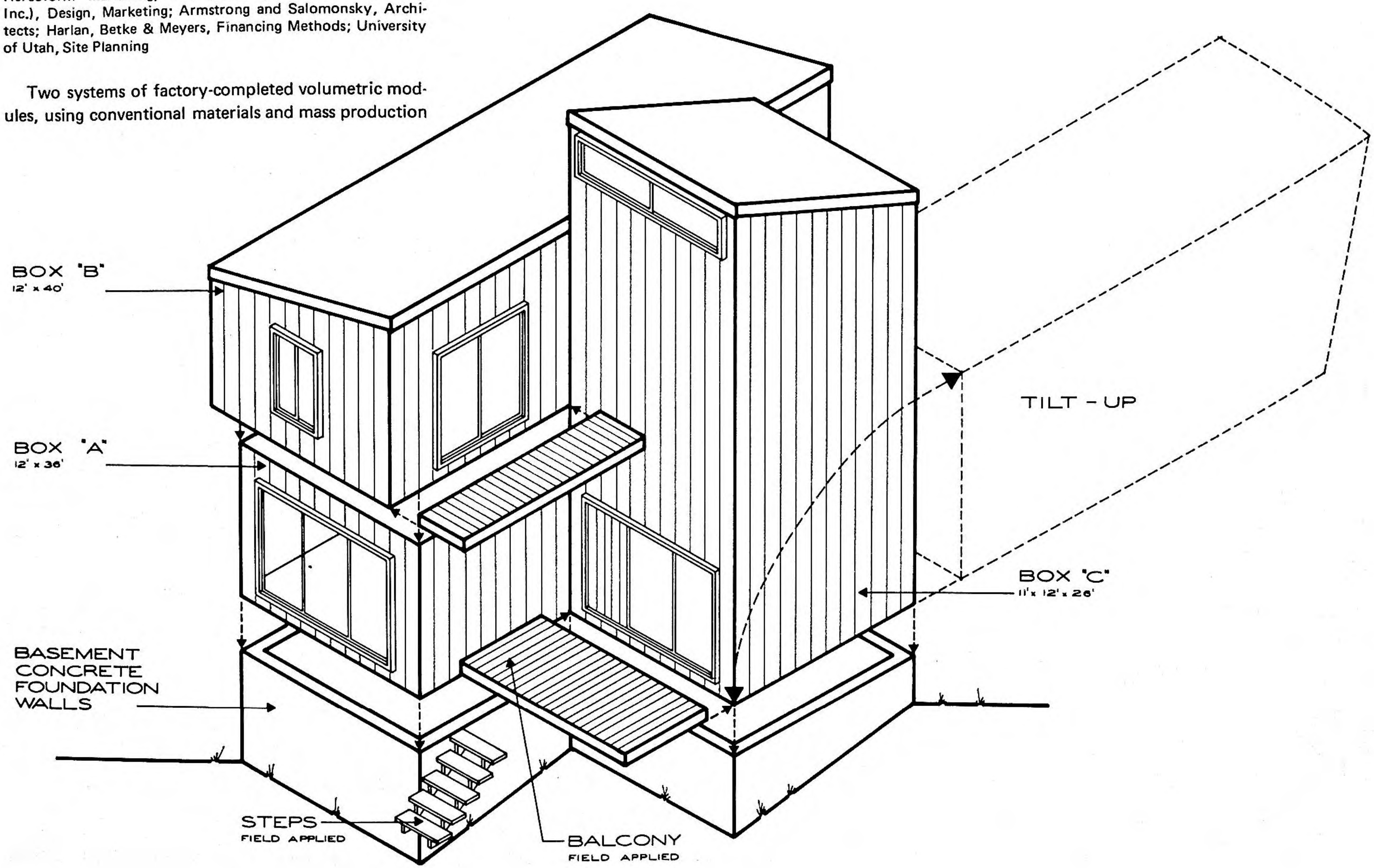
Hercules, Inc., Wilmington, Delaware

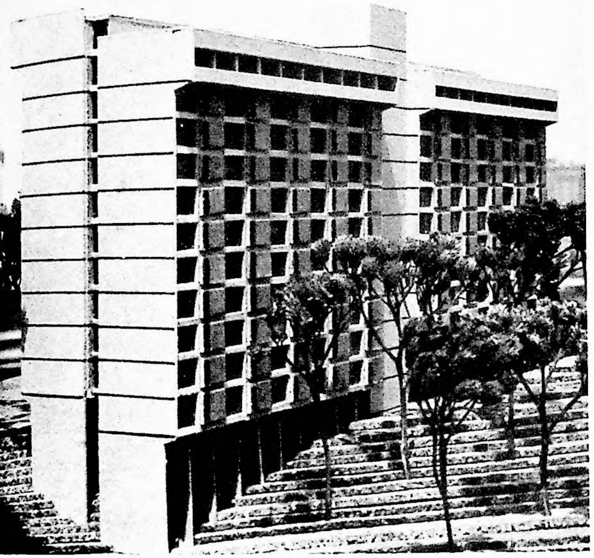
AFFILIATES

Hercoform Marketing, Inc. (formerly Modular Structures, Inc.), Design, Marketing; Armstrong and Salomonsky, Architects; Harlan, Betke & Meyers, Financing Methods; University of Utah, Site Planning

Two systems of factory-completed volumetric modules, using conventional materials and mass production fabrication techniques, are the central thrust of this proposal. The modules are a maximum of 12 ft. wide, 11 ft. high, and up to 60 ft. long, and are joined together onsite. A variety of architectural types, with price ranges based on choices of components and materials, as well as living space and siting adaptabilities, is possible through multiple configurations of the modules.

The proposed multifamily high-rise structure utilizes a new concept of finished steel wall partitions integral





Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN
2	Density Range	1 TO 400 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; CLUSTER, RECTILINEAR; CURVILINEAR; COMMON OPEN SPACES
6	Nonresidential Functions	RECREATIONAL FACILITIES: TOT LOTS; BARBECUE UNITS
7	Circulation	CURVILINEAR STREET GRID
8	Site Planning Services	SUBCONTRACTOR
9	Community Involvement	LOCAL GOVERNMENT OFFICIALS, PLANNERS & REAL ESTATE
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	MULTIFAMILY HIGH-RISE
12	Unit Variations	1 TO 4 BEDROOMS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	BUILDING SYSTEM IN DESIGN STAGE
15	Community Involvement	ESTABLISHMENT OF RELATIONSHIPS TO LARGER COMMUNITY

BUILDING SUBSYSTEMS

16	Structure	SELF-SUPPORTING STEEL-FRAME VOLUMETRIC MODULE; CAST-IN-PLACE CONCRETE FRAME
17	Exterior Elements	CEMENT ASBESTOS CURTAINWALLS
18	Interior Elements	WOOD STUD & GYPSUM BOARD OR PLYWOOD PARTITIONS
19	Foundations	CONVENTIONAL
20	Comfort Systems	GAS OR ELECTRIC FORCED AIR OR RADIANT HEATING; OPTIONAL INTEGRATED COOLING
21	Plumbing	CONVENTIONAL INTEGRATED WITH BUILDING SYSTEM
22	Electrical	CONVENTIONAL INTEGRATED WITH BUILDING SYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	COMPLETE VOLUMETRIC MODULES
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; CONCRETE FRAMING; PLACING OF MODULES; UTILITY HOOK-UPS
27	Labor	SKILLED, SEMISKILLED, UNSKILLED FOR FACTORY & SITE CONSTRUCTION
28	Labor Training Programs	CONDUCTED BY PROFESSIONAL PERSONNEL
29	Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	
31	Financing Methods	CONVENTIONAL; POTENTIAL DEVELOPMENT OF INTERIM FINANCING METHODS
32	Useful Life	VOLUMETRIC MODULE, FRAMING, FOUNDATION AND UTILITY SERVICES—40 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	DESIGN; PRODUCTION; ASSEMBLY
35	External Functions	LAND PLANNING; FINANCING
36	Market Area	NORTHEAST SECTION OF UNITED STATES
37	Delivery Rate	900 DWELLING UNITS PER YEAR PER PLANT, ONE-SHIFT BASIS
38	Consumer Protection	ONE YEAR WARRANTY ON MODULES

GENERAL

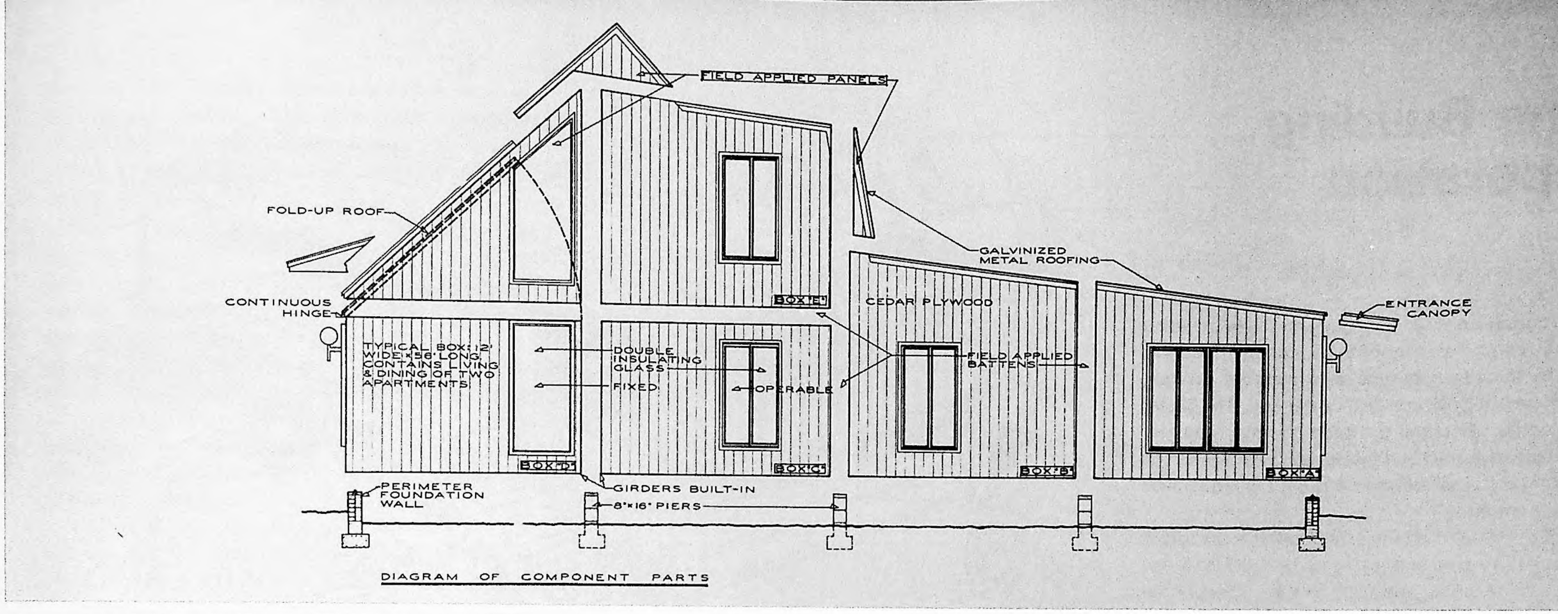
39	Major Innovative Concepts	FRAMING SYSTEM FOR HIGH-RISE: CAST-IN-PLACE CONCRETE INTEGRAL WITH MODULES
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

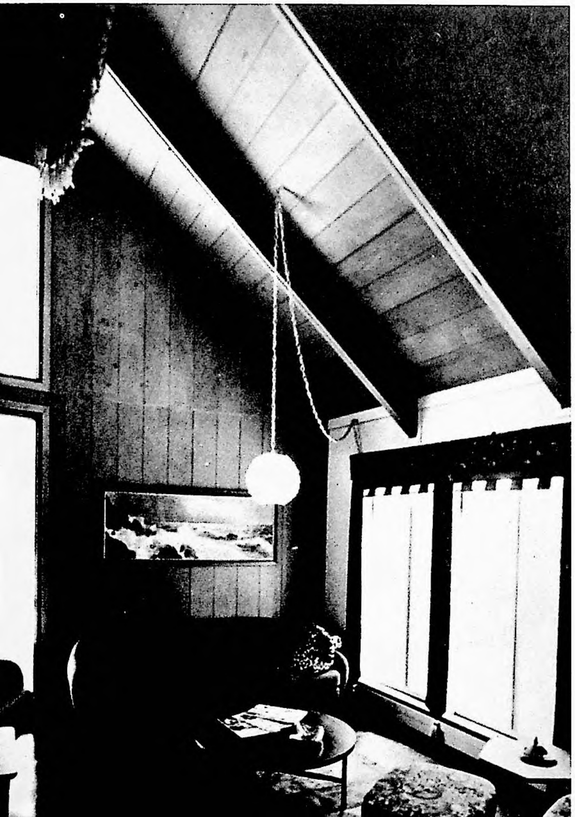
Hercules, Inc. (continued)

with cast-in-place concrete walls. The basic modules provide the concrete forms, and the steel wall components supplement the concrete reinforcement, thereby minimizing site erection costs. The largest modules require two 40-ton cranes for site erection. Rods and eyehooks in the module walls will avoid the necessity for sling pickups. Total installation of facilities, utilities, and final finishes is intended to be at the factory, relying on common utility connections and common foundations to provide for keying the modules together.

Single-family attached townhouses and multifamily low-rise garden apartments are based on a wood-framed modular system. Several single-family homes and resort-condominiums utilizing this system have been erected in Vermont. In Massachusetts, some 130 units were built from 150 modules in 13 days; another 150 units are scheduled for a project in Connecticut.

A program of self-help may be devised for lower-income owners and tenants. For instance, the low-income homeowner might be involved in constructing the foundation as part of the self-help program. However, a local contractor would have to serve in some supervisory capacity to assure quality. The proposer's special expertise in management of large operations, plant design, and mass-production experience should be particularly valuable in the later stages of development.





Low-Rise System

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	ESTABLISHMENT OF RELATIONSHIPS TO LARGER COMMUNITY
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTING WOOD-FRAME MODULE
17 Exterior Elements	PLYWOOD SIDING
18 Interior Elements	WOOD STUD & GYPSUM BOARD OR PLYWOOD PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS OR ELECTRIC FORCED AIR OR RADIANT HEATING; OPTIONAL INTEGRATED COOLING
21 Plumbing	CONVENTIONAL, INTEGRATED WITH BUILDING SYSTEM
22 Electrical	CONVENTIONAL, INTEGRATED WITH BUILDING SYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	COMPLETE VOLUMETRIC MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOK-UPS
27 Labor	SKILLED, SEMISKILLED FOR FACTORY & SITE
28 Labor Training Programs	CONDUCTED BY PROFESSIONAL PERSONNEL
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	\$8.25 TO \$10.50 PER SQ. FT.
31 Financing Methods	
32 Useful Life	VOLUMETRIC MODULE; FOUNDATION & UTILITY SERVICES—40 YEARS

Home Building Corporation

PROPOSER

Home Building Corporation, Sedalia, Missouri.

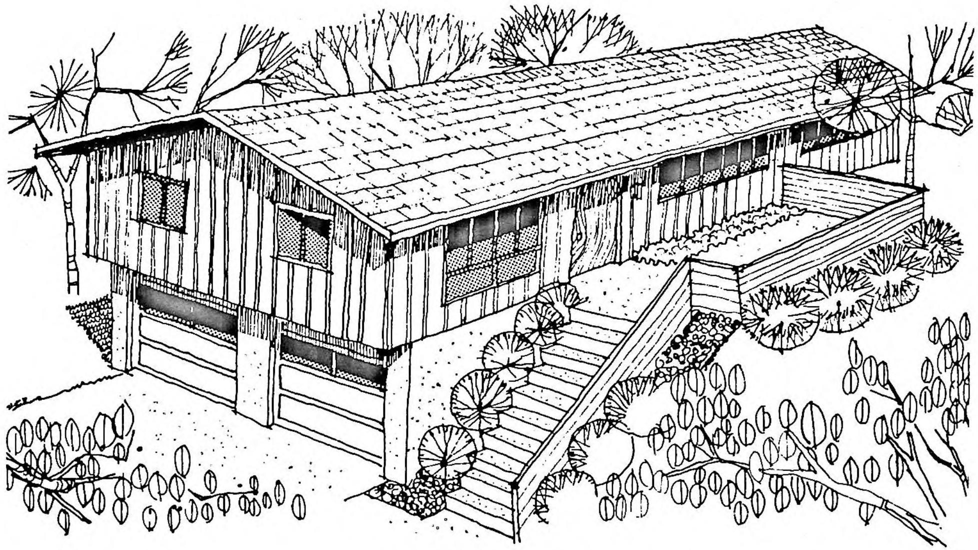
This proposal consists of an industrialized building system that combines factory-built, modular sections, delivered to the site complete with installed utilities, and an unconventional use of a center hall. The center hall, created by offsetting the basic modules, and taking advantage of a post-and-beam structural system, is the key to many possible variations both in appearance and accommodation.

The entire home (with the exception of foundations and onsite utility connections) is to be fabricated and shipped by truck-trailer from the factory. Erection requires a three-man crew for 1 day, once foundations are in place, and a crane operator for 1 hour.

Principal component in the module system is a 4-ft. by room-height panel, which is the basic building block. This standard dimension can be modified to a degree; for example, one panel may be designed to serve as a completely closed interior wall section, but for exterior use can be extended to include a 45-in. x 76-in. thermal-pane window section. The component panels can also accommodate expansion of living units longitudinally, from a minimum of 20 ft. to more than 60 ft.

Exterior wall panels are designed to provide thermal control in any climate. Outer surfaces are usually plywood with a paintable plastic sealer for application at the factory or onsite. A variety of added surfacing is also available, ranging from aluminum-covered plywood to brick and stone. The system makes extensive use of glueing to eliminate nail-popping and similar problems. The inside of the exterior surface carries glued-on fiberglass insulation batts, then an air space, and finally a foil-backed gypsum board (also glued to the studs); thus the panel becomes a sandwich unit.

Roof panels are constructed similarly, with foil-backed gypsum board glued to 2-in. x 4-in. purlins, backed by fiberglass batts, and exterior plywood covering. Two layers of felt and asphalt shingles com-



plete the roof. The roof panels are carried on 4-in. x 8-in. exposed beams, which form both part of the interior decor and the structural system. The paintable interior face of the roof panels serve as the ceiling surface, as well.

The stressed-skin floor sections are created by glueing tongue-and-groove plywood to 2-in. x 6-in. joists 16 in. on center, thus forming a T-beam that has greater strength characteristics than traditional 8 in. joists and eliminating floor squeaking as well. The whole floor section is built around an 8-in. junior I-beam which rests on sitecast foundation piers; the other three sides of the floor panel rest on previously poured concrete foundations and steel beams. The system also can be used on wood-pile foundations, depending on the overall design of the home.

The posts of the structural system are included within the two longitudinal exterior walls and the two walls that form the interior hallway. The perimeter panel studs thus serve as bearing points, and the interior area of the panel supports no more than its own weight. Thus the interior can be modified without weakening the load-bearing structure.

Factory construction includes addition of necessary utility components (electrical and plumbing fixtures and wiring which are fully tested before installation). At the site, erection crews first apply a 1-in. x 3-in. strip of fiberglass insulation to the perimeter of the floor structure to improve the air seal between the foundation and living area. The crane then sets the complete modules in place, to be secured to concrete foundations by steel bands embedded in the concrete at 6-in. centers and nailed to the floor. When a steel grade-beam foundation is used, the beam is bolted to a concrete pier.

Among advantages of the system are acoustical control, achieved through use of floor covering, a design for two-story structures which does not permit joists and beams to touch and thus transfer sound, and the insulation and air space included in each sandwich panel. Double party walls, used in townhouses and apartment variations, are surfaced with two layers of gypsum board, contain additional insulation, and result in a 2-hr. fire rating and a 52-decibel sound rating.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN, SUBURBAN; RURAL
2 Density Range	10 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERING; DENSITY PLANNING; COMMON OPEN SPACES
6 Nonresidential Functions	POOL; PLAY AREA; SOCIAL FACILITIES
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; CUL-DE-SACS
8 Site Planning Services	LOCAL ARCHITECT-PLANNER IN COOPERATION WITH PROPOSER STAFF
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION FACILITIES BUILT; BUILDING SYSTEM DEVELOPED AND MARKETED
15 Community Involvement	COOPERATIVE PLANNING WITH LOCAL COMMUNITY GROUPS; USER NEED SURVEY

BUILDING SUBSYSTEMS

16 Structure	WOOD-FRAME SELF-SUPPORTING MODULES; ROOF PANELS
17 Exterior Elements	WOOD OR COMPOSITION PLASTIC COATED VERTICAL SIDING
18 Interior Elements	WOOD-STUD PARTITIONS WITH GLUED GYPSUM BOARD OR PLYWOOD
19 Foundations	CONVENTIONAL CAST-IN-PLACE CONCRETE; STEEL GRADE BEAM; WOOD PILE
20 Comfort Systems	CONVENTIONAL HEATING, COOLING OPTIONAL, INTEGRAL WITH MODULES
21 Plumbing	CONVENTIONAL; PLASTIC WASTE LINES INTEGRATED WITH MODULES
22 Electrical	CONVENTIONAL, INTEGRAL WITH MODULES, UNDERGROUND OR OVERHEAD DISTRIBUTION
23 Furnishings	

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES; MECHANICAL SERVICES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ASSEMBLY OF VOLUMETRIC MODULES; CONNECTIONS
27 Labor	
28 Labor Training Programs	TRAINING OF UNSKILLED PERSONNEL BY PROPOSER FOR NEW PLANTS
29 Community Involvement	LOCAL SUBCONTRACTORS

ECONOMICS

30 Construction Costs	$10,070 PER DWELLING UNIT
31 Financing Methods	CONVENTIONAL
32 Useful Life	40 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	SYSTEM DESIGN; PRODUCTION
35 External Functions	SITE PREPARATION; FOUNDATIONS; UTILITIES AND CONNECTIONS
36 Market Area	200-MILE RADIUS OF PRODUCTION FACILITIES
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Housing Development Company

PROPOSER CONSORTIUM

Architectural Computer Systems, Inc., Cleveland, Ohio;
Concrete Building Systems Co., Cleveland, Ohio;
John David Management Co., Cleveland, Ohio;
Kinsdale Construction Company, Cleveland, Ohio;
Palevsky Industries, Inc., Cleveland, Ohio;
Thomas G. Snavely Company, Cleveland, Ohio;
Plaskolite Corporation, Cleveland, Ohio;
Zaremba & Sons, Cleveland, Ohio.

AFFILIATES

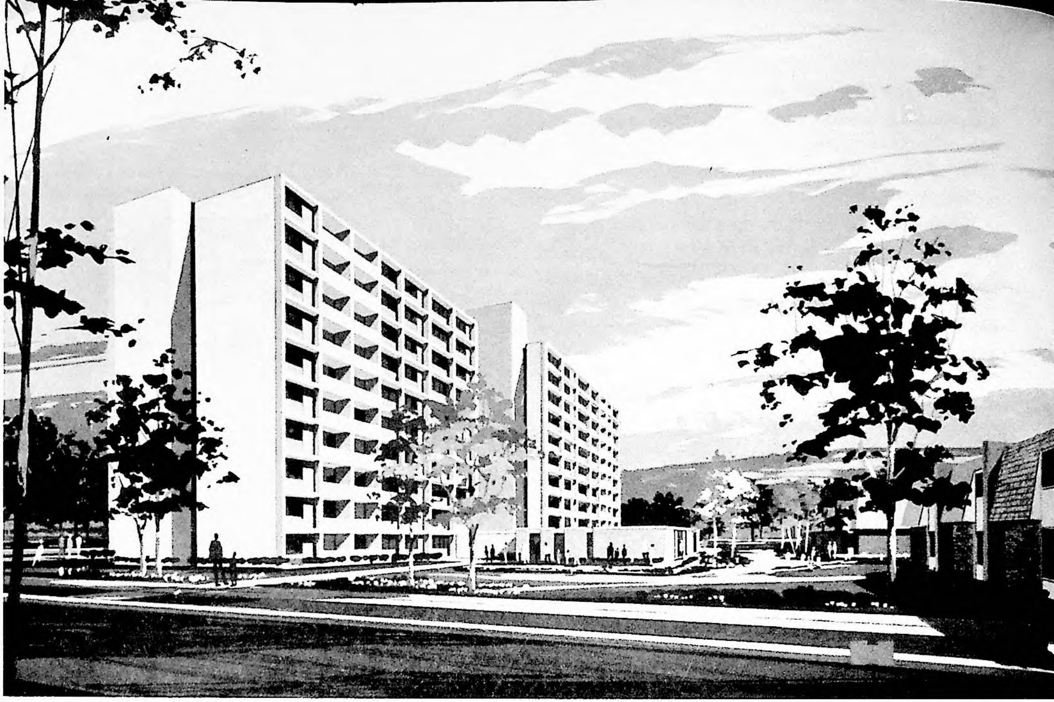
Barber and Hoffman, Structural Engineers; Gregory P. Chacos, Structural Engineer; Damon-Worley-Cady-Kirk, Architects; Don M. Hisaka & Associates, Architects; Walter C. Kretch & Associates, Engineers; David L. Lewin, Soils Engineer; Vincent A. Lombardi, Electrical Engineer; Madison-Madison-Madison, Architects; Whitley and Whitley, Architects and Planners.

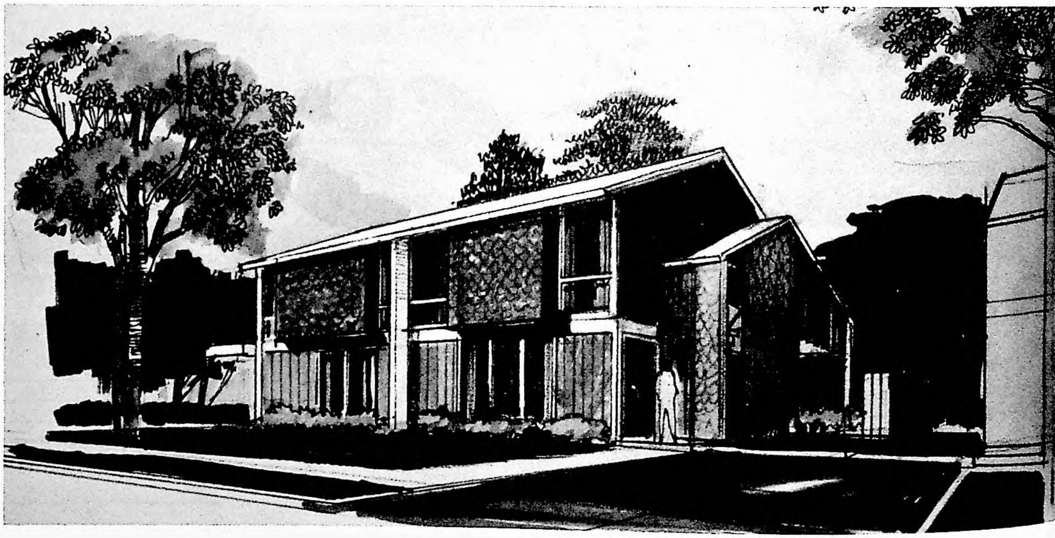
A combination of cast-in-place concrete to provide the structural frame, factory-supplied infill walls and partitions, and factory-fabricated modules for kitchens, baths and other equipment constitute the system proposed.

The proposal is aimed for most economical use at high-rise and mass housing, where the economies of setting up an onsite concrete batch plant and reuse of steel formwork would be most evident. However, the system can also be applied to low-rise, and even scattered-site dwellings, depending on proximity.

Basic field construction is the structural frame of reinforced concrete, which will supply all bearing elements, floors, and ceilings. Single, plastic-encased electrical harnesses are to be supplied to the builders, to be inserted in walls and ceiling areas before concreting operations begin.

Offsite factory work will include construction of finished interior partitions for kitchens and baths, so that these units can be transported as modules for insertion in the structure, and construction of finished exterior walls of conventional materials, plus gypsum board or urethane sandwich interior panels.



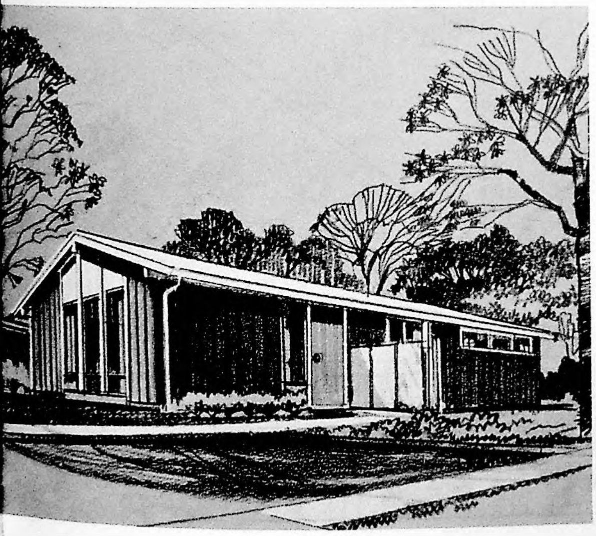


This two-directional approach is intended to produce economies in that work onsite is on the elements most difficult to transport and most easily adaptable to available techniques and labor; factory work is confined to components that require most detailed labor, and which are easily transportable. It is contemplated that the factory-built panels could also be assembled, with or without the concrete framing, to form single-family, scattered-site residences.

The concept calls for casting methods that will produce walls smooth enough for painting and requiring no other finishing; floors are finished with carpet or tile; nonbearing interior partitions and exterior infill walls can be made with almost any desired finish and insulation to suit the requirements of any architectural scheme.

Heating can be electric or gas in any structure; all mechanical systems combine heating and air-conditioning, with piping included as the walls are cast, as in conventional construction. Plumbing is of plastic materials (excepting for hot water systems).

The system's backers are prepared to handle all details from site planning to management.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN
2	Density Range	10 TO 30 DWELLING UNITS PER ACRE (100 UNITS PER ACRE HOUSING FOR ELDERLY)
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	MIXED DENSITIES; COMMUNITY RECREATION SPACE
6	Nonresidential Functions	TENNIS COURTS; PLAYGROUND; SWIMMING POOL; RECREATION BUILDING
7	Circulation	SEPARATE VEHICULAR AND PEDESTRIAN TRAFFIC; WALKWAYS
8	Site Planning Services	LOCAL ARCHITECT
9	Community Involvement	
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	
13	Design Selection	
14	State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED & BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	REINFORCED CONCRETE FRAME, BEARING WALLS; MODULES (SINGLE-FAMILY)
17	Exterior Elements	INFILL PANELS; VARIED FINISHES
18	Interior Elements	BATHROOM AND KITCHEN MODULES; PARTITIONS
19	Foundations	CONVENTIONAL
20	Comfort Systems	CENTRAL HEATING SYSTEM, HIGH-RISE; SINGLE-FAMILY INTEGRATED IN MODULES
21	Plumbing	CONVENTIONAL; PLASTIC PIPING INTEGRATED IN MODULES
22	Electrical	PLASTIC ENCASED WIRING HARNESS, INSTALLATION IN ONE OPERATION
23	Furnishings	

PRODUCTION

24	Offsite Production	MODULES; PARTITIONS; INFILL PANELS; MECHANICAL MODULES & COMPONENTS
25	Onsite Production	CONCRETE BATCH PLANT
26	Onsite Construction	FOUNDATIONS; FRAME; ERECTION OF MODULES & COMPONENTS; UTILITY HOOK-UPS
27	Labor	UNSKILLED ONSITE
28	Labor Training Programs	MINORITY, LOW-INCOME, UNSKILLED TRAINING PROGRAM
29	Community Involvement	LOCAL LABOR

ECONOMICS

30	Construction Costs	$8.20 TO $9.00 PER SQ. FT., 1000 UNITS PER YEAR
31	Financing Methods	
32	Useful Life	

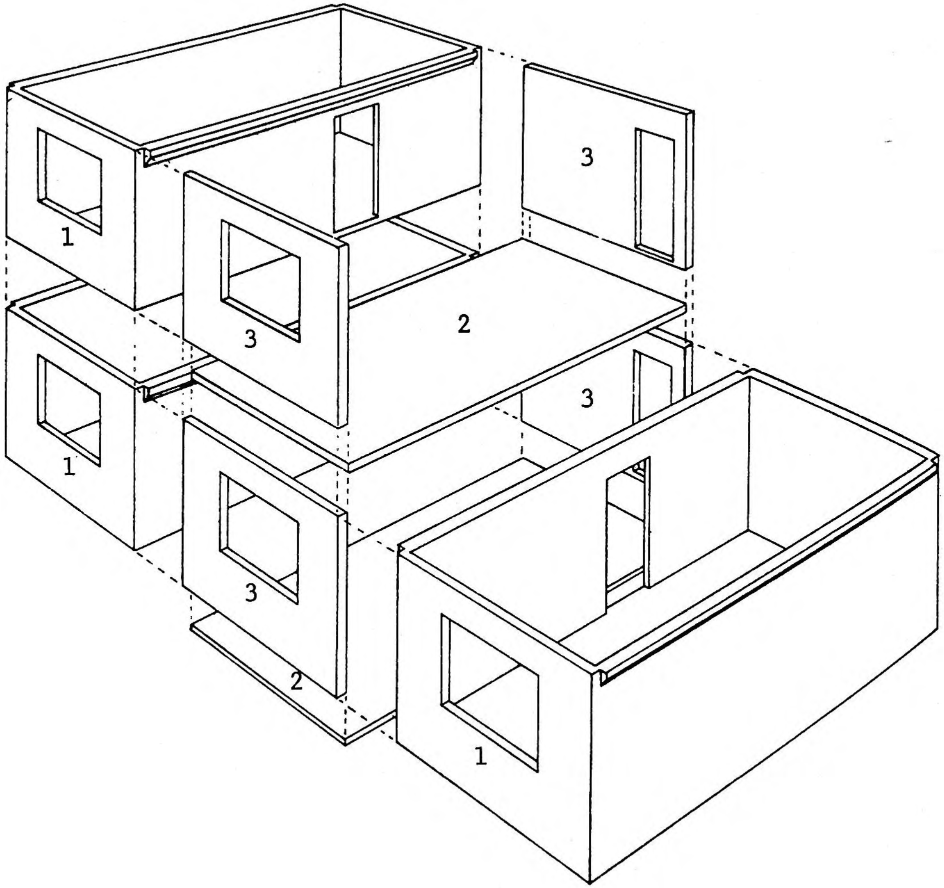
MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	COORDINATION; CONSTRUCTION; ARCHITECTURAL DESIGN; ENGINEERING; FINANCE
35	External Functions	PRODUCTION; SOIL ANALYSIS; STRUCTURAL DESIGN; PLANNING; COMPUTER PROGRAMMING
36	Market Area	400 MILE RADIUS OF EACH PLANT
37	Delivery Rate	1000 UNITS PER YEAR (HIGH-RISE; 100 UNITS PER SITE MINIMUM)
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	STEEL-FORM CONCRETE CASTING; ELECTRICAL HARNESS; LIGHTWEIGHT PANEL
40	Codes	

ITT Research Institute



PROPOSER

IIT Research Institute, Chicago, Illinois

AFFILIATES

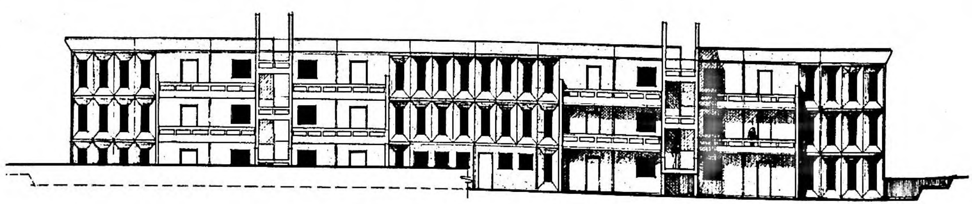
Borg Warner Corporation, Plumbing Producers; Tischeller and Camero, Architects; Precast Concrete Company, Production and Erection, Newtowne Properties, Inc., General Contractors; Material Services, Production and Erection.

Three-dimensional, open-topped box modules of reinforced concrete are the basis of the system offered, with the units themselves forming the structural framing. Modules could easily be demounted from an apartment structure, reconditioned, and then reassembled for other uses.

The module walls are fabricated at factory locations and include all necessary plumbing, ductwork, and electrical subsystems, as well as any required door openings or window spaces. They are cast with L-shaped inward projections at the top to receive the next module when stacked. Stacks are spaced to permit the installation of slabs and endwalls. Special pre-molded connectors are cast into the top edge of the walls for connection devices. With unit walls capable of supporting the loads of the building, no separate structural framework is required. Conventional foundations are acceptable for the system.

Modules are 12 ft. wide and 23 ft. long. Use of lightweight concrete aggregate reduces overall weight of the units to well within the lifting capacity of available cranes.

Exterior walls can be finished in many ways to provide architectural treatment—usually at the manufacturing plant, but possibly at the site. Final interior finish on walls, floors and ceilings may be with conventional materials—such as wood, plastic (vinyl), or ceramic tile.



All piping can be incorporated in the units; kitchens and bathrooms are factory-fabricated for packaged field installation; other interior items can be prepared in the same way. Heating, cooling, and electrical subsystems are also included in the units, for easy connection with adjoining sections and only field connection to main supply lines. Heating may be supplied by gas or electricity.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL
2	Density Range	
3	Topography	
4	Climate	
5	Planning Concepts	CLUSTER
6	Nonresidential Functions	RECREATIONAL FACILITIES
7	Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION; NO THROUGH TRAFFIC
8	Site Planning Services	
9	Community Involvement	SURVEY TO DETERMINE ACCEPTABILITY OF PROGRAM
10	Utilities	UNDERGROUND ELECTRICAL SERVICE

BUILDING SYSTEMS

11	Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 3 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION FACILITY OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	SELF-SUPPORTED, REINFORCED-CONCRETE, OPEN-TOPPED MODULES
17	Exterior Elements	STAIRS
18	Interior Elements	CONVENTIONAL WALL, FLOOR & CEILING FINISHES
19	Foundations	CONVENTIONAL
20	Comfort Systems	HEATING & COOLING SYSTEM INTEGRATED WITH BUILDING SYSTEM
21	Plumbing	PLASTIC PIPE; KITCHENS & BATHROOMS FACTORY FABRICATED
22	Electrical	INTEGRATED WITH BUILDING SYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	MODULE
25	Onsite Production	
26	Onsite Construction	FOUNDATION; ASSEMBLY OF MODULES; CONNECTION OF UTILITIES
27	Labor	
28	Labor Training Programs	TRAINING PROGRAM FOR ONSITE ASSEMBLY
29	Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	$12.41 PER SQ. FT.
31	Financing Methods	
32	Useful Life	

MANAGEMENT

33	Proposer Organization	RESEARCH INSTITUTE
34	Internal Functions	MANAGEMENT
35	External Functions	DESIGN; CONSTRUCTION
36	Market Area	FEW HUNDRED MILES
37	Delivery Rate	
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	MODULES CAN BE DEMOUNTED & REASSEMBLED FOR OTHER USES
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Insta-Buildings

PROPOSER

Insta-Buildings, Inc., Birmingham, Michigan

AFFILIATES

Creative Capital Corporation, Financing; Comac Company, Management Consultants.

The reduction of field construction processes to a minimum by nearly total fabrication of the basic module in plant is the prime cost-saving feature of this system. The concept, tried through actual building and operation, is intended to tap the current rolls of low-skilled and unskilled labor and lends itself readily to the use of minority contractor groups in site placement. Completed cubes are shipped from factory to site in single units, with all mechanical subsystems installed and exterior finishes completed before shipment. At the site the modules are placed on conventional foundations by crane and locked in place by plate connectors.

Each dwelling unit consists of two modules, each module frame measuring 12 ft. x 36 ft. 2 in. x 9 ft. 4 in. Eight clustered units form a service-core and comprise one building; these can be varied in arrangement to provide some site variation.

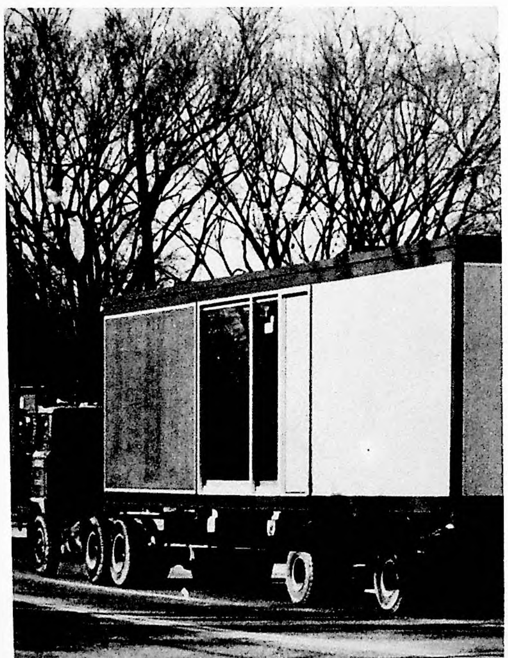
The system consists of a rigid, three-dimensional steel truss, welded to provide firm support for wall, floor, and ceiling panels. This frame provides the necessary rigidity to allow the module to be swung onto a truck and into place at the site without additional reinforcing. Under a patented process, the frame structure can be designed in a variety of rectangular groupings. Thus, the only limitation on module size becomes the ability to transport the finished units to the site. Wall panels of brick, wood, plastic, or glass are installed in the plant.

Innovations include the jig fabrication of piping subassemblies for installation on production assembly lines and factory installation of vertical cold water supply mains, sanitary waste and vent stacks as well as rainwater conductors in a pipe chase. This enables erection crews to make rapid site connections. Roof sumps are

12 x 8 x 36 FT. SHIPPING MODULE LIFTED ONTO TRUCK

installed for all flat surfaces. Toilet exhaust fans discharge through acoustic-lined air passages into a common vertical exhaust stack in the pipe chase which vents through the roof.

Heat is supplied through baseboard units on perimeter walls with electricity the energy source. Through-wall electric air-conditioning units cool living room and master bedrooms by day and the entire apartment unit by night. Wiring of the second bedroom of each unit is arranged so that it can be served from either of two adjacent dwelling cores; this permits flexibility in the forming of one-, two-, or three-bedroom units, requiring only minor partition charges. Secondary electrical service, telephone runs to the unit, and optional central TV antenna service are placed underground.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	80 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	MULTI-STAGED DEVELOPMENT OF CLUSTERS; COMMON OPEN SPACES
6	Nonresidential Functions	POOL; PLAY AREA; COMMERCIAL CENTER
7	Circulation	SEPARATE PEDESTRIAN AND VEHICULAR CIRCULATION; PEDESTRIAN PATHS TO FACILITIES
8	Site Planning Services	
9	Community Involvement	
10	Utilities	PLUMBING — CONVENTIONAL UNDERGROUND; OPTIONAL CENTRAL T.V. ANTENNA

BUILDING SYSTEMS

11	Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 4 BEDROOMS
13	Design Selection	STANDARD PLANS WITH OPTIONS
14	State of Development	SYSTEM DEVELOPED, PROTOTYPE CONSTRUCTED; PRODUCTION FACILITIES DEVELOPED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	STEEL FRAME VOLUMETRIC MODULES; SELF SUPPORTED UP TO 4 STORIES
17	Exterior Elements	BALCONY OR COVERED TERRACE; BRICK, WOOD, PLASTIC OR GLASS WALL PANELS
18	Interior Elements	WOOD STUD & GYPSUM BOARD PARTITIONS
19	Foundations	CONVENTIONAL
20	Comfort Systems	ELECTRIC BASEBOARD HEATING & SEPARATE COOLING UNIT; INTEGRATED WITH SUBSYSTEMS
21	Plumbing	APPROVED PLASTIC MATERIALS; PIPING ASSEMBLIES; INTEGRATED WITH BUILDING SYBSYSTEM
22	Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES; PLUMBING ASSEMBLIES
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PLACEMENT OF VOLUMETRIC MODULES; UTILITIES HOOK-UPS
27	Labor	UNSKILLED & SEMISKILLED LABOR FOR PRODUCTION PLANT & SITE CONSTRUCTION
28	Labor Training Programs	SHORT TRAINING PERIOD BY PROPOSER OR INCORPORATION OF GOVERNMENT PROGRAMS
29	Community Involvement	LOCAL CONTRACTORS; MINORITY GROUP CONTRACTORS; SELF-HELP LABOR

ECONOMICS

30	Construction Costs	$10,419 PER DWELLING UNIT FOR 1,000 UNITS; $9,000 PER UNIT FOR 2,000 UNITS
31	Financing Methods	MORTGAGE LENDER
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT; ADMINISTRATION; DESIGN; PRODUCTION; ERECTION; GOVERNMENT RELATIONS
35	External Functions	FINANCING; FINANCIAL SYSTEMS; SITE DESIGN & ENGINEERING
36	Market Area	
37	Delivery Rate	1,000 TO 2,000 DWELLING UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	MODULE IS ALSO SHIPPING & HOISTING CONTAINER
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Institute of Public Administration

PROPOSER CONSORTIUM

Institute of Public Administration, Washington, D.C.,
Ben Dyer Associates, Engineers, Riverdale, Maryland,
Morse Associates, Riverdale, Maryland

A structural panel built from 18 gauge steel Z-sections and wood comprises the basic element of this proposal for providing volume housing. Employing a proven method of mass plant production, the system consists of roof, trusses or box beams, and wall and floor sections produced in standard sizes of 4 ft. x 8 ft. up to 8 ft. x 8 ft. The modular sections are transported from factory to prepared foundations at the site.

A single-family unit shell can be erected in one day by unskilled labor. A continuous 2-in. x 4-in. wood plate is installed over floors to receive the wall units which are secured with twist nails. Similar application provides a top connection between contiguous panels. The panels can be lifted into place by hand, saving heavy equipment costs. Floor construction and some wall units are conventional, and ceiling finish, ceiling insulation, roof sheathing, roofing and siding are field installed.

The web of the Z-section is 3 5/8 in., the flanges measuring 1 1/8 in. and 1 1/2 in. Inch-long pointed barbs are formed in the wider flange for fastening facing material. These are clinched in place after penetrating 1/2-in. fiberboard sheathing and plywood headers. Sheathing is stapled to all wood framing members. Framing for plain wall units consists of Z-section marginal studs and top and bottom horizontals. An alternative exterior facing to the fiberboard sheathing is 3/8-in. grooved, roughsawn cedar plywood. The clinched barb exposures are covered with field-applied cedar batten strips. A 2-in. mineral wool insulation fills all cavities. A 1/2-in. foil-bakced gypsum board, fixed to the steel studs with adhesives, comprises the interior wall facing.

An innovation in this proposal is the projected use of a new sewage treatment principle—electro-coagulation for sanitary drainage disposal. Single-room heating units and the plumbing tree principle are other features of the plan.

Summary Information

SITE SYSTEM

1	Site Situation	SUBURBAN
2	Density Range	MIXED DENSITY
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTER; COMMON OPEN SPACES
6	Nonresidential Functions	POOL; PLAY AREA; HEALTH CLINIC; SOCIAL HALL; SHOPPING & OFFICE FACILITIES
7	Circulation	CUL-DE-SACS WITH COLLECTOR ROADS TO HIGHWAYS
8	Site Planning Services	CONSORTIUM MEMBER
9	Community Involvement	TEAM TO EVALUATE COMMUNITY NEEDS
10	Utilities	ELECTRO-COAGULATION SEWAGE DISPOSAL SYSTEM

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	
13	Design Selection	FLEXIBLE
14	State of Development	PROPRIETARY PRODUCTION PLANT OPERATIONAL
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	STEEL & WOOD FRAME PANELS; ROOF TRUSSES OR BOX BEAMS & WALL & FLOOR SECTIONS
17	Exterior Elements	PLYWOOD & MASONRY FINISHES
18	Interior Elements	GYPSUM BOARD WALL, PARTITION & CEILING COVERING
19	Foundations	CONVENTIONAL
20	Comfort Systems	INDIVIDUAL ROOM HEATING UNITS; COOLING & VENTILATING
21	Plumbing	PLUMBING TREE
22	Electrical	
23	Furnishings	

PRODUCTION

24	Offsite Production	PANELS BY SUPPLYER
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; FLOOR, WALL & ROOF ASSEMBLY; CONVENTIONAL FINISHING
27	Labor	UNSKILLED
28	Labor Training Programs	DEVELOPER GIVEN JOB OPPORTUNITY & EDUCATION PROGRAM
29	Community Involvement	USE OF LOCAL LABOR

ECONOMICS

30	Construction Costs	$20,000 PER UNIT
31	Financing Methods	
32	Useful Life	40 YEARS

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	MANAGEMENT; PLANNING; DESIGN & ENGINEERING; COMMUNITY DEVELOPMENT
35	External Functions	MANUFACTURE
36	Market Area	
37	Delivery Rate	ONE SINGLE-FAMILY UNIT PER DAY
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	ELECTRO-COAGULATION FOR SANITARY DRAINAGE DISPOSAL
40	Codes	

Interstate General Corporation

PROPOSER

Interstate General Corporation, San Juan, Puerto Rico

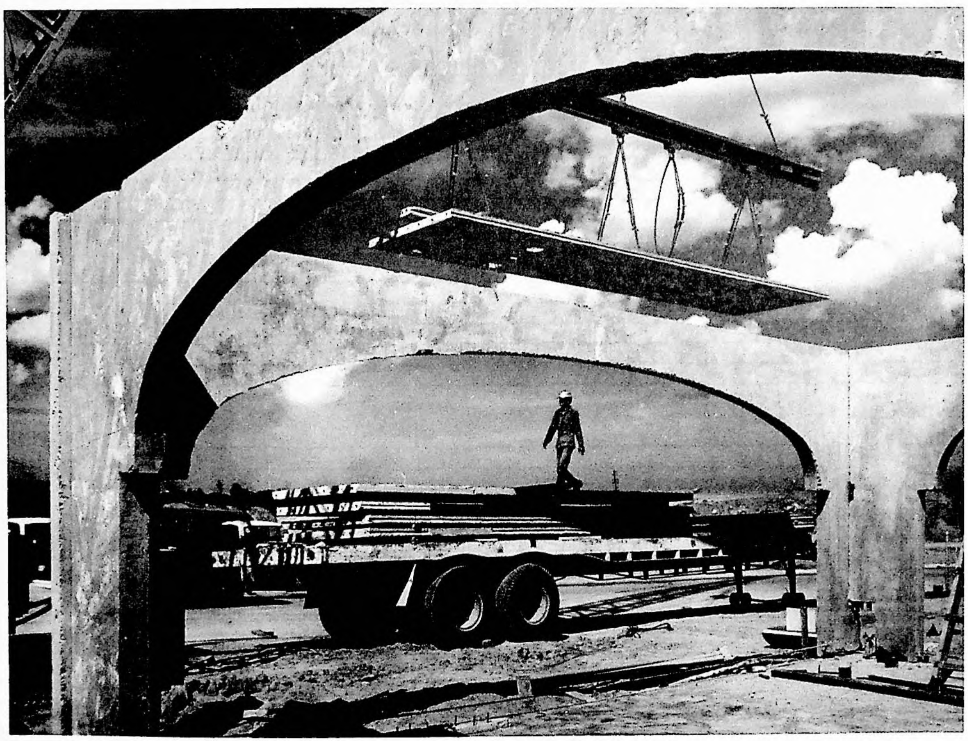
Site-cast, reinforced concrete panels are the basis of the housing system proposed. The housing system, which is fully developed, being manufactured and marketed in Puerto Rico, was designed to help solve the substandard housing problem found especially in the San Juan area.

The modular, panelized system is expected to be applied to single-family detached and attached homes, and to multi-family structures and is considered especially adaptable for small, separated projects in residential areas.

The modules formed include floor and roof slabs, exterior walls and interior partitions, and stairs—all structural elements—and are self-supporting up to six stories. The elements are joined to each other by dry-packed, grouted interlock joints which provide a mechanical lock between panels, prevent relative displacement, and make the resultant structure both earthquake and hurricane resistant.

Casting of the floor and roof slabs is done on long concrete-based beds, with pretensioned cables added for reinforcement, and hooks embedded on the edges for lifting. The wall panels are cast in modular steel forms which afford a primary, smooth finish to the inside surface, which subsequently is painted. The exterior surface is exposed concrete, painted, the colors along with texture varying to give architectural diversity to the external appearance.

Plumbing (copper water lines and polyvinyl chloride drainage lines), electrical distribution, and conduits (for both telephone lines and television antenna leadin) are cast into the panels, with only interconnection of these facilities being required after the modules have been assembled into a structure. Windows are installed at the site-casting yard, as are door frames; where possible prefabricated kitchen cabinets, specifically designed for the modules depending upon size of the dwelling unit,



are installed after the structure has been erected.

Each dwelling unit has its own electric hot water heater, but no provision has been developed for a heating system, the system having been developed for the Puerto Rico climate. Cooling, however, is provided by locating jalousie windows and door openings to take advantage of the cooling trade winds. Flooring for the units is factory-finished terrazzo tile, readily obtainable in Puerto Rico, applied to the floor slabs after the structures have been erected.

With virtually the entire casting-erection-construction-finishing sequence performed onsite, and with unskilled labor being able to do most of the work (only one in each five workers need be skilled), the system offers much potential for involvement of the local community and potential future occupants.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	10 TO 30 DWELLING UNITS PER ACRE
3 Topography	SUITABLE FOR TOPOGRAPHY & SOIL IN PUERTO RICO
4 Climate	SUITABLE TO CLIMATE IN PUERTO RICO
5 Planning Concepts	
6 Nonresidential Functions	RECREATIONAL FACILITIES; COMMUNITY BUILDINGS; EDUCATIONAL FACILITIES
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	2 TO 5 BEDROOMS
13 Design Selection	
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM BEING MARKETED (PUERTO RICO)
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	CONCRETE PANELS PRECAST ONSITE; CONCRETE ROOF & FLOOR SLABS
17 Exterior Elements	BALCONY; CONVENTIONAL FINISHES; STAIRS
18 Interior Elements	FLOORS—FACTORY-FINISHED TERRAZZO TILE
19 Foundations	CONVENTIONAL; FOUNDATION BEARING WALLS; COLUMNS OR TIERS
20 Comfort Systems	CROSS VENTILATION PROVIDED; HEATING NOT INCLUDED
21 Plumbing	COPPER PIPES; PLASTIC TUBING; INTEGRATED WITH BUILDING SYSTEM
22 Electrical	INTEGRATED IN BUILDING SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	DOOR FRAMES; KITCHEN CABINETS
25 Onsite Production	CONCRETE PANELS; PARTITIONS; FLOOR PANELS
26 Onsite Construction	CONCRETE COMPONENTS CAST ONSITE; PLUMBING CONNECTIONS
27 Labor	SKILLED; SEMISKILLED; UNSKILLED
28 Labor Training Programs	
29 Community Involvement	SELF-HELP POSSIBLE; LOCAL CONTRACTOR

ECONOMICS

30 Construction Costs	$9.94 PER SQ.FT.
31 Financing Methods	
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	ALL
35 External Functions	
36 Market Area	1000 DWELLING UNITS PER YEAR (WITH 4 PLANTS)
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Jefferson Construction

PROPOSER

Jefferson Construction Company, Cambridge, Mass.

AFFILIATE

Henneberg & Henneberg, Architects & City Planners

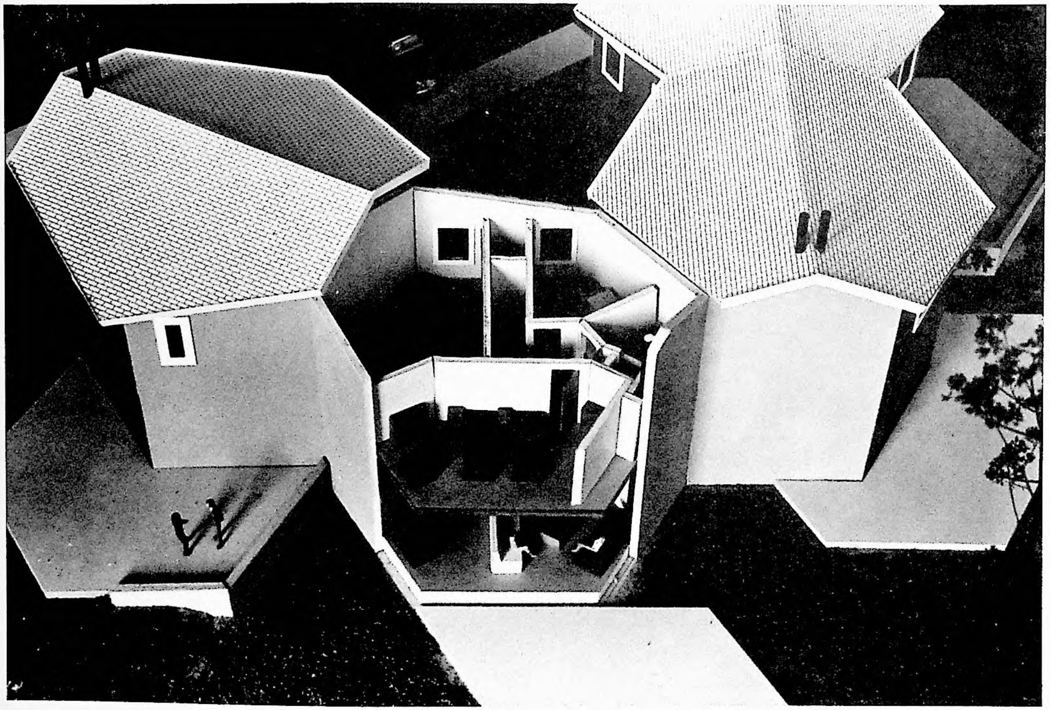
This proposal calls for construction of six-sided dwelling units. The basic structural unit is a panel constructed of 2-in. x 4-in. studs for exterior walls and 2-in. x 3-in. studs for interior walls, all placed 24 in. on center. Interior facing is painted gypsum board; the exterior will be covered with clapboards, panels, plywood, or masonry veneer. A 4-in. fiber foil-backed insulation provides thermal protection and vapor barrier. Ten of these basic panels are fitted together to comprise a single modular unit. Entirely load-bearing, they can support assemblies up to four stories with a central column introduced for second, third, and fourth floor support.

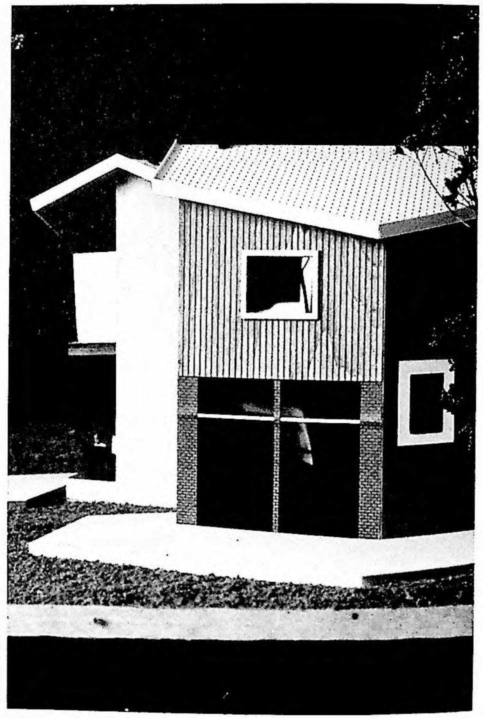
Metal connectors join panel edge plates assuring strength and rigidity in this hexagonal system. The roof structure is composed of two or four panels, size and number depending upon distance to the site from central production facilities. The roof subsystem consists of rigid cellular insulation interspaced with wood members, bonded between 1/2" plywood sheets for the roof application and 1/4" plywood sheets for the underside. The two panels are bolted at the ridge line to create a folded plate structure. The roof element is bolted to a continuous anchor plate.

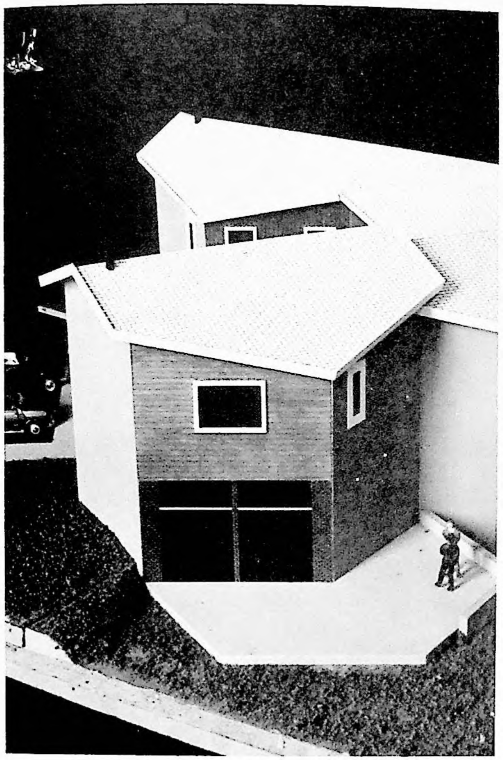
The grade floor is conventionally cast concrete slab, while second and additional floors are comprised of three panels, each constructed of joists decreasing in size, tied together with plywood facing.

A systems innovation involves use of the Lilgendahl vacuum plumbing technique with plastic pipe specified. Aluminum ducts will be used in the ventilating system.

The basic modular units can be expanded by 100 percent through flexibility of design. By interconnecting basic modules, units from single efficiencies up to six-bedroom apartments are provided. Owners will complete much of the interior work such as painting, cabinetry and tiling.







Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	30 TO 80 UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTERS; COMMON OPEN SPACES
6	Nonresidential Functions	RECREATIONAL FACILITIES; SHOPPING/SERVICE FACILITIES
7	Circulation	STREET GRID; PEDESTRIAN TRAFFIC AT DIFFERENT LEVEL THAN VEHICULAR; SEDEWALKS
8	Site Planning Services	
9	Community Involvement	
10	Utilities	CONVENTIONAL; OPTIONAL COMMUNAL WASTE DISPOSAL SYSTEM; UNDERGROUND TELEPHONE

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	EFFICIENCIES UP TO 6 BEDROOMS
13	Design Selection	STANDARD PLANS WITH OPTIONS
14	State of Development	BUILDING SYSTEM IN DESIGN STAGE REQUIRING DEVELOPMENT
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WOOD STUD WALL PANELS; CENTRAL COLUMN; WOOD JOIST & PLYWOOD FLOOR & ROOF PANELS
17	Exterior Elements	CONVENTIONAL FINISHES
18	Interior Elements	WOOD STUD GYPSUM PARTITIONS; WOOD STAIRS & TRIM; OPTIONAL FIREPLACE
19	Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20	Comfort Systems	OPTIONAL FUEL HOT AIR HEATING PER DWELLING UNIT
21	Plumbing	CONVENTIONAL; OPTIONAL VACUUM WASTE SYSTEM WITH PLASTIC PIPING; PLASTIC VENT PIPING
22	Electrical	CONVENTIONAL
23	Furnishings	

PRODUCTION

24	Offsite Production	WALL, FLOOR & ROOF PANELS; CENTRAL COLUMN; PARTITIONS OPTIONAL
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PANEL ERECTION; OPTIONAL CONSTRUCTION OF PARTITIONS & CABINETS
27	Labor	SEMISKILLED & SKILLED FOR ONSITE CONSTRUCTION & ERECTION
28	Labor Training Programs	TRAINING OF PROSPECTIVE OWNERS FOR ONSITE SELF-HELP CONSTRUCTION
29	Community Involvement	PROSPECTIVE OWNER PARTICIPATION IN ONSITE CONSTRUCTION

ECONOMICS

30	Construction Costs	$18,750 PER 3 BEDROOM UNIT
31	Financing Methods	
32	Useful Life	STRUCTURE AND INTERIOR—50 YEARS; PLUMBING AND ELECTRICAL—30 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	CENTRAL RESPONSIBILITY
35	External Functions	DESIGN & PLANNING
36	Market Area	NATIONAL
37	Delivery Rate	500 TO 1,000 DWELLING UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	BUILDING SYSTEM HEXAGONAL DESIGN; VACUUM WASTE SYSTEM
40	Codes	GENERALLY ADAPTABLE TO ALL NATIONAL MODEL CODES

Jesperson-Kay Systems, Inc.

PROPOSER CONSORTIUM

Jespersen-Kay, Inc., Prototype Construction and Site Preparation, New York, New York
Skidmore, Owings and Merrill, Architecture and Planning, New York, New York
Hackett Housing Systems, Inc., Marketing and Sales, Washington, D. C.
Arthur Andersen and Company, Finance and Mortgage Programs, Chicago, Illinois
Quanta Systems Planning Corporation, Management Support Systems, Rockville, Maryland

Standardization and dimensional coordination and control are among the key tenets which find expression in the proposed housing made up of modularized, precast concrete floor and wall panels. Originating in Denmark, the system has had extensive application there and elsewhere. Over 50,000 units have been constructed, the components having been manufactured in eight plants in Europe. A ninth plant has been constructed in Canada, and an additional eight are proposed for construction in the United States, with anticipated optimum volume production projected at nearly 3,000 dwelling units per year.

The dimensional coordination begins with the first design step of the building process and extends to the ultimate occupant. Holding the structural components and all subsystems to modular coordinates and to close tolerances assures that everything will mate initially as well as at a later time with modifications or additions, when made subject to the same coordinates.

The basic design discipline is a 1-ft. x 4-ft. horizontal grid about which all plans are developed (with the exception of special areas around stairs and elevator shafts). Thus, the center lines of load bearing walls fall on the grid lines. The precast, hollow core floor panels are always 4 ft. wide and in increments of 1 ft. up to 20 ft. long. All other subsystems conform to this discipline in plan, and generally are held to close dimensional tolerances, which permit their fitting into the dwelling unit with no need for field measuring or cutting, with a consequent savings in erection time, and with no waste.

A further aspect of the system's dimensional, modular coordination is that it is an open system, relying for its effectiveness on both a maximum repetition of a relatively small number of components and upon the fact that components from other manufacturers may be utilized, provided they meet the modular parameters established.

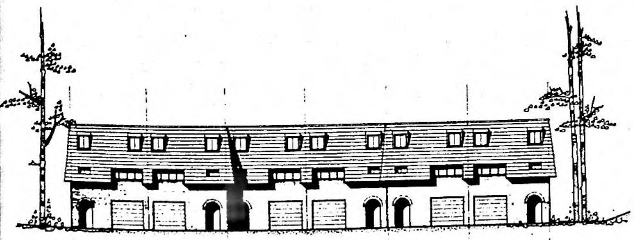
The two major structural components of the system, the load bearing walls and the floor slabs, are manufactured in continuous flow, highly rationalized factories where dimensional control begins with high precision steel molds. These molds turn out components which are smoothly finished with no further finishing required, except for appearance, and finishing may be applied directly to the surface as it comes from the form.

On the site, mobile or tower cranes set pairs of the 8-ft. or 12-ft. wide wall panels on conventionally designed, cast-in-place foundations; the wall panels are spanned with modular floor slabs; and the open sides are closed in with nonbearing exterior facades. Components then are joined with reinforcing bar, grout and concrete, and the cycle is repeated. With close dimensional coordination, the entire process is subject to crit-

ical path scheduling to realize the utmost in erection time economy. Even the infill and service elements, packaged in two or three crates per dwelling unit, arrive on the site on CPM schedule, just in time to be located before closure of the unit with both steps being accomplished in quick step, making each unit ready for finishing work at the earliest possible moment.

Two cranes and a small crew of men average erection of components for five dwelling units in an 8-hr. day. The infill and service elements comprise all the necessary premanufactured, prefinished components required to deliver a completed housing unit including partitions, windows, doors, flooring, bath and kitchen equipment and all mechanical services and utility networks. Although none of these elements are precast into the major structural concrete components, they are readily fitted into the dwelling units onsite. For example, the plumbing tree may be part of a partition or even exposed (as done in some parts of Europe), with modular coordination assuring an accurate fit. Wiring may be distributed in the joints between adjacent floor slabs, or may be run within nonbearing walls.

Exteriors of the load-bearing end walls may be textured, colored concrete to provide architectural interest, with further diversity available by treatment of the side, nonbearing facades which may be concrete, brick, metal or plastic. Interior surfaces may be painted, papered or tiled, with wood parquet, tile or carpeting on the floor, or as an option, a floating plywood floor on padded sleepers for superior sound absorption may be installed.



FRONT ELEVATION

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	25 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	COMMUNITY STUDY TO DETERMINE PLANT & HOUSING LOCATION
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	VARIABLE
13 Design Selection	FLEXIBLE OPEN PLANNING
14 State of Development	PRODUCTION FACILITIES COMPLETELY DEVELOPED; SYSTEM BEING MARKETED
15 Community Involvement	POLLS TO BE TAKEN TO DETERMINE EXTERIOR FINISHES

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE HOLLOW-CORE FLOOR & WALL PANELS
17 Exterior Elements	BALCONIES, FACADE PANELS
18 Interior Elements	PARTITIONS, STAIRS, ELEVATORS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	GAS OR ELECTRIC; HYDRONIC OR AIR FURNACE; INTEGRATED WITH BUILDING SYSTEM
21 Plumbing	CONVENTIONAL; PLASTIC PIPING WHERE APPROPRIATE; INTEGRATED WITH BUILDING SYSTEM
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	CONCRETE WALL AND FLOOR PANELS; SERVICE & INFILL ELEMENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF COMPONENTS; UTILITY INSTALLATIONS; FINISHING
27 Labor	SKILLED AND UNSKILLED AT PLANT
28 Labor Training Programs	TRAINING OF CONTRACTORS IN OPERATIONS
29 Community Involvement	LOCAL CONTRACTORS AND SUBCONTRACTORS; SELF-HELP

ECONOMICS

30 Construction Costs	$10.38 TO $11.38 PER SQ. FT., 2736 UNITS (BEST RATE)
31 Financing Methods	
32 Useful Life	

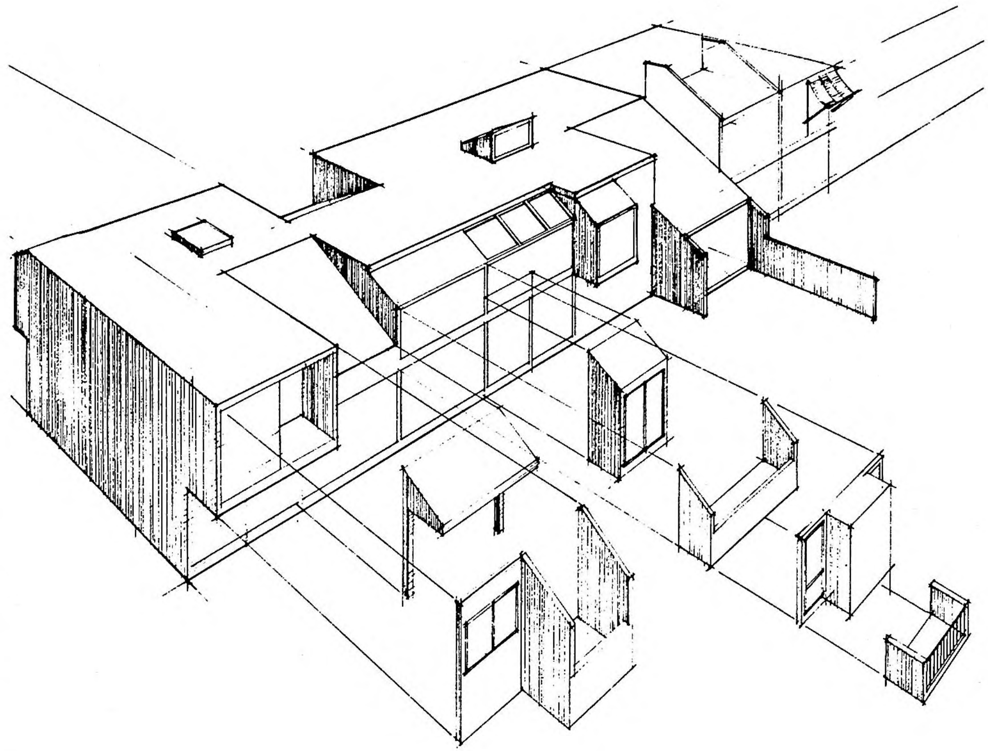
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	2736 DWELLING UNITS PER YEAR (BEST RATE)
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM: DIMENSIONAL COORDINATION & CLOSE TOLERANCES OF ELEMENTS
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Levitt Technology Corporation



PROPOSER

Levitt Technology Corporation, Lake Success, New York.

AFFILIATES

B. A. Berkus Associates, Inc., Architects; The Stanley Works; Simpson Timber Company; Auerbach Corporation, Management Planning; Dunham-Bush, Inc., Heating and Air conditioning; Hamilton-Howe, Inc., Interior Design.

Two basic building systems are included in this proposal—a wood-frame module system for immediate application and a concrete module system for future development. Provision of medium-density townhouses and low-rise apartments is the aim of the five-part, wood-frame module plan proposed here; however the system is fully adaptable to both single-family and high-rise construction.

For consideration at a later stage of operations, there is a possible application of concrete modules, rather than the relatively conventional first-stage wood construction, for the same medium-density housing field. Difficulties posed by lack of general public acceptance of concrete housing, plus the need for special tooling, are implicit in the decision to use concrete at a point where larger mass markets may develop.

Within the system proposed for the initial work, however, there are many innovations: fold-out, slide-out, or hinged sections to make shipping easier, yet provide considerable variation in appearance and usable space; a packaged air-conditioning-heating system that utilizes small, flexible ducts that fit easily between wall studs and facings; standardized wet modules (kitchen-bathroom sections); use of plastic piping for all plumbing; and module strength great enough to permit offsets that create almost as much open space as the modules themselves. Included in the package are pieces of furniture, some of which can double as partitions, that can be assembled, installed, and relocated by the owner or occupant without special skills or tools. Wiring harnesses, plumbing assemblies, and other mechanical systems are factory-installed, requiring only field connections.

1. A small townhouse plan, based on a 56 ft.-long module, in which each module contains parts of two, two-and-a-half, or three dwelling units. Widths of these units vary from 18 ft. 6 in. to a maximum of 28 ft. when assembled. Only two wet modules are used in these units, despite a variety of possible floor plans in multistory structures. The program is aimed at low-cost, government-assisted, and limited-profit housing.

2. The second program is a medium-sized townhouse, based on the 28-ft.-long modules to accommodate a variety of dwelling types, by interspersing 18-ft. and 36-ft. modules to develop major options. Two- to six-bedroom units are possible, with units arranged for 24-ft.-wide lots, though some can be turned 90 deg. to take advantage of terrain and turn corners. This program is designed for a sales and rental bracket somewhat higher than Program 1, and includes more square footage and other facilities, making it more suitable for limited-profit corporations or private open-market housing.

3. This plan calls for medium- to large-size patio townhouses, enhanced by semienclosed private outdoor spaces, with the dwelling area on a somewhat larger scale—ranging from 2-bedroom, 1½-bath units to 4 bedrooms with 2½ baths. The units are planned for a density of 10 per acre.

4. and 5. Both of these programs are low-rise apartment schemes, using several common apartment units and include the townhouses in Program 2 as duplexes. Program 4 is based on a corridor-circulation building, Program 5 on a stair-landing circulation. Guiding concern in these apartment designs is to keep a strong townhouse scale and unit character, while achieving relatively high densities.

The wood-framed building system is a development of conventional platform-framed construction, with the added factor of industrial production technology. Structural components resemble conventionally built frames (with 2-in. x 4-in. and 2-in. x 3-in. wood studs), with glued-on skins applied to walls and ceilings. This achieves greater strength and lower material costs, particularly because it makes possible the use of box

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN, SUBURBAN; RURAL
2 Density Range	8 TO 27 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; CLUSTER VILLAGES; GREENBELTS; PLANNED UNIT DEVELOPMENT
6 Nonresidential Functions	SWIM & TENNIS CLUBS; RECREATION BUILDING; GAZEBO; LIBRARY; SCHOOLS
7 Circulation	SEPARATE VEHICULAR TRAFFIC; CURVILINEAR STREETS, CUL-DE-SACS, T-ALLEYS; BRIDGES
8 Site Planning Services	BY PROPOSER & AFFILIATES
9 Community Involvement	ATTITUDE & OPINION SURVEYS TO IMPLEMENT PLANNING
10 Utilities	CONVENTIONAL; UNDERGROUND ELECTRIC WIRING; POSSIBLE TOTAL ENERGY SYSTEM
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	EFFICIENCY, 1 TO 6 BEDROOMS
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	PROTOTYPE CONSTRUCTED; PRODUCTION PLAN BEING DEVELOPED
15 Community Involvement	ATTITUDE-OPINION, POST-OCCUPANCY EVALUATION, & CONSUMER ACCEPTANCE STUDIES
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAME SELF-SUPPORTED MODULES; WALL & FLOOR STRESSED-SKIN INFILL PANELS
17 Exterior Elements	IN-FILL PANELS; CONVENTIONAL FINISHES; BALCONIES; PORCHES; DECKS; PARAPETS
18 Interior Elements	WOOD PARTITION-CLOSET PANELS; CONVENTIONAL WALL, FLOOR, CEILING FINISHES
19 Foundations	CONVENTIONAL CONCRETE OR MASONRY; POSSIBLE BASEMENT SYSTEM WITH PRECAST CONCRETE
20 Comfort Systems	UTILITY CORE; HIGH-VELOCITY HEATING-COOLING UNIT INTEGRATED IN BUILDING SYSTEM
21 Plumbing	PLASTIC PIPE & FITTINGS FOR WATER SUPPLY & DRAINAGE; INTEGRATED WITH BUILDING SYSTEM
22 Electrical	WIRING HARNESSES; INTEGRATED WITH BUILDING SYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULES, IN-FILL PANELS; ADD-ON UNITS; PREFABRICATED FOUNDATION PANELS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF MODULES, IN-FILL PANELS & EXTERIOR COMPONENTS
27 Labor	SEMISKILLED & UNSKILLED IN FACTORY; UNSKILLED ONSITE
28 Labor Training Programs	DIRECT LABOR; INDIRECT PRODUCTION SUPPORT PERSONNEL
29 Community Involvement	LOCAL, UNDER-USED & MINORITY LABOR; SELF-HELP GROUPS; FRANCHISERS
ECONOMICS	
30 Construction Costs	$13,104 PER UNIT, 4,000 UNITS PER YEAR (BEST RATE)
31 Financing Methods	CONVENTIONAL
32 Useful Life	WOOD MODULE—50 YEARS; HEATING & AIR CONDITIONING—25 YEARS.
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; ENGINEERING; PRODUCTION; CONSTRUCTION; MARKETING; FINANCE
35 External Functions	DESIGN; PLANNING; SYSTEMS ENGINEERING; DEVELOPMENT OF CONCRETE SYSTEM
36 Market Area	400-MILE RADIUS FROM EACH PLANT; 7 PRIMARY MARKET AREAS PLANNED
37 Delivery Rate	4,000 UNITS PER YEAR (BEST RATE)
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	HIGH-VELOCITY-AIR HEATING & COOLING PACKAGE; FUTURE TOTAL ENERGY SYSTEMS
40 Codes	ADAPTABLE TO NATIONAL MODEL CODES

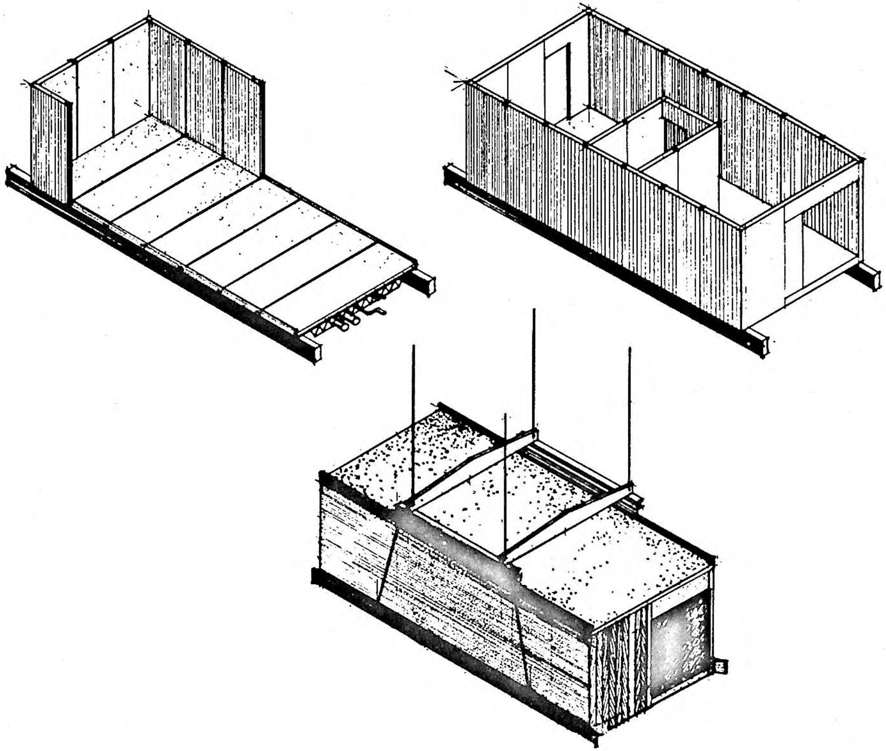
Levitt Technology (continued)

beams (in multistory assemblies) and stressed-skin panel trusses. Floor structures are built with heavier than average perimeter beams, to withstand loads imposed by transportation and crane handling at the site. The use of the hinged panels and sliding walls (for entries, bays, and interior partitions) provides greater architectural flexibility within transportation limitations. In effect, an adjustable structure is built in the factory for easy change and erection on site. Mechanical connecting systems such as blind spring clips and buried cam-lock clamps allow for low-labor, positive-action installation of panels and connections both in the factory and on the site.

The concrete module system, to be used later, is based on developments by one of the subcontractors employing a two-step mixing process that combines cement, water, chemical additives, and protein foam to produce panels with a selected density of 35 lb. per sq. in. (higher densities can be attained for special requirements of foundations and textured surfaces).

A patented panel joining method will be used in this system. Abutting surfaces of the panels will be coated with an adhesive before the panels are tied together with sheetmetal strips whose punched teeth are inserted into kerfs in the panels. A gripping tool, part of the system, fixes the teeth into the concrete and forces edges into tight compressive contact. No reinforcing steel is used in side panels, but the floor-ceiling sandwich makes use of an open-web steel joist to produce a 12-in.-deep unit that allows for easy integration of mechanical and electrical components.

Development of attitude and opinion surveys, post-occupancy evaluation studies, and consumer acceptance studies are proposed to implement planning and design development and marketing programs. The optimum volume production rate projected is 4,000 dwelling units per year.



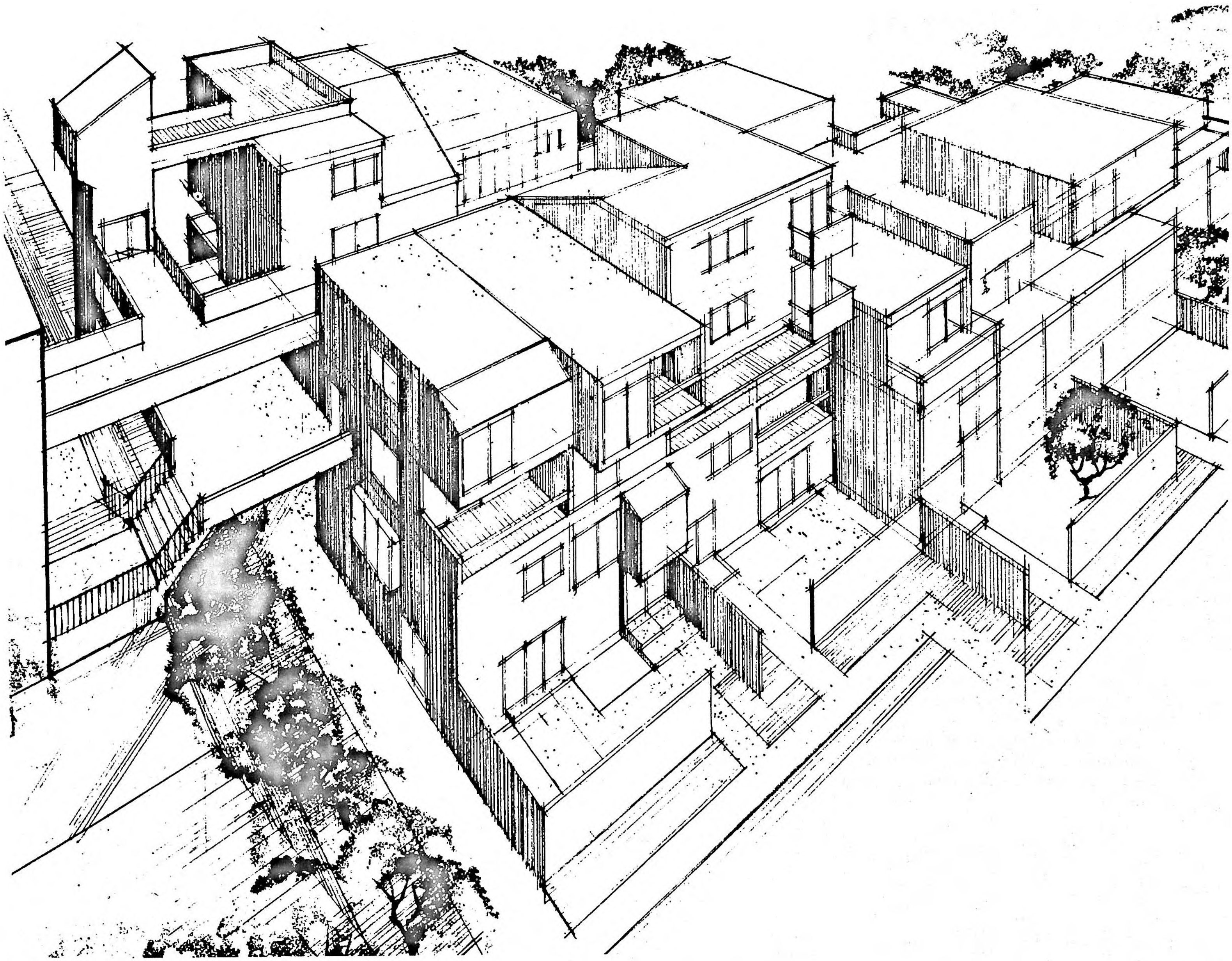
Concrete System

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW RISE (POSSIBLE HIGH-RISE)
12 Unit Variations	EFFICIENCY, 1 TO 6 BEDROOMS
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DESIGN STAGE
15 Community Involvement	ATTITUDES-OPINION, POST-OCCUPANCY EVALUATION, & CONSUMER ACCEPTANCE STUDIES

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE SELF-SUPPORTED MODULES; WALL & FLOOR STRESSED-SKIN IN-FILL PANELS
17 Exterior Elements	IN-FILL PANELS; CONVENTIONAL FINISHES; BALCONIES; PORCHES; DECKS; PARAPETS
18 Interior Elements	WOOD-PARTITION CLOSET PANELS; CONVENTIONAL WALL, FLOOR, CEILING FINISHES
19 Foundations	CONVENTIONAL CONCRETE OR MASONRY; POSSIBLE BASEMENT SYSTEM WITH PRECAST CONCRETE
20 Comfort Systems	UTILITY CORE; HIGH-VELOCITY-AIR HEATING-COOLING UNIT INTEGRATED IN BUILDING SYSTEM
21 Plumbing	PLASTIC PIPE & FITTINGS FOR WATER SUPPLY & DRAINAGE; INTEGRATED WITH BUILDING SYSTEM
22 Electrical	WIRING HARNESSES; INTEGRATED WITH BUILDING SYSTEM
23 Furnishings	



Lockheed Aircraft

PROPOSER

Lockheed Aircraft Corporation, Ontario, California

AFFILIATES

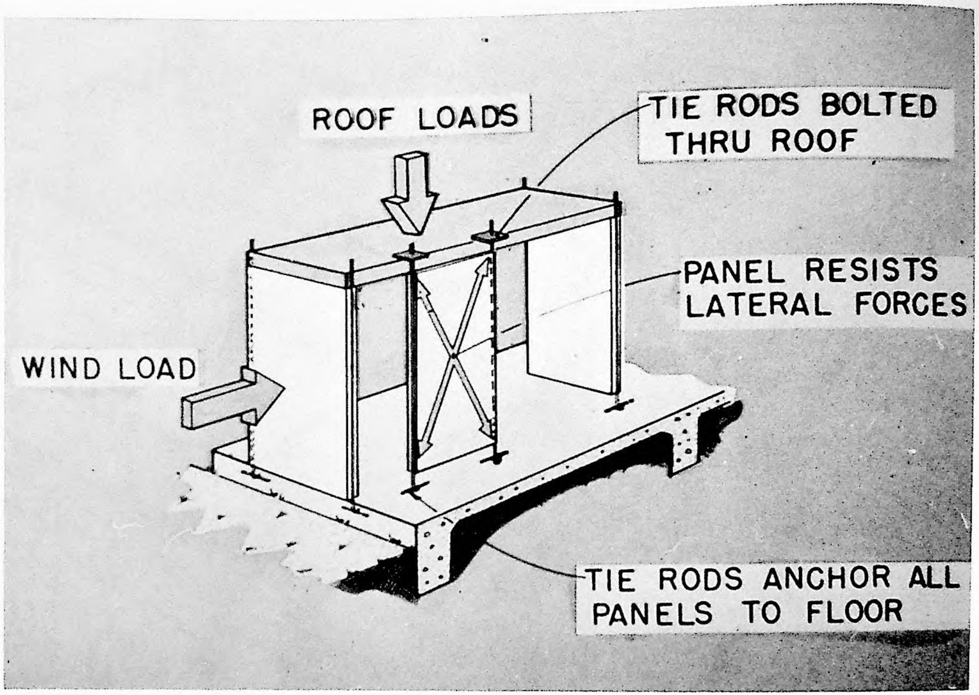
American Cement Tech Center; Victor Gruen Associates, Architects; Smith-Emery Testing Labs; Steinbrigge & Moon Consultants; Dillingham Corporation

A simple panel lock method of joinint precast aluminum-edged concrete panels are features of this proposal for construction of dwellings. The modular building concept allows mass production of independent components also adaptable for construction of schools, hotels-motels, apartments, dormitories or shopping centers.

The panels are cast in onsite production facilities which are relocatable. Panel dimensions for wall components are standard at 4 ft. wide, 8 ft. long and 2 in. thick. These are assembled on prepared conventional slab foundations with integral grade beams, with extruded edge members securely fastened with locking clips.

Structural stability is obtained by using a continuous tension bolt run through each joint and secured at foundation and roof. This bolted extrusion intersection forms a load-bearing column for roof support. For pitched roof styles, lightweight supporting trusses and purlins are installed and covered with roofing materials such as sheet, tiles, and shingles. Flat roof configurations utilize precast concrete roof panels measuring 13 ft. 2 in. by 4 ft. by 3-1/2 in. which match the standard 4 ft. wall panel dimension.

Electrical conduit, or wiring, is cast in place in the panels as are some plumbing service lines. It is estimated that 10 percent of the site labor is skilled, 90 percent unskilled.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	
3	Topography	ADAPTABLE TO TOPOGRAPHIES WITH GRADIENTS UNDER 12% & TO ALL NORMAL SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	
6	Nonresidential Functions	NON-RESIDENTIAL FACILITIES MAY BE ADDED
7	Circulation	
8	Site Planning Services	PROFESSIONAL SERVICES
9	Community Involvement	STUDY TO ASCERTAIN USERS' OPINIONS HAS BEEN CONDUCTED AT PROTOTYPE SITES
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	2 TO 4 BEDROOMS
13	Design Selection	
14	State of Development	PRODUCTION PLANT—DESIGN STAGE; BUILDING SYSTEM BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	PRECAST ALUMINUM-EDGED CONCRETE WALL & ROOF PANELS; ROOF TRUSSES & PURLINS
17	Exterior Elements	
18	Interior Elements	STAIRS; CARPETING; ASBESTOS TILES
19	Foundations	CONVENTIONAL
20	Comfort Systems	DESIGNED FOR CLIMATIC CONDITIONS OF SITE
21	Plumbing	INTEGRATED INTO BUILDING SYSTEM
22	Electrical	INTEGRATED INTO BUILDING SYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	PANELS
25	Onsite Production	ELECTRICAL & PLUMBING HOOK-UP; FOUNDATIONS; ASSEMBLY OF PANELS
26	Onsite Construction	SKILLED; SEMISKILLED; UNSKILLED
27	Labor	CLASSES & ON-THE-JOB TRAINING FOR HARD CORE UNEMPLOYED
28	Labor Training Programs	LOCAL CONTRACTORS; LABOR
29	Community Involvement	

ECONOMICS

30	Construction Costs	$6,935 PER DWELLING UNIT (1000 2-BEDROOM UNITS PER YEAR)
31	Financing Methods	DWELLING UNIT—25 YEARS; UTILITIES—20 to 50 YEARS
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT
35	External Functions	TESTING; DESIGN; ENGINEERING; PLANNING; CONSTRUCTION
36	Market Area	ONE DWELLING UNIT PER DAY WITH 6 MEN ONSITE
37	Delivery Rate	
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	ADAPTABLE TO ALL NATIONAL MODEL CODES
40	Codes	

Low Income Housing Development

PROPOSER CONSORTIUM

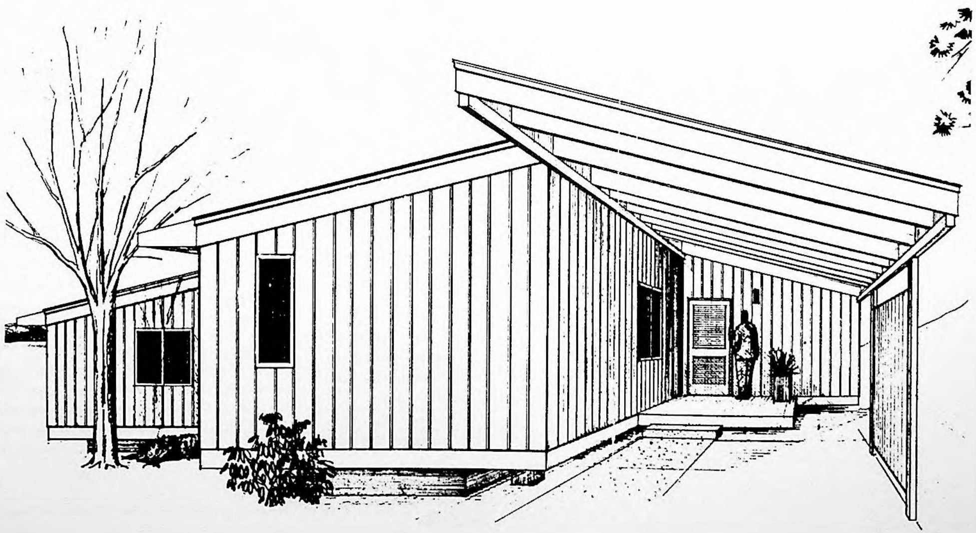
Low Income Housing Development Corporation, Durham, North Carolina
Techni-Craft Inc., Ashville, North Carolina
United Durham, Inc., Durham, North Carolina
Manpower Development Corporation, Chapel Hill, North Carolina
Research Triangle Institute, Durham, North Carolina

Wood-framed, volumetric modules with sloping ceilings, factory-completed and shipped to the site on steel frames, as are mobile homes, comprise the system proposed. One or more of the 12-ft. x 36-ft. or longer modules may be joined to form a single dwelling unit. As many as 10 moduels may make up multiple dwelling units separated by fire walls.

The proposal is aimed primarily at low income groups, and the proposer organization includes among its shareholders community representatives from the North Carolina regions where the system hopes to find initial acceptance. Although a new production plant is being planned, facilities exist already for temporary manufacture of a limited number of units.

There are basically only two types of modules: the living module in which is located the plumbing wall, with bathroom and kitchen backed up to it, with other mechanical facilities closely associated; and the bedroom module which includes no plumbing facilities. Both types of modules are of similar post-and-beam construction; a beam-and-deck roof system affords an open, sloped ceiling. Exterior walls are 2-in. x 4-in. load bearing studs, batt insulated, with the exterior skin being rough-sawn stained plywood, available in a variety of textures, patterns and colors.

Interior partitions are of nonbearing stud construction, finished with gypsum board or optional plywood paneling. Floor construction is plywood on 2-in. x 8-in. joists, batt insulated, and vinyl asbestos finish or op-



tional carpeting. The roof finish is asphalt-shingled, vinyl-coated wood fiber decking.

The modules are sited on concrete-filled masonry block piers with concrete footings, and are self-supporting. Under certain topographical conditions, however, the steel frame used to transport the module may be left as a supporting girder system, rather than being returned to the factory for reuse.

In addition to variety in arrangement and joining of the modules, architectural diversity is gained by optional use of additions such as exterior decks, terraces, trellises, carports, exterior storage, and fireplaces.

All mechanical services are factory-installed in the modules, only plumbing hook-up and electric panel connection being required at the site. Electric baseboard heating is standard, but an optional forced warm air heating and cooling system also is available.

Further emphasizing their marketing to low income groups, the proposer intends to hire representatives from the communities involved to act as consultants in determining preferences once a model home has been displayed. They also plan to publish lists of areas in which prospective owners can participate in completing construction of the modules, both in the factory and onsite.

Summary Information

SITE SYSTEM	
1 Site Situation	SUBURBAN; RURAL
2 Density Range	7 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES & SOIL CONDITIONS EXCEPT MARSH
4 Climate	GENERALLY ADAPTABLE EXCEPT FOR HEAVY RAINFALL, HIGH WIND, OR SEISMIC AREAS
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	LOCAL CONSULTANTS TO DETERMINE USER PREFERENCES
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	TEMPORARY PRODUCTION PLANT; BUILDING SYSTEM REQUIRES FURTHER DEVELOPMENT
15 Community Involvement	LOCAL CONSULTANTS TO DETERMINE USER PREFERENCES
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTING POST-AND-BEAM WOOD-FRAME VOLUMETRIC MODULES
17 Exterior Elements	STAINED PLYWOOD EXTERIOR; OPTIONAL DECKS, TERRACES, CARPORTS
18 Interior Elements	WOOD STUD-GYPSUM BOARD PARTITIONS; STORAGE UNITS; OPTIONAL FIREPLACES
19 Foundations	CONCRETE-FILLED MASONRY BLOCK PIERS WITH CONCRETE FOOTINGS
20 Comfort Systems	ELECTRIC BASEBOARD HEATING; OPTIONAL FORCED WARM AIR HEATING & COOLING
21 Plumbing	FACTORY-INSTALLED
22 Electrical	FACTORY-INSTALLED
23 Furnishings	
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES INCLUDING MECHANICAL SYSTEMS & ADDITIONS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING & JOINING OF MODULES; UTILITY HOOK-UPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	SELF-HELP IN FACTORY & ONSITE WORK
ECONOMICS	
30 Construction Costs	\$8,772 PER UNIT (\$9 PER SQ.FT.), 1,000 UNITS PER YEAR
31 Financing Methods	PROPOSER SUPPLIED; PRIVATE INVESTORS; EQUITY PARTICIPATION; LAND BANK
32 Useful Life	TOTAL UNIT; 40 TO 50 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN; PRODUCTION; CONSTRUCTION; MARKETING; MANAGEMENT
35 External Functions	
36 Market Area	150 MILES FROM DURHAM, NORTH CAROLINA AT PRESENT
37 Delivery Rate	2 TO 3 HOUSES PER DAY
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	ORGANIZATIONAL CONCEPTS
40 Codes	CONFORMS TO ALL NATIONAL CODES

Macon Prestressed Concrete Company

PROPOSER

Macon Prestressed Concrete Company, Macon, Georgia.

AFFILIATES

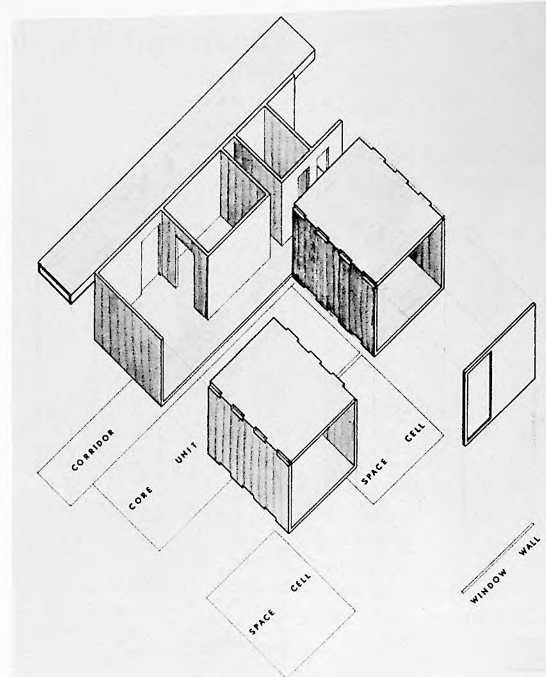
Atlanta Gas Light Company; Smith and Polychrone, Architects.

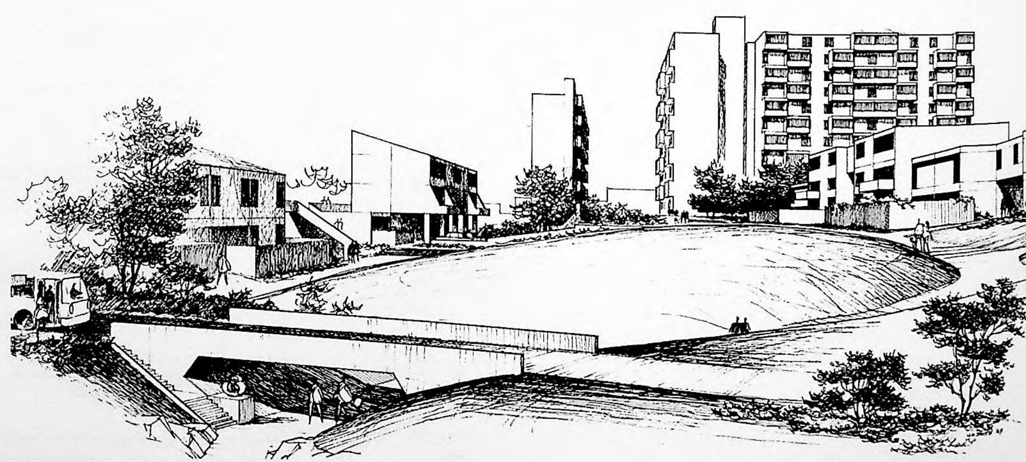
Two types of reinforced-concrete volumetric modules—a core unit and a space cell—comprise the housing system proposed. One core unit, embodying kitchen, bath, plumbing stack and other utilities, combined with one or more space cells makes up a dwelling unit.

Both types of modules are 12 ft. wide, room high, and vary in length. In a typical high-rise project, the units are assembled by stacking the core units one above the other to form built-in vertical chases and utlity distribution systems for servicing the entire building. The space cells are stacked checkerboard or honeycomb fashion, living space thus being created both within the 4-sided cells and between them. The ends of the cells are closed on the exterior by prefabricated window walls and on the interior by partitions of concrete or polyurethane sandwich panels. Other elements required to complete a typical high-rise structure include hallway slabs of reinforced concrete and conventionally constructed foundations.

Both types of modules are fully fabricated and finished in a choice of conventional finishes on an assembly line and will be delivered to the site with only jointing and connection of utilities required.

The core module, the heart of the dwelling unit, contains, in addition to kitchen and bath (backed up to a common factory-installed plumbing wall) a hallway, an additional room, and an individual heating system, with hot or chilled air being distributed through a prefabricated plenum situated along the ceiling of the hallway, which is common to the core and the space cells.





Electrical distribution, from the vertical chase in the core, is via plastic conduit cast into the walls of both core and space cells. Hot water for each dwelling unit is supplied from the heating system.

Market area for the proposed housing system is within a 300-mile radius of Atlanta or Macon, Ga., with further research and development being required before actual production can begin.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN
2 Density Range	4 TO 10 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER; COMMON OPEN SPACES
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN CIRCULATION; PEDESTRIAN WALKWAYS WITH VEHICULAR OVERPASS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 3 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEM DEVELOPMENT REQUIRED; PRODUCTION FACILITIES IN DESIGN
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	CONCRETE SELF SUPPORTED MODULES & PARTIAL MODULES; CONCRETE CORRIDOR SLABS
17 Exterior Elements	WINDOW & CLOSURE-WALL UNITS; BALCONIES; CONVENTIONAL FINISHES
18 Interior Elements	POLYURETHANE SANDWICH PARTITIONS; HALLWAY PLENUM; PAINT OR VINYL WALLCOVERING
19 Foundations	CONVENTIONAL
20 Comfort Systems	CENTRAL HYDRONIC OR FORCED AIR HEATING PER 2 UNITS; INTEGRATED COOLING
21 Plumbing	INTEGRATED WITH UTILITY CORE MODULE; PVC DRAINAGE PIPING
22 Electrical	PLASTIC RACEWAYS; INTEGRATED WITH UTILITY CORE MODULES & BUILDING SYSTEMS
23 Furnishings	

PRODUCTION

24 Offsite Production	COMPLETE & PARTIAL MODULES; CORRIDOR SLABS; CLOSURE WALLS; PARTITIONS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; UTILITY CORE PLACEMENT; ERECTION OF MODULES; UTILITIES HOOK-UPS
27 Labor	SEMISKILLED AND SKILLED FOR SITE CONSTRUCTION & PRODUCTION PLANT
28 Labor Training Programs	PROPOSER TO TRAIN CONCRETE FINISHERS FOR PLANT PRODUCTION
29 Community Involvement	

ECONOMICS

30 Construction Costs	$14,300 PER 2-BEDROOM DWELLING UNIT FOR 1,000 UNITS
31 Financing Methods	
32 Useful Life	TOTAL STRUCTURE—50 YEARS

MANAGEMENT

33 Proposer Organization	COMPANY
34 Internal Functions	CONSTRUCTION
35 External Functions	FINANCIAL; DEVELOPMENT; COORDINATION & PROJECT MANAGEMENT; MECHANICAL DESIGN
36 Market Area	300-MILE RADIUS FROM MACON OR ATLANTA, GEORGIA
37 Delivery Rate	4 UNITS PER WEEK
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	GENERALLY ADAPTABLE TO NATIONAL MODEL CODES

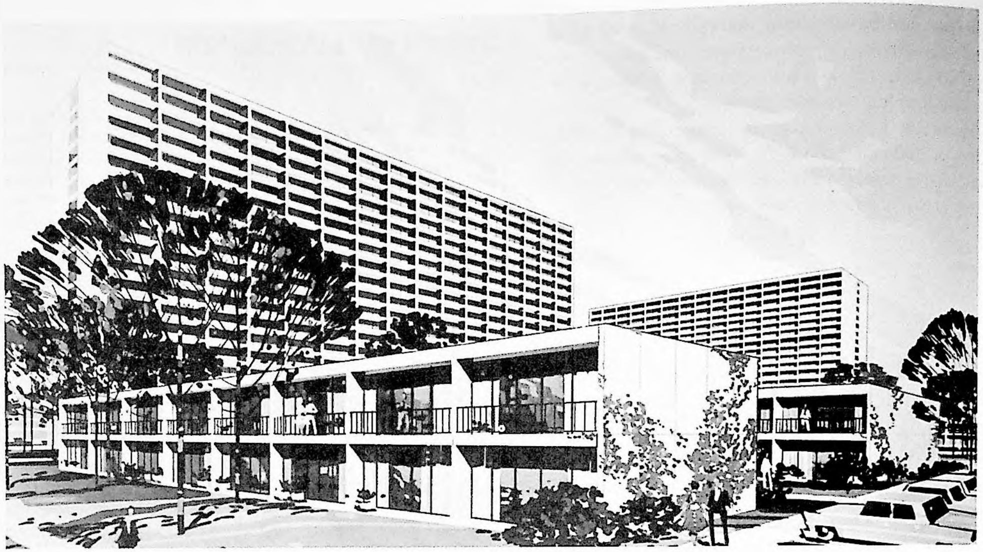
Martin-Marietta

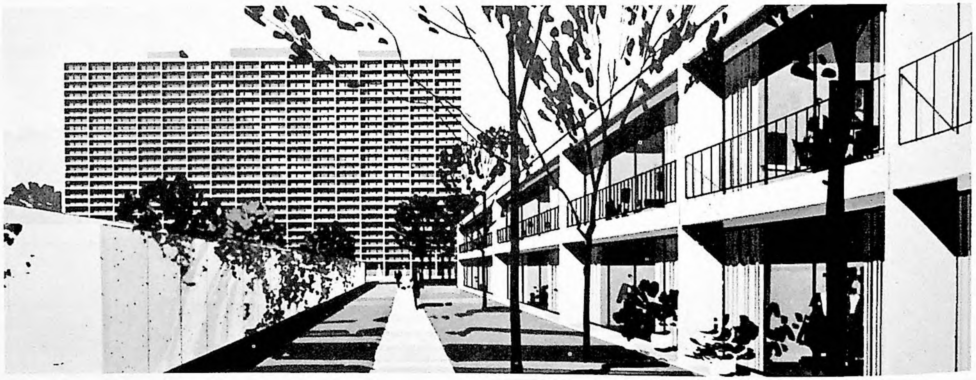
PROPOSER CONSORTIUM

Martin-Marietta Corporation, New York, New York
Precast Systems, Inc., Rosemont, Illinois
U.S. Gypsum Company, Chicago, Illinois
Lennox Industries, Marshalltown, Iowa
C.F. Murphy Associates, Architects, Chicago, Illinois

AFFILIATES

Wiss, Janny, Elstner & Associates; The Consulting Engineers Group, Inc.





Basic to this proposed system is the teaming of the proved reliability and erection speed of precast concrete structural building elements with advanced concepts in prepackaged, removable, and replaceable mechanical systems or elements of those subsystems.

Only two kinds of precast structural members are required to erect dwelling units and high-rise structures up to 25 stories: concrete bearing wall panels; and prestressed, long span concrete double-T beams for floor and roof systems. These elements alone comprise the entire structural system; and without need for a structural framework, the 8-in. thick walls are able to sustain dead and live loads for the entire structure and transmit them to the foundations.

The use of double-T floor and roof beams gives the proposed system increased flexibility of interior arrangements because the long-spanned members reduce the number of bearing walls required, thus permitting nonbearing interior partitions where desired and use of nonstructural glass curtain exterior walls, for a feeling of spaciousness. The double-T sections, ranging in length from 24 ft. to 48 ft., are from 6 ft. to 8 ft. wide, these widths being butted together to form the subfloor or the roof of the dwelling unit, and the ceiling being formed by gypsum board framed across the bottom of the T stems.

Through standardization of the relatively few types and sizes of concrete components required, and through their widespread availability from the 40 precasting companies affiliated with the proposer consortium, increased quality and lowered costs are anticipated. A volume production rate of 80,000 dwelling units per year (200,000 in the second year of production) from 68 casting plants is projected.

The precast components may be finished on the interior with painted or plastered gypsum board over 2 in. of rigid insulation, and on the exterior with a textured design cast into the surface, or coated with natural or decorative aggregates. The pre-fabricated glass curtain walls, usually set off by a balcony, will be aluminum-framed. Floors will be finished with carpeting or resilient tile.

Matching in importance is the systems approach to mechanical subsystems. Each element is prefabricated and prepackaged into an easily installed unit. Wiring harnesses for main and branch circuits may be preinstalled in wall panels or may be installed quickly onsite through prepared conduits. All appliances and fixtures are prewired and plug instantly via interconnectors to their respective wiring harnesses.

Kitchen and bath facilities arrive onsite as units ready for hook-up, the plumbing lines being tied in by snap-on prefabricated connections, sealed with polyvinyl chloride.

Each apartment or dwelling unit in a typical low- or high-rise housing project is served by an equipment room in which is located an individual heating and ventilating system, accessible from the building's corridor (for greater serviceability and heightened security for the apartment). A vertical chase adjacent to this room supplies the heating system with both fuel and electricity, with main and branch harnesses further distributing the electricity to the rest of the unit via the space between the legs of the double-T floor and roof beams and the gypsum board ceiling which enclosed the space.

This space is used also for distribution of the forced air from the heating system, for piping, for venting the heating system horizontally to outside air, and for refrigerant lines connecting the air conditioners condensing unit to the evaporator coil in the equipment room. Access openings, precast into the stems of the double-T beams, permit future servicing from adjacent perimeter walls of any of these mechanical linkages.

In high-rise structures, provision is made to force an additional supply of fresh air into the building's corridors, which in turn supplies fresh air for each dwelling unit and for combustion of the individual heating systems. These systems have been designed for inexpensive and effective conversion to full air conditioning.

The pool of unskilled labor common to urban areas may be tapped for training in installation of some interior partition work in the dwelling units, as well as for painting and floor finishing. The design flexibility of the proposed system permits arrangement and re-arrangement of rooms to meet the tenants' needs or desires, which will further help to involve the occupant-owner or tenant. Also, in each project the proponent plans to engage a special consultant in the area of socio-environmentalism, to accommodate the different living patterns of varying social or ethnic groups.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	6.75 TO 187 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	LINEAR; SPOT; CLUSTER; OPEN SPACES; MIXED DENSITIES
6 Nonresidential Functions	LAUNDRY; COMMUNITY CENTER; SHOPPING CENTER
7 Circulation	SEPARATE VEHICULAR; PEDESTRIAN CIRCULATION; CUL-DE-SAC; GRID STREETS
8 Site Planning Services	GENERAL CONTRACTOR; COMMUNITY & NEIGHBORHOOD PLANNING
9 Community Involvement	SURVEYS TO DETERMINE USER NEEDS
10 Utilities	MULTIFAMILY HIGH-RISE—POSSIBLE ONSITE SOLID WASTE TREATMENT
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 to 3 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	PRODUCTION FACILITIES OPERATIONAL; BUILDING SYSTEM DEVELOPED & MARKETED
15 Community Involvement	INVESTIGATION OF USER NEEDS IN HOUSING DESIGN & COMMUNITY PLANNING
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE WALL PANELS; PRESTRESSED DOUBLE-T FLOOR AND ROOF SLABS
17 Exterior Elements	PREFABRICATED CURTAIN WALLS; BALCONIES—HIGH-RISE
18 Interior Elements	PREFABRICATED GYPSUM PARTITIONS; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	LOW-RISE: INDIVIDUAL FORCED AIR HEATING; HIGH-RISE: CENTRAL SYSTEM
21 Plumbing	CONVENTIONAL; FACTORY FABRICATED KITCHEN AND BATHROOM UNIT
22 Electrical	PREFABRICATED WIRING HARNESS INTEGRATED WITH BUILDING SUBSYSTEMS
23 Furnishings	
PRODUCTION	
24 Offsite Production	T-BEAMS; WALL PANELS; MECHANICAL COMPONENTS; KITCHEN & BATHROOM UNITS
25 Onsite Production	
26 Onsite Construction	ERECTION OF PANELS—WALLS, ROOF, FLOORS; MECHANICAL HOOK-UPS; FINISHING
27 Labor	SKILLED LABOR IN PLANT; SKILLED, SEMISKILLED, UNSKILLED ONSITE
28 Labor Training Programs	TRAINING FOR FACTORY ONSITE LABOR
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	LOW-RISE: $12.66 TO $13.96 PER SQ.FT.; HIGH-RISE: $13.91 PER SQ.FT.
31 Financing Methods	
32 Useful Life	STRUCTURAL SYSTEM—100 YEARS; PARTITIONS AND PANELING—50 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; CONSTRUCTION; MARKETING; DESIGN
35 External Functions	
36 Market Area	150 MILE RADIUS OF 40 CASTING PLANTS NATIONALLY LOCATED
37 Delivery Rate	80,000 DWELLING UNITS PER YEAR; 200,000 DWELLING UNITS PER YEAR IN TWO YEARS
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM: ARCHITECTURAL & ENGINEERING DESIGN
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Material Systems

PROPOSER

Material Systems Corporation, Palm Springs, California.

AFFILIATES

U. S. Financial Corporation, Finance, Marketing; Skidmore, Owings and Merrill, Architects; Componoform, High-rise Adaptation.

The basis of this proposal is a composite material-fiber-reinforced polyester with a base filler—molded in a systematic way to appear as durable and strong as traditional materials. The proposer has used the process to construct dwelling units, which have the appearance of adobe block walls with Spanish tile roofs, for an Indian reservation in California. These experimental homes, prototype of the proposal, can be assembled on site in two days. In addition, a modification to these units was developed which permits them to be sold under the California mobile home code. These units have a similar brick and tile appearance but are constructed in three modules. The modules are delivered to the site where they are assembled into a complete housing system.

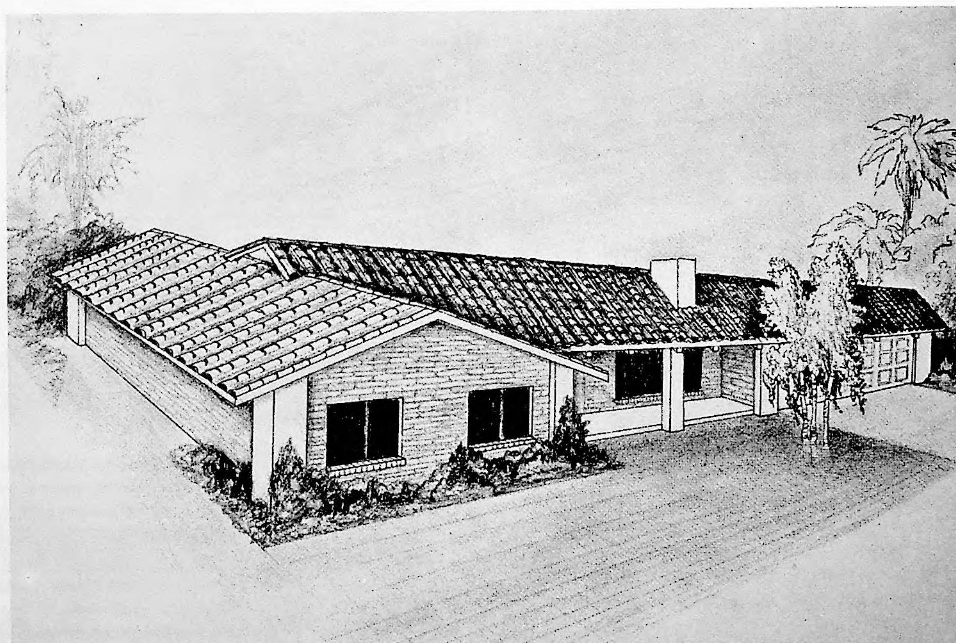
It is estimated that this construction can save from $3.00 to $7.00 per sq. ft., depending upon the styles replicated. Keystone to the polyester-resin formulation is an ultraviolet ray absorber and a polymer film for protection against surface erosion. These new elements and unique design and manufacturing techniques differentiate this proposal from earlier attempts to make housing from a polyester-reinforced composite material.

Although slab-on-ground foundations were used in the experimental homes, the three-module units utilized a composite sandwich flooring. The flooring system is built to include all ducting, wiring, and plumbing. The walls, floors, and roofs are interconnected by a joining system of composite material elements. All joining is accomplished by chemical methods.

The entire housing system can be fabricated from eight types of wall elements, two roof elements, and two floor elements. The wall sections, 3 ft., 6 ft., 9 ft., and 12 ft. wide, are composed of composite laminate ribs bonded to internal and external laminates, and include plastic foam or blown asbestos in the sandwich core for thermal and sound insulation. Depending on the load requirements, the walls can be from 1 in. to 6 in. thick. The proposer explains that any texture, replicating any kind of material, can be used inside and out. The tooling required for replicating different materials adds significantly to cost but this tooling is a one-time expense.

The roof elements and finish trim also can be replicated in any form or material. Assembly can be in the factory or onsite and is adaptable to use of onsite, unskilled and semiskilled labor. Self-help programs are proposed. Repair of units can be accomplished through room-temperature curing of polyester fiber composites, an activity which the proposer sees as a logical outgrowth of the self-help program.

The bathroom assembly is produced as a laminated system that includes the floor, shower, sink, and 6-ft. splashwalls, and is the first to be placed on the foundation, thus permitting easy access to wiring and plumbing. The kitchen assemblies are integrally formed by spraying a structural composite into a mold, with all the appurtenances. When the assembly is completed, it is removed from the mold, installed on the foundation, and is laminated to the adjoining wall structures. Wiring, including most electrical outlets and piping are carried in the joining elements of the wall structure, providing easy access for repair or alterations.



Summary Information

SITE SYSTEM

1	Site Situation	SUBURBAN; RURAL
2	Density Range	5 TO 23.7 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	COMMON OPEN SPACES
6	Nonresidential Functions	RECREATION FACILITIES; COMMERCIAL FACILITIES
7	Circulation	PEDESTRIAN & VEHICULAR SEPARATION
8	Site Planning Services	
9	Community Involvement	PLAN DEVELOPED IN ACCORDANCE WITH ETHNIC & ECONOMIC NEEDS OF COMMUNITY
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE; HIGH-RISE POSSIBLE
12	Unit Variations	1 TO 5 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION FACILITY IN DESIGN STAGE; BUILDING SYSTEM MARKETED
15	Community Involvement	RESIDENTS TO BE INVOLVED IN DESIGN

BUILDING SUBSYSTEMS

16	Structure	FIBER-REINFORCED, POLYESTER-RESIN & BASE-FILLER WALL, ROOF & FLOOR PANELS
17	Exterior Elements	
18	Interior Elements	PREFABRICATED BATHROOM AND KITCHEN ASSEMBLIES; PREFABRICATED PARTITIONS
19	Foundations	CONVENTIONAL SLAB-ON-GROUND OR PREFABRICATED COMPOSITE SANDWICH PANELS
20	Comfort Systems	ELECTRIC RADIANT STRIP HEATER; SEPARATE COOLING SYSTEM OPTIONAL
21	Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM; KITCHEN & BATH ASSEMBLIES
22	Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM; PLASTIC CONDUITS
23	Furnishings	

PRODUCTION

24	Offsite Production	ROOF, FLOOR & WALL PANELS; FOUNDATION PANELS; KITCHEN AND BATHROOM ASSEMBLIES
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PANEL ASSEMBLY; UTILITY HOOK-UPS
27	Labor	UNSKILLED LABOR FOR ONSITE CONSTRUCTION & ERECTION
28	Labor Training Programs	TRAINING TO BE PROVIDED FOR UNSKILLED LABOR
29	Community Involvement	LOCAL BUILDING CONTRACTORS, ARCHITECTS, ENGINEERS; TENANT MANAGEMENT

ECONOMICS

30	Construction Costs	$4.57 TO $5.93 PER SQ. FT.
31	Financing Methods	CONVENTIONAL
32	Useful Life	STRUCTURE—40 YEARS; MECHANICAL & ELECTRICAL EQUIPMENT NORMAL

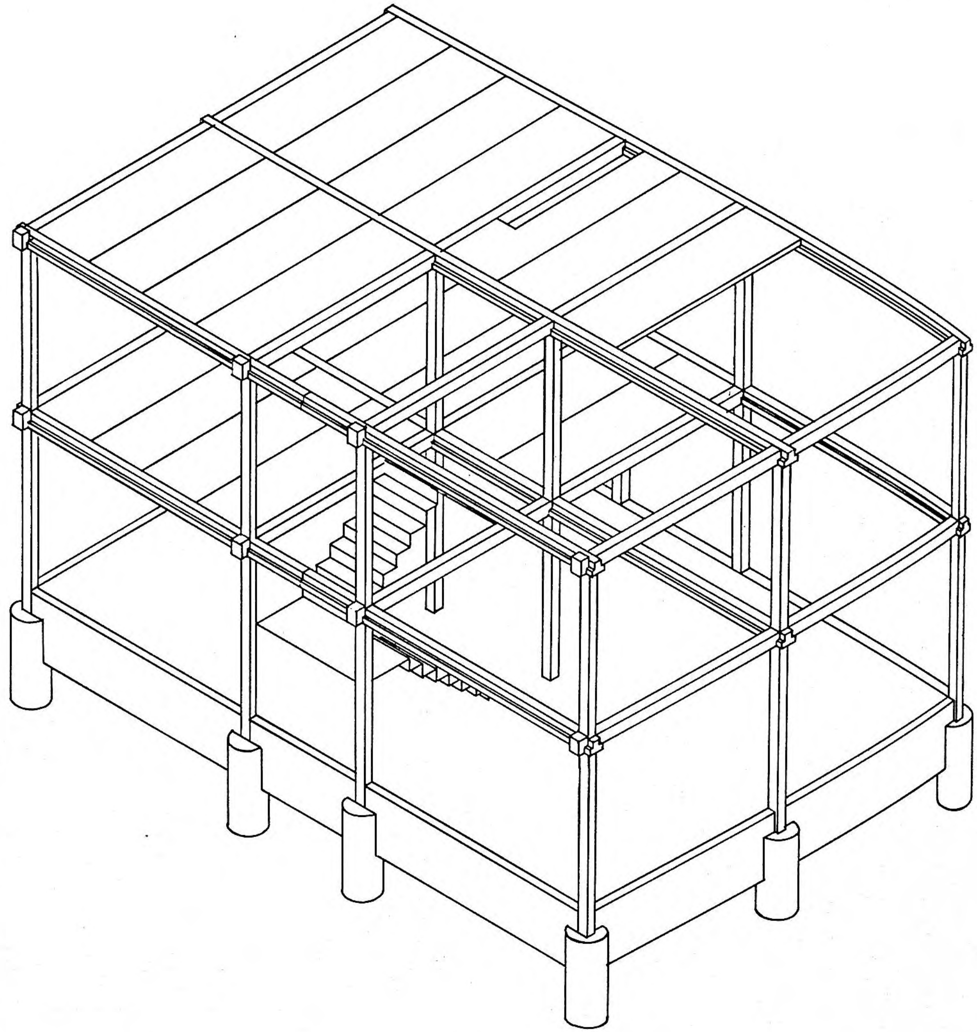
MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	PRODUCTION
35	External Functions	FINANCE, MARKET, DESIGN
36	Market Area	
37	Delivery Rate	100 TO 700 DWELLING UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	FIBER-REINFORCED, POLYESTER-RESIN & BASE-FILLER PANEL
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Mid-City-Mitchell



PROPOSER CONSORTIUM

Mid-City Developers, Inc., Builders and Developers, Washington, D.C.
Kaufman and Broad, Inc., Builders and Developers, Los Angeles, California.
Neal Mitchell Associates, Inc., Architects and Engineers, Cambridge, Massachusetts.
International Construction & Marketing, Inc., Builders and Developers, Cambridge, Massachusetts.
Building Systems Development, Inc.—TRW Systems Group, San Francisco, Redondo Beach, California.

AFFILIATES

National Urban League, Minority Community Interests; Council for Equal Business Opportunity, Minority Community Business; Armstrong Custom Fabricators, Precast Forms Manufacturer; The Budd Company, Wall Systems; The Wallace Murray Corporation, Eljer Plumbingware Division, Bathroom Systems; Genova Products, Inc., Plumbing Systems; B. F. Goodrich Company, Industrial Products Division, Sealants; W. R. Grace and Company, Construction Products Division, Waterproofing Systems; Lennox Industries, Inc., HVAC Systems; The Tappan Company, Kitchen Systems; Jerome Berger, of LaClede Town Company, Management & Environmental Design Consultant; Stanley H. Rutterberg and Associates, Inc., Labor Consultant; Millstone Associates, Inc., Labor Consultants; Circle, Inc., Black Economic Development & Construction Consultant; Phoenix Systems, Inc., Community Resources; Keneth Korb, Attorney; Philip M. Brownstein, Legal Counsel.

A precast, reinforced concrete framing system, designed to carry all structural loads, is the basis of the building system proposed. The system is adaptable to single-family and multifamily construction in either urban or rural areas. Volume production of frame components, panels and subsystem assemblies is proposed through franchise or partnership agreement with an estimated minimum production of 400 units per year per plant, and a target aggregate production of 50,000 units per year for all activities.

Since the framing system performs the structural function for a module of 12 ft. by 10 ft., the interior partitions are adaptable to almost any desired interior arrangement, and to a variety of architectural treatment on exterior skins is possible. Any type of finish

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL; ESPECIALLY ADAPTABLE TO IN-CITY INFILL
2	Density Range	UP TO 32 DWELLING UNITS PER ACRE; MAXIMUM DENSITY NOT YET TESTED
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	UNIT, BLOCK & GROUPING DESIGN FOR SPECIFIC SITES & ENVIRONMENTAL CONSTRAINTS
6	Nonresidential Functions	STUDY & EVALUATION OF ARRANGEMENTS; SYSTEM EXTENDED FOR COVERED SPACES
7	Circulation	USE OF EXISTING ROAD SYSTEMS FOR IN-CITY DENSITY INCREASES
8	Site Planning Services	PROPOSER'S DESIGN TEAM & LOCAL ARCHITECTS & PLANNERS
9	Community Involvement	OPINION & USER SURVEYS; CONSUMER ACCEPTANCE STUDIES; SIMULATION GAMES
10	Utilities	EXISTING WATER, SEWER & GARBAGE COLLECTION SYSTEMS FOR IN-CITY DENSITY INCREASES

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE; ADAPTABLE TO HIGH-RISE
12	Unit Variations	MODULAR FRAMING SYSTEM PROVIDES HORIZONTAL & VERTICAL FLEXIBILITIES
13	Design Selection	STANDARD PLANS FOR IMMEDIATE CONSTRUCTION; DEVELOP FLEXIBLE SELECTION METHOD
14	State of Development	PRODUCTION PLANT DEVELOPED; BUILDING SYSTEM REQUIRES DEVELOPMENT & TESTING
15	Community Involvement	URBAN SIMULATION GAME WITH USER-PLAYER MODELING & REMODELING OF HOME

BUILDING SUBSYSTEMS

16	Structure	REINFORCED CELLULAR CONCRETE COLUMN & BEAM FRAME, TIE BEAMS & ROOF & FLOOR PANELS
17	Exterior Elements	METAL FRAME OR RIGID INSULATION CORE WALL PANELS; BALCONIES, DECKS & PORCHES
18	Interior Elements	GYPSUM BOARD PARTITIONS; CANTILEVERED BEDROOM CLOSETS; CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL; CONCRETE CAISONS, OPTIONAL FROSTWALLS; OR UNIQUE GRID RAFT
20	Comfort Systems	FORCED AIR HEATING; OPTIONAL FUEL, COOLING, ROOFTOP INSTALLATION
21	Plumbing	PVC PIPING; SINGLE STACK PLUMBING TREE; KITCHEN & BATHROOM PACKAGES
22	Electrical	PRIMARY & SECONDARY DISTRIBUTION INTEGRATED WITH BUILDING SUBSYSTEMS
23	Furnishings	

PRODUCTION

24	Offsite Production	FRAME COMPONENTS; PANELS; MECHANICAL SUBSYSTEM PACKAGES; PLUMBING TREES
25	Onsite Production	OPTIONAL FRAME COMPONENTS & PANELS, ASSEMBLY OF PLUMBING TREES
26	Onsite Construction	FOUNDATIONS; FRAME & PANEL ERECTION; UTILITY PACKAGE PLACEMENT & HOOK-UPS
27	Labor	UNSKILLED & SEMISKILLED FOR PRODUCTION; UNSKILLED & SEMISKILLED FOR CONSTRUCTION
28	Labor Training Programs	FRANCHISEES—FRAME FABRICATION & ASSEMBLY; CONSTRUCTION & ERECTION
29	Community Involvement	CONTRACTORS, MINORITY GROUP DEVELOPERS, PROPERTY MANAGERS; SELF-HELP LABOR

ECONOMICS

30	Construction Costs	$13.00 TO $14.00 PER SQ. FT., 400 UNITS PER YEAR
31	Financing Methods	CONVENTIONAL & PROPOSER SUPPLIED; PARTIAL CAPITAL INVESTMENT BY JOINT VENTURES
32	Useful Life	TOTAL STRUCTURE—IN EXCESS OF 50 YEARS

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	DESIGN, DEVELOPMENT; NEIGHBORHOOD HOUSING SYSTEM COMPANY; FRANCHISING
35	External Functions	FRANCHISERS; SITE DEVELOPMENT; PRODUCTION, TRAINING; LABOR RELATIONS
36	Market Area	NATIONAL; VOLUME PRODUCTION, 100 FRANCHISED SITES
37	Delivery Rate	400 UNITS PER YEAR PER FRANCHISER, MINIMUM; TARGET, 50,000 UNITS PER YEAR, TOTAL
38	Consumer Protection	INSURABLE STRUCTURE; WARRANTEES: KITCHEN, HVAC, EXTERIOR SEALANTS, INTERIOR

GENERAL

39	Major Innovative Concepts	BUILDING SYSTEM; PRODUCTION, MARKETING & NEIGHBORHOOD HOUSING SYSTEMS
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Mid-City-Mitchell (continued)

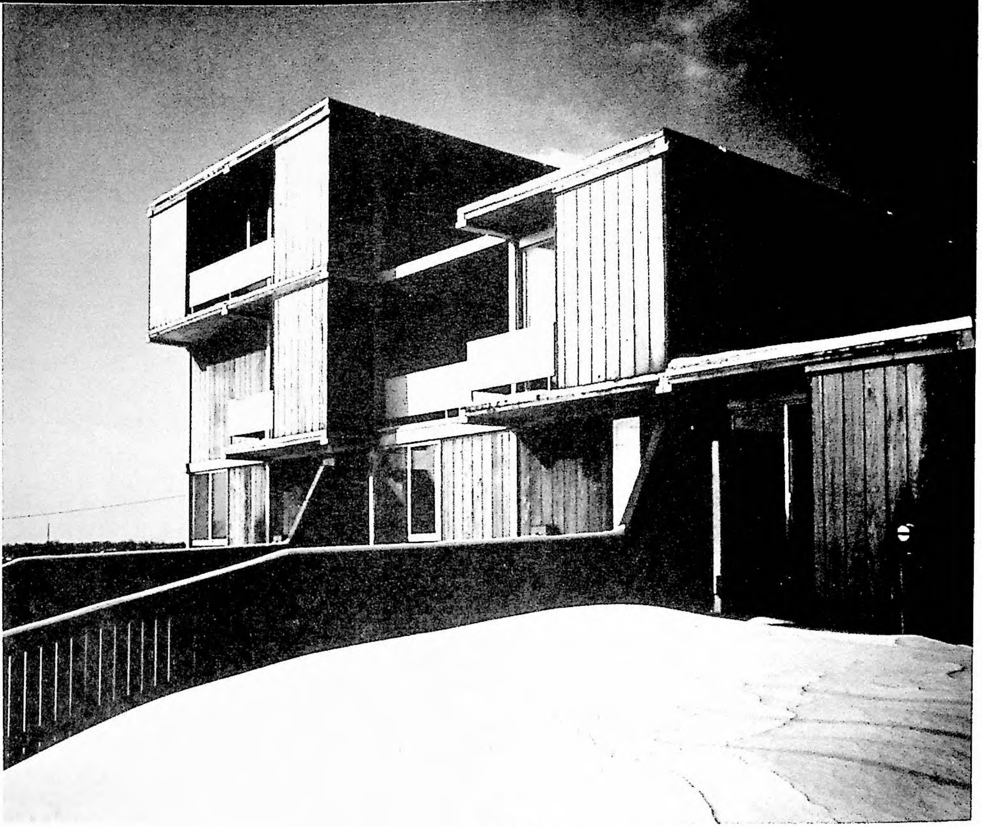
can be applied to nonbearing panels, and insulation to suit the desired climate and noise levels can be added.

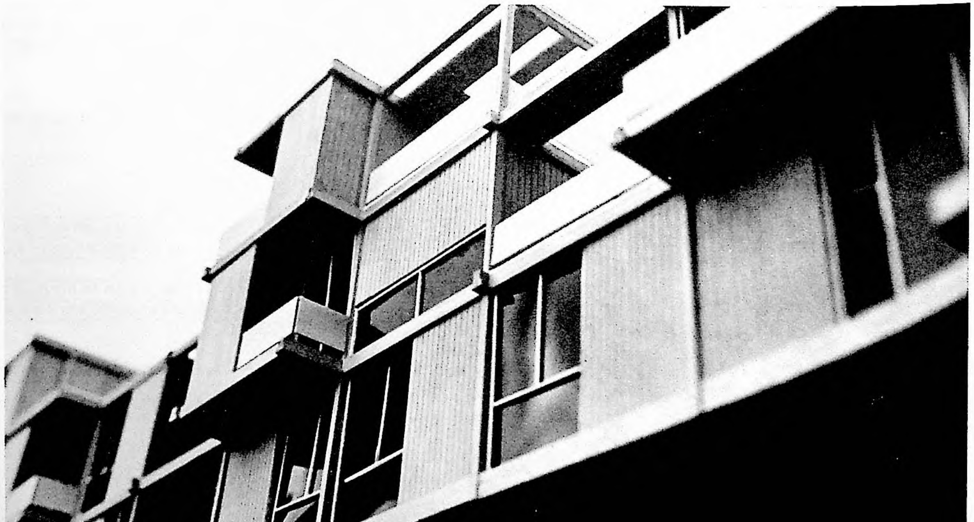
Basic elements of the system are a series of four reinforced, precast cellular concrete components: a column, a cantilever frame beam; a tie beam; and a precast slab with field applied topping which serve both for roof and floor elements and provide stiffness to the structure by diaphragm action. The columns and beams are notched to receive components and maintain positional accuracy during erection; elements are tied together with a patented system of bolts to transfer loads and impart structural integrity. The bolted areas, extending outside the beams, are later concreted for protection. The basic bay may be massed or spread in almost any configuration and may be erected to heights of four stories.

Columns are bolted to caissons, spread footings, or unique raft foundations with frostwalls. Local craftsmen for installation of all systems can be utilized.

Interior and exterior finishes may be of any desired material and texture—ceilings may be either sprayed accoustical material or hung ceilings. The latter are preferred, since they then provide space for ducts and returns for a forced, warm air heating system that may also be used for cooling if desired.

Closets provided are all larger than standard; cabinetry, primarily located in the kitchen area, is shipped preassembled and prefinished, as part of a total kitchen-appliance and cabinet assembly (which includes a structural appliance wall and prefinished replaceable counter tops). Stairs for interior private areas are wood; exterior public stairs are of steel and concrete construction.





All plumbing fixtures are located adjacent to a central mechanical core. In a single-story unit, the bathroom is back-to-back with the kitchen; in multistory units, laundry areas are back-to-back with the kitchen and bathrooms are located on upper floors above the laundry. Because a single, standard distribution and collection plumbing tree is used throughout, there is provision made for subsequent addition of a toilet and lavatory within the laundry area. This also permits addition of future bathrooms on expanded intermodules, created by vertical expansion. The tree is of plastic pipe, for hot and cold water, as well as for waste lines.

A complete system for electrical distribution has been designed; the primary, vertical distribution is located in a vertical chase; secondary horizontal distribution is located either within an adjacent hallway ceiling, or covered with cast-in-place concrete topping. In either case, circuits are fed directly from a particular partition, outlet, or fixture directly back to a junction box located at slab level within the vertical mechanical core.

Midland Company

PROPOSER

The Midland Company, Cincinnati, Ohio

AFFILIATE

Midland Guardian Company, Finance

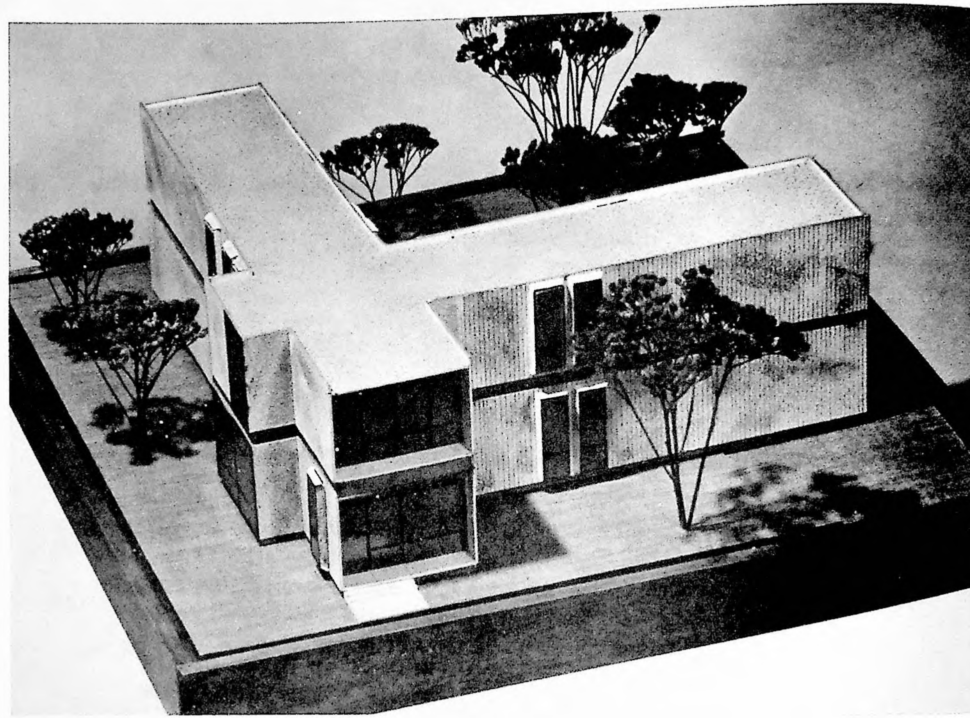
Eight basic room- or dwelling-sized modules, subject to a total of fourteen possible variations, resulting in a wide variety of living arrangements, are offered. Modules are manufactured in similar manner to homes on an assembly-line procedure.

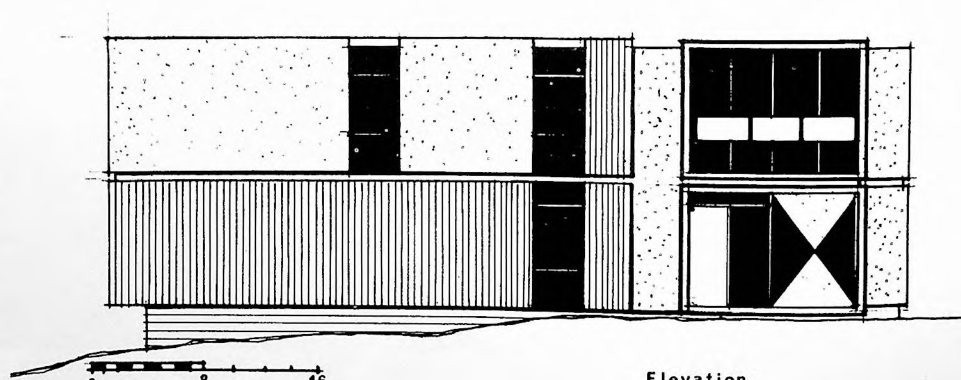
Architectural interest is offered by variation in joining of the modules to each other vertically, side-by-side, or at right angles; by roof treatment; and by exterior finish. A gabled roof, for example, results from side-by-side joining of two modules with single slope roofs, while a steep slope roof over second-story living space can be provided by fold-up side walls and roof which swing into place from hinges affixed to the lower module. Some units may be furnished with a mansard-effect, particularly for 2-story town-house and garden apartment plans.

The modules, all 12-ft. wide and 9 1/2-ft. high, range in length from 3 ft. to 60 ft; the 3-ft. stub being a linking or transition module for use between larger units and is a key to flexibility of layout. Many configurations of housing may be produced from the modules, ranging from single-family detached, two-story houses with gabled roofs, to two-story townhouses and garden apartments.

Common to one module in each dwelling unit is a center partition which incorporates a plumbing wall which services bath, kitchen and laundry facilities. This is so located that, when the modules are stacked vertically, the plumbing networks interlock with a consequent saving in plumbing runs for the resultant low-rise structure. The only onsite work required, therefore, is connection between these interlocking plumbing walls and connection to utility service lines.

The modules are self-supporting, and, although somewhat conventional in their wood-framed con-





Elevation

struction, have greater structural strength than their conventional counterparts. They are assembled on a steel-framed carrier which serves as a building platform. Once assembled, the modules may be crane-lifted or rolled from the carrier for transport and placement on prepared foundations.

Exterior finishes vary from textured, wood-grained aluminum siding furnished as a standard, to options such as vinyl siding, plywood, painted surface, natural stone or brick veneer, or 4-in. regular brick, the latter three, of course, being applied at the site.

Interior walls are generally 1/4-in. prefinished plywood, with painted surfaces available as an option. Standard floor finish is vinyl asbestos tile, with padded carpeting available as an option. The roof deck is 5/8-in. plywood, covered with built-up roofing.

Insulation is fiberglass, with built-in acoustical protection resulting from the 1 in. of air space which occurs between the modules when joined side-by-side. The modules and their built-in mechanical services—plumbing, heating, and wiring—require only positioning and hook-up to be ready for occupancy, onsite work requiring no more than a day.

The proposer has five plants built and presently capable of manufacturing the modular units, with delivery time being no more than a day to locations in 19 states, where an organization of 280 dealers is already in existence. An optimum volume production rate of 2,800 modules per year per plant is indicated.

Summary Information

SITE SYSTEM

1	Site Situation	NEW COMMUNITY
2	Density Range	4 TO 60 UNITS PER ACRE
3	Topography	
4	Climate	
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; CLUSTER; COMMON OPEN SPACES
6	Nonresidential Functions	SCHOOLS; PARKS; INDUSTRIAL AREA; COMMERCIAL & RECREATIONAL FACILITIES
7	Circulation	SEPARATE VEHICULAR CIRCULATION; WALKING PATHS; CUL-DE-SACS; CURVILINEAR STREETS
8	Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	
10	Utilities	COORDINATED LAYOUT FOR TOTAL RESIDENTIAL DEVELOPMENT

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	1 TO 7 BEDROOMS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	BUILDING SYSTEM REQUIRES CONSTRUCTION & TESTING; PRODUCTION PLANT BUILT
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WOOD FRAME MODULES
17	Exterior Elements	OPTIONAL WOOD, ALUMINUM, VINYL, STONE, OR BRICK SIDING/FACING; BALCONIES
18	Interior Elements	PREFINISHED PLYWOOD OR GYPSUM BOARD PARTITIONS; MECHANICAL CORE UNIT
19	Foundations	REINFORCED CONCRETE FOOTINGS; CONCRETE BLOCK OR CONCRETE WALL
20	Comfort Systems	FORCED WARM AIR; DUCT SYSTEM IN JOIST SPACE; BASEBOARD REGISTERS
21	Plumbing	CORE UNIT; VENT FAN; INTEGRATED IN MODULE
22	Electrical	INTEGRATED IN MODULE
23	Furnishings	

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES; PARTITIONS; BALCONIES
25	Onsite Production	
26	Onsite Construction	FOUNDATION; PLACING OF MODULE; UTILITY HOOK-UPS; FINISHES
27	Labor	
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	$6.95 TO $11.95 PER SQ.FT.
31	Financing Methods	PRIMARILY PROPOSER SUPPLIED
32	Useful Life	COMPARABLE TO CONVENTIONAL DWELLINGS

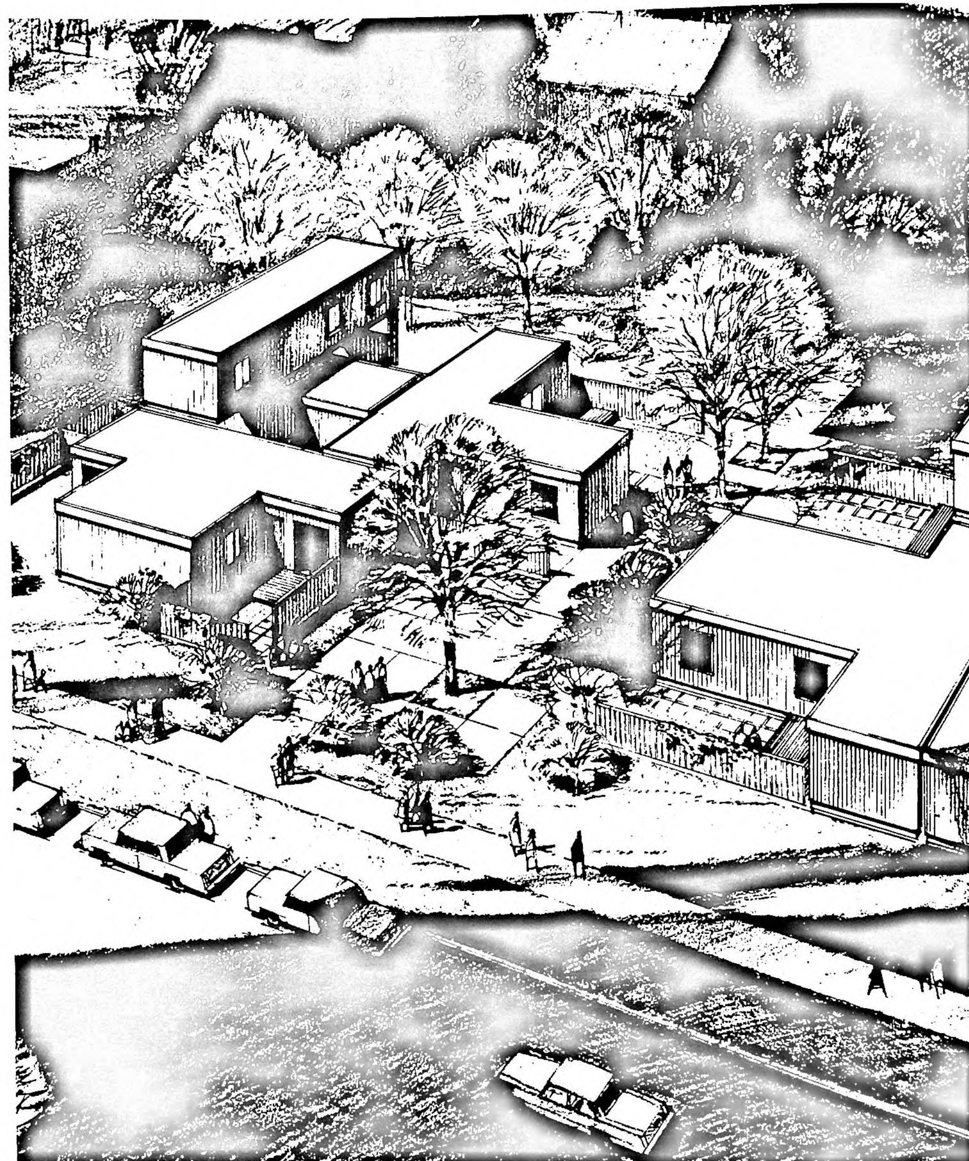
MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANUFACTURING; MANAGEMENT; FINANCE
35	External Functions	
36	Market Area	PLANTS IN AMERICAS, GEORGIA; OREGON; INDIANA; VIRGINIA; 280 DEALERS IN 19 STATES
37	Delivery Rate	2,800 MODULES PER YEAR PER PLANT "BEST RATE"
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	FULL COMPLIANCE WITH ALL APPLICABLE CODES

Modular Community Development, Inc



PROPOSER

Modular Community Development, Inc., Silver Spring, Maryland

This proposer advances an all-inclusive, comprehensive plan for an entirely integrated, self-supporting community. A substantial portion of the development cost would be underwritten by stock subscription managed by the developer. The balance of funds would emanate from federal, state, or local community entities.

It is proposed that a site be selected for a test community area, located midway between Baltimore and Washington, D. C. The plan visualizes: Complete recreational facilities, immediately adjacent to the community site; Transportation media, fulfilling school, market, and recreation requirements; Full commercial and industrial facilities supporting the community complex; An education facility plan embracing preschool through consolidated upper grades, high school, and college with a complete social mix; And a facility supplying all public health needs.

The basic type of housing will be single-family attached construction which can be readily expanded with modular additions for growing families. The structures utilize conventional materials of wood, steel, aluminum, plastic, fiberglass, and concrete. All units are color coordinated and architecturally flexible. Heating, ventilation, and air conditioning will be provided by through-the-wall packaged units, with electric resistance heating elements. Plumbing is prepiped to central service bases. Hence, only quick connection to central service facilities will be required. Bathroom fixtures are packaged fiberglass. Wiring outlets are of multioutlet design requiring single connection onsite. All services will be electric with separate washer and dryer units provided.

Financing for individual units would be obtained by the developer under innovative financing techniques.

Summary Information

SITE SYSTEM

1	Site Situation	RURAL; SELF-SUPPORTING NEW TOWN
2	Density Range	3 TO 150 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	SELF-SUPPORTING NEW TOWN
6	Nonresidential Functions	OPEN SPACES; RECREATIONAL FACILITIES; SCHOOLS; COMMERCIAL PROPERTIES
7	Circulation	SEPARATE VEHICULAR TRAFFIC
8	Site Planning Services	BY PROPOSER
9	Community Involvement	LIAISON WITH COMMUNITY GROUPS TO DISCUSS SITE NEEDS
10	Utilities	ALL ELECTRIC; ADAPTABLE TO GAS

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 6 BEDROOMS
13	Design Selection	
14	State of Development	DESIGN STAGE
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WOOD FRAME & PANEL MODULES
17	Exterior Elements	WOOD, CEMENT ASBESTOS & PLASTIC COATINGS ON WOOD FOR EXTERIOR FINISH
18	Interior Elements	VINYL COVERING OVER GYPSUM BOARD
19	Foundations	CONVENTIONAL
20	Comfort Systems	ELECTRIC THROUGH-WALL HEATING & COOLING UNITS; OR CENTRAL FORCED AIR
21	Plumbing	INTEGRATED WITH BUILDING SYSTEM AT FACTORY; PLASTIC PIPING WHERE APPROPRIATE
22	Electrical	CONVENTIONAL
23	Furnishings	

PRODUCTION

24	Offsite Production	MODULES
25	Onsite Production	POTENTIAL PRODUCTION OF MODULES FOR LARGE SITES
26	Onsite Construction	PLACEMENT OF MODULES; HIGH-RISE FRAME
27	Labor	
28	Labor Training Programs	TRAINING OF HARDCORE UNEMPLOYED
29	Community Involvement	

ECONOMICS

30	Construction Costs	$9.15 PER SQ. FT., 1000 UNITS PER YEAR (BEST RATE)
31	Financing Methods	$300,000 FROM STOCK SUBSCRIPTION; CONVENTIONAL FOR REMAINDER
32	Useful Life	40 TO 60 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT
35	External Functions	ARCHITECTURAL DESIGN; FINANCING; ENGINEERING; PLANNING
36	Market Area	MIDWAY FROM BALTIMORE & WASHINGTON
37	Delivery Rate	1000 UNITS PER YEAR (BEST RATE)
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	

Modular Sciences

PROPOSER

Modular Sciences, Inc., Valley Forge, Pennsylvania (Subsidiary of Certain-Teed Products Corporation).

AFFILIATES

Edward M. Morrissey and Associates, Builders; Hanner/Breitweiser/McLaughlin, Architects, Inc.; Vilican-Leman and Associates, Inc., Site Planners; Research and Development Departments, Certain-Teed Products Corporation.

Wood-framed modules of conventional construction, but built in the factory by assembly-line methods, are the basic blocks of this proposed housing system. Room high, 12 ft. wide, and up to 58 ft. long, the units are virtually complete, requiring only placement, joining, and utility hook-up prior to occupancy.

Sited on conventional foundations, the modules may be assembled in a variety of configurations—end-to-end, side-by-side, or stacked—and are self-supporting in dwelling units up to two stories high. The units are finished conventionally outside and inside. Floor covering may be vinyl, carpeting, or parquet wood. Roofing may be built-up flat, or pitched with asphalt shingles.

The modules will be delivered with all mechanical systems complete. Kitchen and bathroom fixtures will be factory installed, and the plumbing will be copper or plastic piping. Heating will be by electric radiant panels or forced warm air.

The proposer is producing the conventionally framed units, which have been employed for dwellings as well as for motels and restaurants. However, this current approach to housing does not preclude future use of other materials. For example, the proposer is thoroughly investigating the possible use of steel or concrete for modules to be used in multistory housing.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CITY WITHIN A CITY
6 Nonresidential Functions	RECREATIONAL, EDUCATIONAL, & COMMERCIAL FACILITIES
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	WATER DISTRIBUTION; ELECTRICAL SERVICES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	FLEXIBLE
13 Design Selection	
14 State of Development	PRODUCTION PLANT OPERATIONAL, ADDITIONAL PROPOSED; BUILDING SYSTEM MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTED WOOD-FRAMED MODULES; PLYWOOD ROOF DECK
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	PLYWOOD SUBFLOOR; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL
20 Comfort Systems	CONVENTIONAL, INTEGRATED WITH MODULE
21 Plumbing	COPPER AND PLASTIC PIPE; FACTORY-INSTALLED KITCHEN & BATHROOM UNITS
22 Electrical	CONVENTIONAL INTEGRATED IN MODULE
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOK-UPS
27 Labor	UNSKILLED
28 Labor Training Programs	TRAIN UNSKILLED WORKERS ON-THE-JOB
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$10.75 PER SQ. FT., 1000 UNITS (1000 SQ. FT. PER UNIT)
31 Financing Methods	
32 Useful Life	BUILDING—40 YEARS; MECHANICAL-ELECTRICAL SYSTEM—20 YEARS; ROOF—10 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MARKETING
35 External Functions	PLANNING, DESIGN, CONSTRUCTION, PRODUCTION
36 Market Area	
37 Delivery Rate	1000 DWELLING UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	THREE-DIMENSIONAL MODULAR (OR SECTIONAL) FACTORY CONSTRUCTION
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Modular Structures

PROPOSER

Modular Structures, Inc., Pipestone, Minnesota

AFFILIATE

The Times Annex Architects

A tubular steel-framed volumetric module, completely finished inside and out, is joined in a variety of configurations to form housing units in the system proposed. Complete assembly-line manufacture of the modules, with reduction of onsite labor held to a minimum, is the concept embodied by this system.

Basic to the design of the unit itself is the use of 1 1/2-in. diameter tubular steel, joined by welding, to form a structurally self-supporting framework. It is this framework which affords the unit the rigidity to withstand the stresses of transport, handling and placement. It is designed so that virtually all stresses are resolved within the frame, thus relieving the nonstructural exterior and interior wall panels of crack-producing or rupturing stresses.

Assembly of the modules starts with jigs upon which are assembled and welded the tubular members for framing three subassemblies: floor truss system, wall system, and ceiling/roof system. These subassemblies then are joined together to form a box outlining a complete module. Furring strips are fastened by power driven fasteners to both sides of the wall framework and to the floor and ceiling frameworks, followed by subfloor and roof underlayments, and rough-in of plumbing, heating, and wiring.

Polyurethane foam is sprayed over all exposed surfaces providing insulation and integral vapor barrier. Exterior siding of prefinished wood or aluminum is applied and doors and windows are inserted in the openings framed for them. Finally all finish work on the module's interior is accomplished, which may include: painted gypsum board or vinyl-clad walls, carpeting or tile, suspended gypsum board ceiling, prebuilt cabinets, baseboard, plumbing fixtures, light fixtures, and mechanical systems.

Onsite, the modules are set on conventional foundations and joined with others side-by-side, end-to-end or stacked two high. Where modules are to be joined, corresponding exterior and interior skins of the modules are omitted from the framework during plant assembly.

Being self-supporting, the modules when joined vertically may be cantilevered or may even span from one to another, thus creating open but sheltered, free space below. The modules are 12 ft. wide and vary in length by 4-ft. increments, from 24 ft. to 52 ft.

A 90,000 sq. ft. plant in Minnesota has been completed for manufacture of the tubular-framed modules and production of an initial group of buildings has been completed.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	6.37 TO 11.1 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	VARIATIONS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	TUBULAR STEEL FRAME MODULES
17 Exterior Elements	WOOD OR STEEL PANEL FINISH MATERIAL
18 Interior Elements	CONVENTIONAL FINISHES; GYPSUM BOARD; SPRAYED POLYURETHANE FOAM
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	GAS, OIL OR ELECTRIC HEATING; DISTRIBUTION SYSTEMS INTEGRATED IN MODULES
21 Plumbing	CONVENTIONAL; PLASTIC PIPING WHERE APPROPRIATE, INTEGRATED IN MODULES
22 Electrical	CONVENTIONAL; DISTRIBUTION SYSTEM INTEGRATED IN MODULES
23 Furnishings	

PRODUCTION

24 Offsite Production	STEEL FRAME MODULE INCLUDING WALL & CEILING PANELS; MECHANICAL SUBSYSTEMS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOK-UPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	\$13,420 PER UNIT; (\$8.50 PER SQ.FT.) 1200 UNITS PER YEAR (BEST RATE)
31 Financing Methods	CONVENTIONAL
32 Useful Life	SAME AS CONVENTIONAL STRUCTURES

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; CENTRAL RESPONSIBILITY; PRODUCTION
35 External Functions	ARCHITECTURAL DESIGN
36 Market Area	350 MILE RADIUS OF FACTORY
37 Delivery Rate	1,200 UNITS PER YEAR (BEST RATE)
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	TUBULAR, STEEL FRAME MODULES
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Module Communities

PROPOSER CONSORTIUM

Module Communities, Inc., Delaware
Celanese Corporation, Summit, New Jersey
American Standard, Inc., New York, New York

AFFILIATES

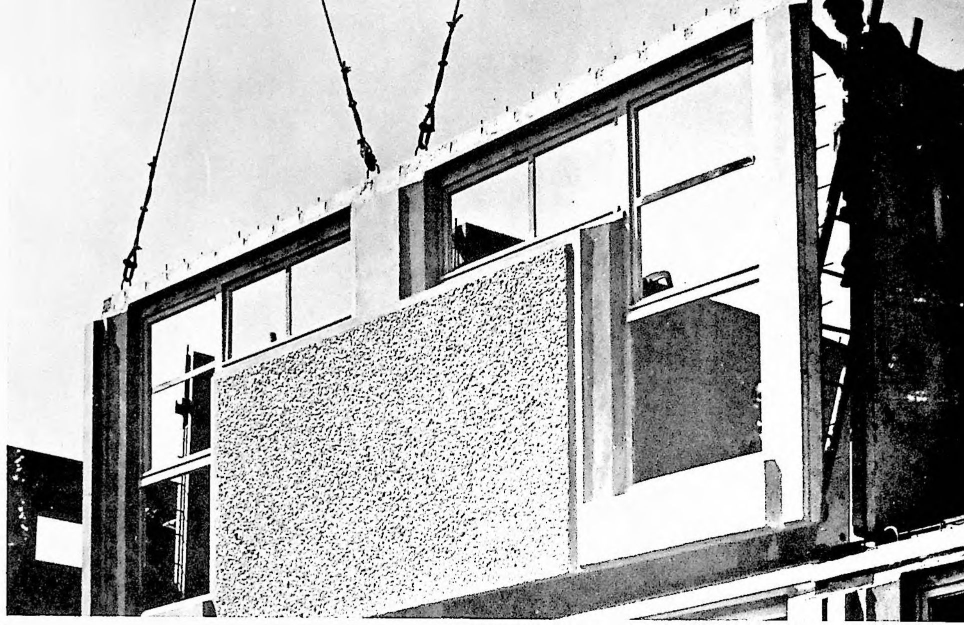
F. D. Rich Company; IBS Industrialized Building Systems, Inc. Systems Design; Paul Weidlinger, Engineering; Cosentini Associates, Engineering; Skidmore, Owings & Merrill, Architectural Design; Hudson Institute, Social Research

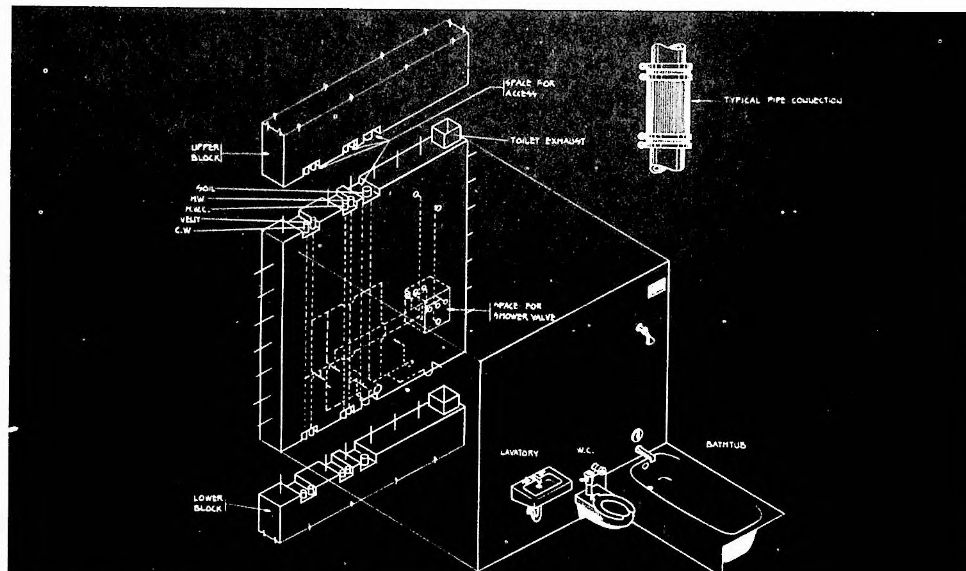
A consortium of major industrial producers, builders, and developers proposes to promote the French Tracoba system of precast concrete panel construction in conjunction with several planning and social research contractors.

Some 70,000 housing units have been produced in Europe with the Tracoba system since 1961. The first factory has been completed in the Bronx, New York, and will be erecting its first American Housing Structure, a 21 story luxury apartment tower in Yonkers, immediately.

The Tracoba system consists of load-bearing cross walls, floor panels, facade panels (which are the sandwich type of nonbearing walls), and various special elements. Cast in factory on steel tables or in vertical batteries, the panels possess a smooth finished surface ready for decoration. Facade panels can be treated in a variety of ways, including mosaics, tiles, and sandblasting.

After curing, the panels are transported to the site and raised by a 10- or 12-ton crane. Walls are positioned and secured through cast-in-place joints. Engineering details of the joints, employing hooked dowels and shear keys, have been prefected sufficiently to result in continuous thermal insulation and a rigid structure capable of resisting lateral forces from wind and earthquake as well as gravity loads. A Tracoba-built high-rise in Alergia, for instance, remained in place after the bottom cross wall was blown up during





a war. The structures possess a minimum of 52-decibel attenuation for sound insulation.

One of the consortium sponsors (American Standard) intends to supply the plumbing core via its preassembled Component Plumbing System. Standard electrical connections and electric heating and air conditioning elements, usually precast into the wall panels, are planned with use of the plastic-coated flexible conduit widely used in Europe.

The consortium submitting the proposal has already developed a successful Harlem, New York turnkey project using conventional construction techniques. A management-training program for a neighborhood organization in central Harlem has been developed that has since been copied throughout the city through the Ford Foundation-supported Center for Community Change. The consortium intends to use the Hudson Institute for long-range evaluation of the purposes and accomplishments of its program as well as the overall assessment of housing capabilities and national resources. Currently a manpower training program, under Jobs '70, is preparing personnel for production jobs in Factory # 1.

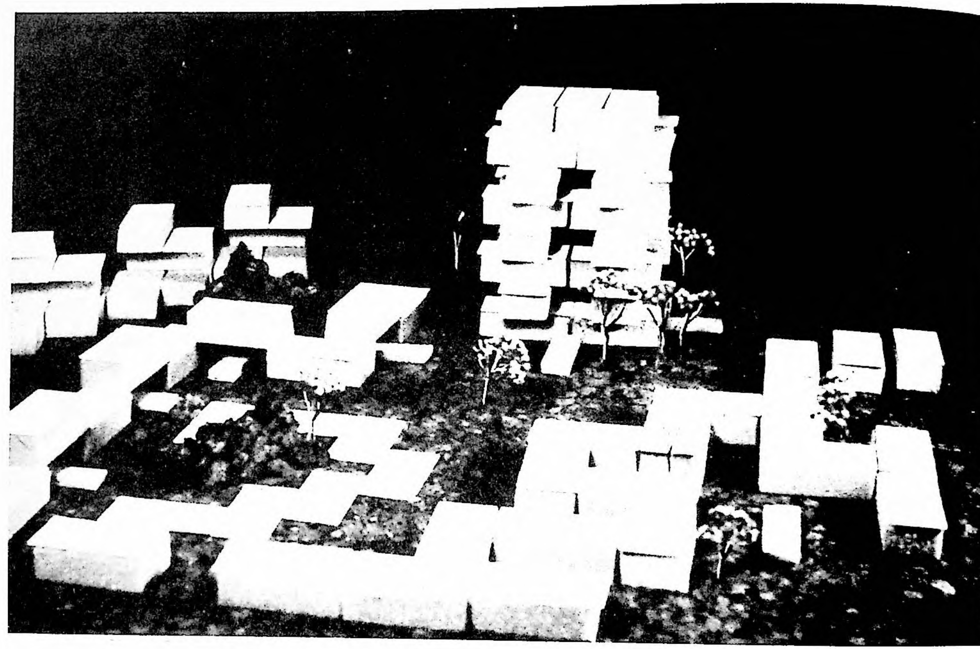
The consortium looks upon such innovations as community participation, labor relations, and land use and taxation as the major research and development efforts, since the engineering capabilities of the Tracoba system have been largely demonstrated, through widespread use in Europe.

The Tracoba system has been packaged for franchising throughout the United States. A formula has been developed, including franchise fees, and negotiations are underway with several builder-developers. American Standard intends to conduct market research and evaluation through its sales offices to define consumer expectation and assess local contractor capabilities as part of its marketing effort for the proposal.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	TOTAL ENVIRONMENT; CENTER SPINE (LINEAL DEVELOPMENT); COMMON OPEN SPACES
6 Nonresidential Functions	RECREATIONAL, COMMERCIAL & COMMUNITY FACILITIES
7 Circulation	PEDESTRIAN TRAFFIC SEPARATION; MULTILEVEL DRIVES; WALKWAYS; BRIDGES
8 Site Planning Services	PROPOSER TEAM WORKING WITH COMMUNITY
9 Community Involvement	RESEARCH & DEVELOPMENT OF COMMUNITY PARTICIPATION
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	BUILDING SYSTEM DEVELOPED & MARKETED IN UNITED STATES
15 Community Involvement	PARTICIPATION OF LOCAL GROUPS IN ESTABLISHING NEEDS
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE WALL, ROOF & FLOOR PANELS JOINTED BY POURED-IN-PLACE CONCRETE
17 Exterior Elements	SANDWICH-TYPE FACADE PANELS VARIETY OF FINISHES
18 Interior Elements	
19 Foundations	CONVENTIONAL
20 Comfort Systems	ELECTRIC BASEBOARD OR HYDRONIC IN EXTERIOR PANELS; OPTIONAL INTEGRATED COOLING
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM
22 Electrical	FLEXIBLE PLASTIC CONDUIT INTEGRATED WITH BUILDING SYSTEM WHEREVER POSSIBLE
23 Furnishings	
PRODUCTION	
24 Offsite Production	PRECAST CONCRETE PANELS; MECHANICAL EQUIPMENT
25 Onsite Production	PRECAST CONCRETE PANELS (POSSIBLE)
26 Onsite Construction	ASSEMBLY & ERECTION OF PANELS; CONNECTIONS; FOUNDATIONS
27 Labor	
28 Labor Training Programs	TRAINING PROGRAM BY PROPOSER
29 Community Involvement	
ECONOMICS	
30 Construction Costs	
31 Financing Methods	FINANCING PROVIDED FOR BY SPONSOR
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MECHANICAL SYSTEMS; MANAGEMENT; MARKETING; RESEARCH & DEVELOPMENT
35 External Functions	SYSTEM DESIGN; PRODUCTION; ERECTION
36 Market Area	NATIONAL
37 Delivery Rate	500 DWELLING UNITS PER YEAR PER PLANT; 1,500 UNITS (OPTIMUM)
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Module Corporation



PROPOSER

Module Corporation, Minneapolis, Minnesota.

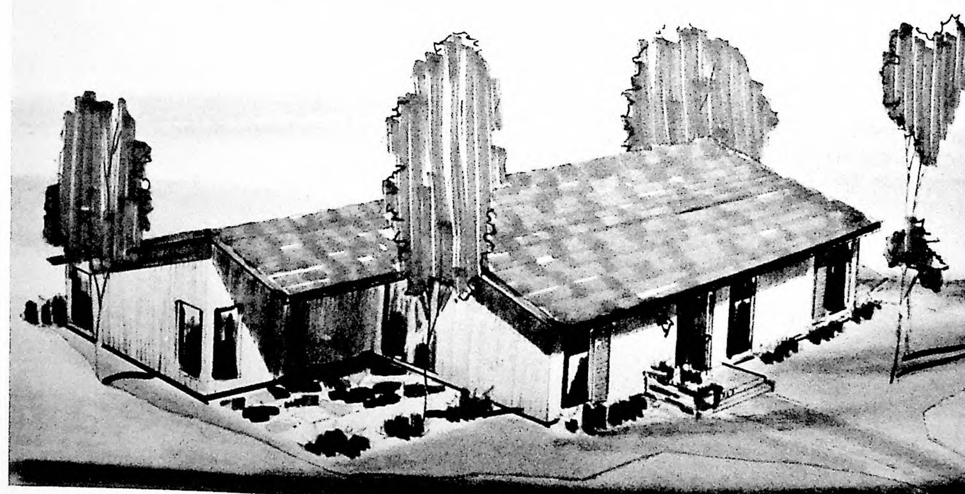
AFFILIATE

Polifka Logan, Design Engineer, Minneapolis, Minnesota.

Room-sized modules of wood and other conventional materials, but factory-built on jigs on an assembly-line basis, are the main ingredients of the housing system proposed. Design dimensions are 14 ft. x 14 ft., with floor plans up to 28 ft. x 42 ft. being evolved from these basic dimensions horizontally, or stacked two or three high for multifamily low-rise projects. However, it is planned that self-supporting modules will be built (and transported) in either the 14-ft. x 14-ft. size, or in a 14-ft. x 28-ft. section, still suitable for over-the-highway shipment in many states.

The modules will arrive on the site ready for furnishing and occupancy, after siting and hook-up of the stubbed-out utility lines in the wet module which incorporates plumbing for bathroom, kitchen, washer and dryer, hot water system, optional air conditioner, and other mechanical facilities.

Exterior finishes on the modules will be as varied as there are acceptable and available materials on the market. Inside finish can be painted gypsum board, paneling, vinyl covered board, or ceramic tile with market and economic considerations often governing the options. Standard acoustical treatment also will be applied in the factory, probably including acoustical tile ceiling. Standard cabinetry, trim and formica counters in the kitchen are planned for the units, with carpeting or similar material expected to be applied to the floors.



"Honeycombing" of the modules in building up dwelling units is expected to result in lower overall cost because approximately 100 percent more living space can be gained through use of the space enclosed between the modules, without any loss in overall structural strength of the low-rise project.

The system is expected to offer certain self-help opportunities to owners or occupants. Partitions may readily be added and painting and application of wall covering may be accomplished with only moderate skill or experience.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	RECREATION AREAS; SWIMMING POOL
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION FACILITIES BUILT & OPERATIONAL
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	ROOM-SIZE SELF-SUPPORTING WOOD FRAME MODULES
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	CONVENTIONAL FINISHES; BATHROOM/KITCHEN MODULES; ACOUSTICAL TILE CEILING
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	OPTIONAL FORCED AIR, HYDRONIC OR RADIANT HEATING; INTEGRATED COOLING
21 Plumbing	CONVENTIONAL; INTEGRATED WITH FACTORY-FABRICATED MODULE
22 Electrical	CONVENTIONAL; INTEGRATED WITH FACTORY-FABRICATED MODULE
23 Furnishings	

PRODUCTION

24 Offsite Production	WOOD FRAME ROOM-SIZE MODULES; BATH/KITCHEN CORES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PLACING OF MODULES
27 Labor	
28 Labor Training Programs	
29 Community Involvement	SELF-HELP

ECONOMICS

30 Construction Costs	$9.00 TO $10.00 PER SQ. FT., 1,000 PER YEAR (MAXIMUM)
31 Financing Methods	FHA CONVENTIONAL
32 Useful Life	STRUCTURE—25 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	CONSTRUCTION; MANAGEMENT; MARKETING; SITE DEVELOPMENT
35 External Functions	DESIGN; ENGINEERING
36 Market Area	300 MILE RADIUS OF FACTORY
37 Delivery Rate	1,000 UNITS PER YEAR (MAXIMUM)
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

N-Q-C Group

PROPOSER CONSORTIUM

N-Q-C Group, Santurce, Puerto Rico
Octaviano-Navarrete-Kindelman, C.E., Engineer
Nicholas Quintana Gomez, AIA, Architect.

Apartment-sized, prefabricated concrete modules attached to a central core tower, starting from the top down, comprise the principal structural elements of the multifamily, high-density, high-rise system proposed. Basic to the proposal is a conviction that there is a need to join a high-rise solution of the problem of intensive land use with the efficiencies of prefabricated dwelling units. Combining these two approaches required the solution of two problems: (1) Providing permanent structural support for, and functional access to, prefabricated living modules; and (2) Creating a means of raising such living modules into position.

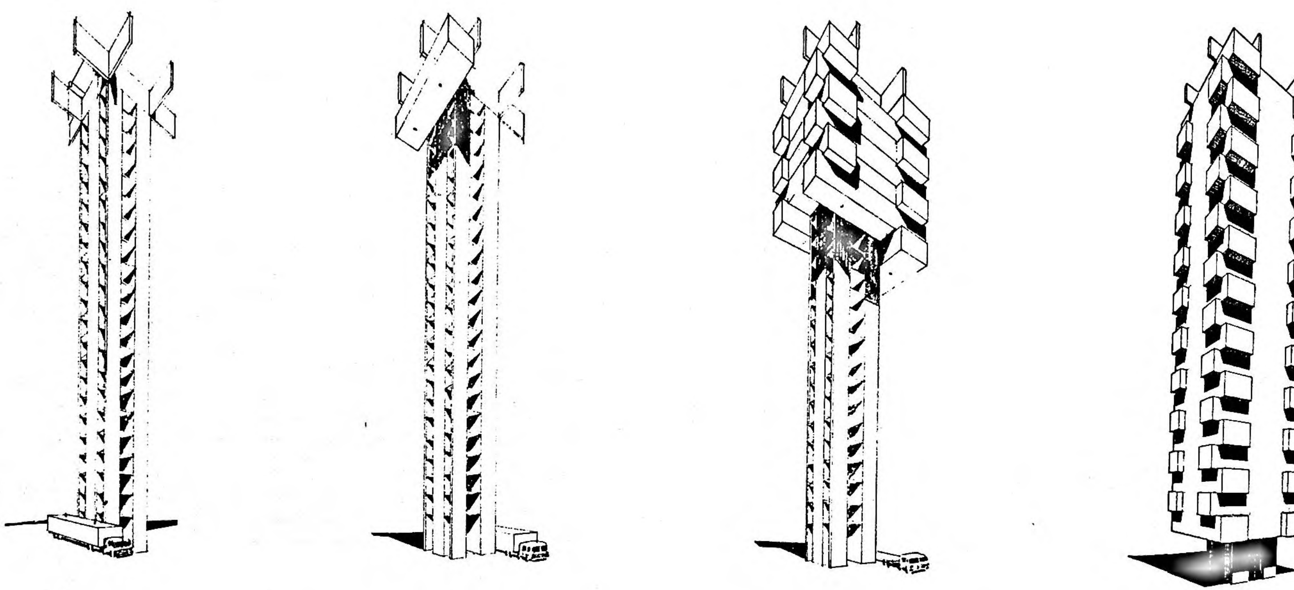
The system consists of three subsystems: (1) The slip-formed, reinforced-concrete core tower, limited in height only by structural design considerations, and embodying elevators, stairwells, conduits for services and utilities, and possibly including laundry facilities, waste disposal, heating, ventilating and air conditioning services, security provisions, and CATV; (2) The reinforced concrete modules ready for occupancy after attachment to the core and utility hook-up; and (3) Temporary components for lifting the modules into place.

Construction begins with slip-forming of the 18-ft. x 21-ft. 4-in. core, which is designed as a vertical tower resembling a vierendeel beam, considering the many openings for landings and stairs. Two pairs of 8-ft.-deep gantry beams, 48 ft. long, top out the tower, one pair at right angles to the other, the rectangle formed by the intersecting beams girdling the perimeter of the tower, the ends cantilevering out on all four faces of the core. Next, the temporary lifting gear is installed, a worm-gear-drive, double-drum winch, anchored to the base of the tower, with winch cables passing up through the center of the tower to a sheave arrangement which passes the cables to one of the pairs of projecting gantry beams.

A trailer truck carrying a concrete module is positioned directly under the gantry beams. The winch cables are attached to a lifting crib through holes in both ceiling and floor slabs. The module is then hoisted into place and mechanically attached to the tower and the gantry beams. The sheave arrangement is then swung 180 degrees to the opposite face of the core, and another module lifted and attached at the same level.

The process continues for the next pair of modules for the next lower level, but against the two faces at 90 degrees to the first two modules. The top of the prefabricated modules are notched to permit a mortising effect between each pair of modules and those above.

The module-hoisting procedure continues until the entire structure has been built completely to the first floor level. The space formed against the core between



each pair of cantilevering modules is utilized, and added to the living space provided within the modules by enclosing this bonus space with an exterior panel. The floor and ceiling for this space is formed by the top and bottom of the pairs of modules below and above and at right angles to the first pair.

The concrete modules will be completely factory fabricated, including installation of all utilities and services. Dimensions of the module are 12 ft. wide x 8 ft. high x 48 ft. long with 4-in.-thick walls, floors, and ceilings. Design of the system will take into account resistance against damage during shipment and erection and will provide for added cantilever beams against the face of the core. Additional rigidity may be afforded the completed structure through buttressing of the tower below the lowest level of modules and through tension ties from tower to top modules to modules below.

The proposer states that the three major subsystems around which its system is built are fully developed, are in use, and are available as required, subject to existing technology, standards, and specifications.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL
2 Density Range	60 TO 120 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	PLAY AREAS; MEETING AREAS; COMMERCIAL SHOPPING
7 Circulation	
8 Site Planning Services	
9 Community Involvement	ENCOURAGEMENT OF CITIZEN PARTICIPATION AT ALL POSSIBLE STAGES OF DEVELOPMENT
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	MULTIFAMILY HIGH-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	PRODUCTION PLANT DESIGN STAGE; RESEARCH REQUIRED FOR BUILDING SYSTEM
15 Community Involvement	CITIZEN PARTICIPATION ENCOURAGED AT ALL POSSIBLE STAGES OF DEVELOPMENT

BUILDING SUBSYSTEMS

16 Structure	SLIP-FORMED REINFORCED CONCRETE CORE TOWER; CANTILEVERED PRECAST-CONCRETE MODULES
17 Exterior Elements	
18 Interior Elements	CENTRAL SERVICE TOWER UTILIZING SINGLE DUCT
19 Foundations	CONVENTIONAL; DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	CONVENTIONAL; CENTRAL HEATING-COOLING SYSTEM INTEGRATED WITH TOWER & MODULES
21 Plumbing	CONVENTIONAL; INTEGRATED WITH CORE TOWER AND MODULES
22 Electrical	CONVENTIONAL; INTEGRATED WITH CORE TOWER AND MODULES
23 Furnishings	

PRODUCTION

24 Offsite Production	MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATION; SLIP-FORMED TOWER; PLACEMENT MODULE; UTILITY INSTALLATIONS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	USE OF LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	$8.00 PER SQ. FT. (1000 SQ. FT. UNIT), 600 UNITS PER YEAR (BEST RATE)
31 Financing Methods	
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CONSORTIUM TO BE INCORPORATED INTO A PRIVATE COMPANY
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	10 UNITS PER DAY, 600 UNITS PER YEAR (BEST RATE)
38 Consumer Protection	

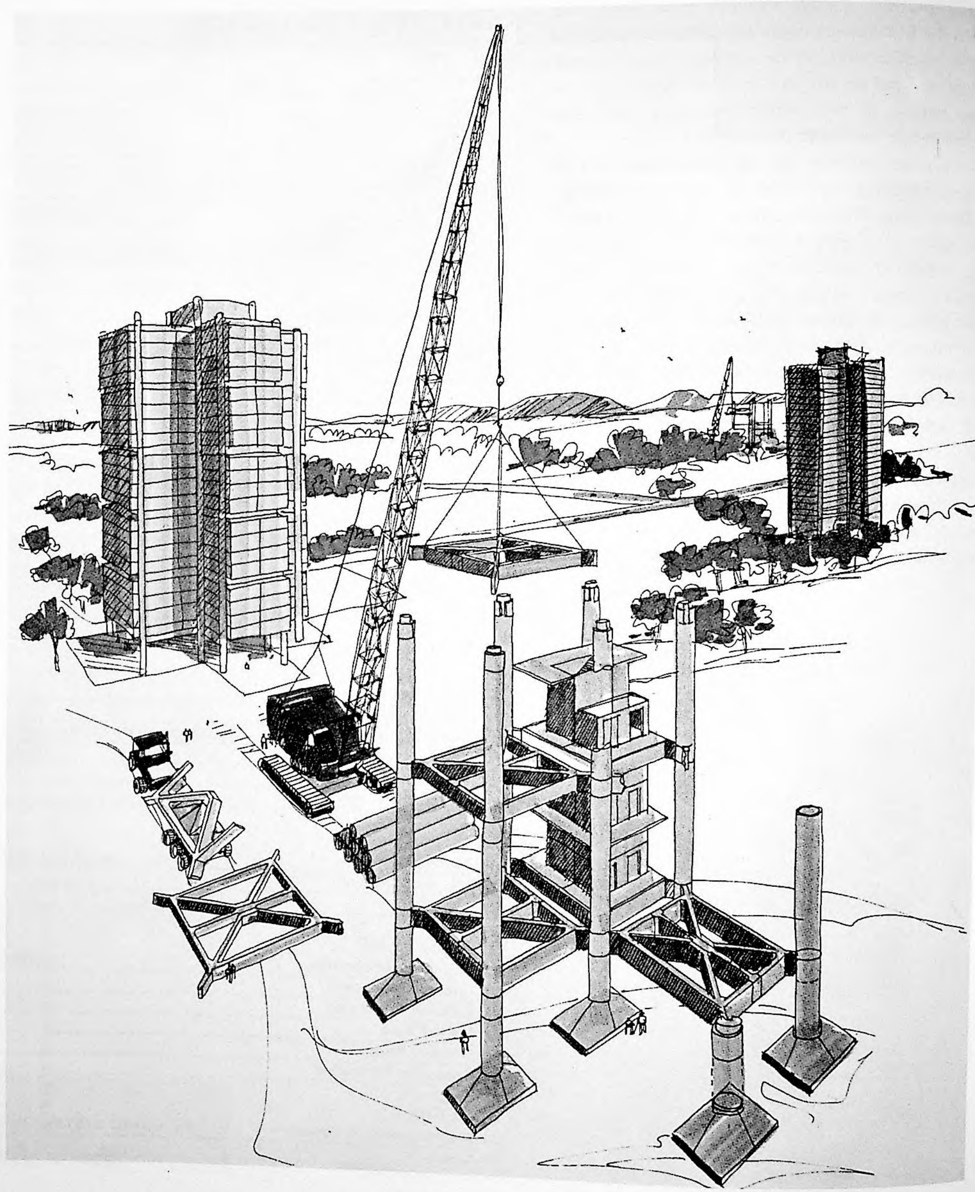
GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM, TOWER CONSTRUCTION AND MODULE ERECTION TECHNIQUE
40 Codes	ADAPTABLE TO MOST BUILDING CODES

National Homes

PROPOSER CONSORTIUM

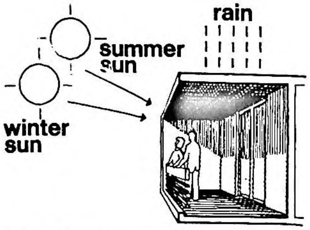
National Homes Corporation, Housing System Producer, Lafayette, Indiana
Edward Durell Stone & Associates, Architect, New York, New York
Edward D. Stone, Jr. & Associates, Land Planner, Fort Lauderdale, Florida
Semer, White & Jacobsen, Government Relations, Washington, D.C.
Praeger-Kavanagh-Waterbury, Structural Engineers, New York, New York
Cosentini Associates, Mechanical and Electrical Engineers, New York, New York
Computer Applications Inc., Computerized Management System, New York, New York



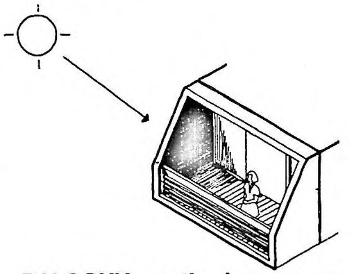
Factory-produced volumetric modular dwelling units are stacked vertically in this system. The modules can be stacked to six floors without extra support. A separate structural frame support has been developed which permits stacking to a 24-story limit. The proposal also involves extensive use of computer applications to program preparation, site analysis, master plan preparation, design development, and cost-benefit analysis. A principal innovation is use of the vacuum sewage system developed and used in Sweden for the past 10 years, demonstrating a major savings in operating and ancillary construction costs. A volume production of 10,000 units per year is anticipated for the housing system.

The system embodies four main elements: (1) the three basic planning units—living, utility, and sleeping; (2) the building block assemblies, factory produced from the basic planning units and delivered to site by truck; (3) the completed dwelling units at the site; and (4) the building itself. All modules are 14 ft. wide, affording good room sizes, more house per module, and considerable latitude for architectural arrangement. The building planning system takes full advantage of plant line economies and is not dependent upon specific materials, technologies, or subsystems.

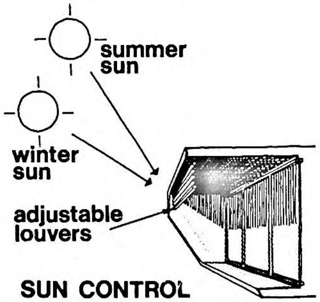
Modular assembly possibilities are extensive. The elements of a dwelling unit are first assembled into the basic modules, then into the modular assemblies (or building blocks), and finally into the dwelling units that compose the finished structure. The townhouse



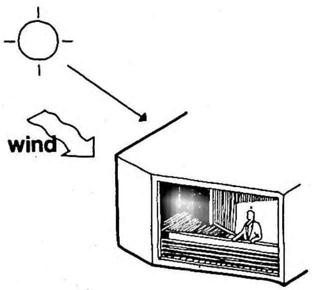
BALCONY **weather protected**
MODULE 1



BALCONY **northerly exposure milder climates**
MODULE 2



SUN CONTROL
MODULE 3



BALCONY **view oriented private weather protected**
MODULE 4

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2 Density Range	20 TO 600 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMPUTERIZED SITE LAYOUT; SLOT-SITE LAYOUT; COMMON OPEN SPACES
6 Nonresidential Functions	RECREATION; COMMUNITY CENTER; SHOPPING AREA; DAY CARE CENTER
7 Circulation	NO THRU TRAFFIC; CUL-DE-SACS; PEDESTRIAN LINK FROM DWELLING UNITS TO OPEN SPACES
8 Site Planning Services	CONSULTANT; "SLOT" DESIGN & PLANNING ANALYSIS
9 Community Involvement	
10 Utilities	CENTRAL SITE SYSTEM (HIGH-RISE)

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCIES; 1 TO 6 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	DESIGN STAGE REQUIRING FURTHER DEVELOPMENT
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	SELF-SUPPORTING STEEL-FRAME MODULE ASSEMBLIES; FRAME-SUPPORTED OVER 6 STORIES
17 Exterior Elements	BALCONIES; SUN SHIELDS; SKYLIGHTS
18 Interior Elements	STAIR & ELEVATOR CORE MODULES; METAL-FRAME GYPSUM BOARD PARTITIONS.
19 Foundations	PREFABRICATED SPREAD FOOTINGS
20 Comfort Systems	CENTRAL GAS OR OIL HEATING SYSTEM (HIGH-RISE); INTEGRATED COOLING SYSTEM OPTIONAL
21 Plumbing	VACUUM SEWAGE SYSTEM; WATER SUPPLY INTEGRATED WITH UTILITY CORE; ABS DRAINAGE PIPING
22 Electrical	CONVENTIONAL
23 Furnishings	

PRODUCTION

24 Offsite Production	MODULE ASSEMBLIES; PRECAST ELEMENTS FOR FRAME & FOUNDATION
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS JOINING OF MODULES; MECHANICAL HOOK-UPS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	

ECONOMICS

30 Construction Costs	$11.20 TO $18.35 PER SQ. FT., 10,000 DWELLING UNITS PER YEAR
31 Financing Methods	PROPOSER SUBSIDIARY; CONVENTIONAL
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; PRODUCTION; RESEARCH; PLANNING
35 External Functions	LAND PLANNING; DESIGN; MANAGEMENT
36 Market Area	150 MILE RADIUS OF PRODUCTION PLANT
37 Delivery Rate	1,000 TO 10,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	VACUUM WASTE SYSTEM; COMPUTER ANALYSIS, DESIGN & PLANNING
40 Codes	DOES NOT MEET ALL CODE REQUIREMENTS; STRUCTURAL SYSTEM ADAPTABLE TO MODEL CODES

National Homes (continud

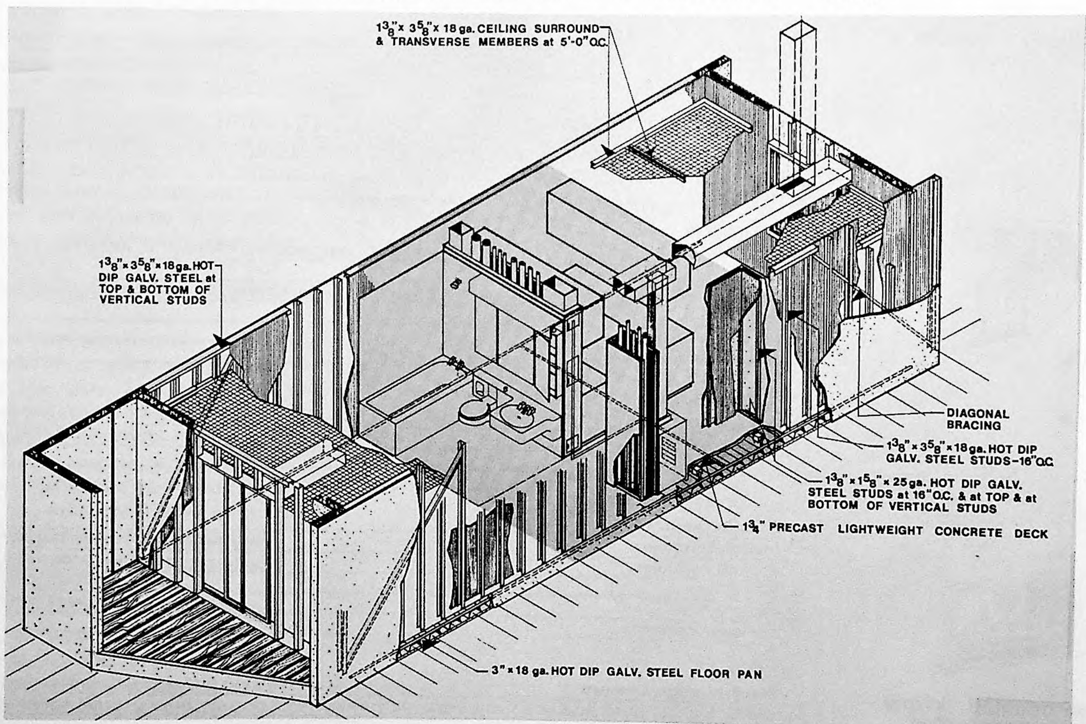
plan is the most recurrent theme within the various building types. High-rise units are two-story townhouses stacked one over the other around a public circulation core, permitting more economical skip-stop elevator service. There also is a capacity for forming simplex apartments, both garden and high-rise, with a low bedroom count. High-rise types for senior citizen occupancy are proposed.

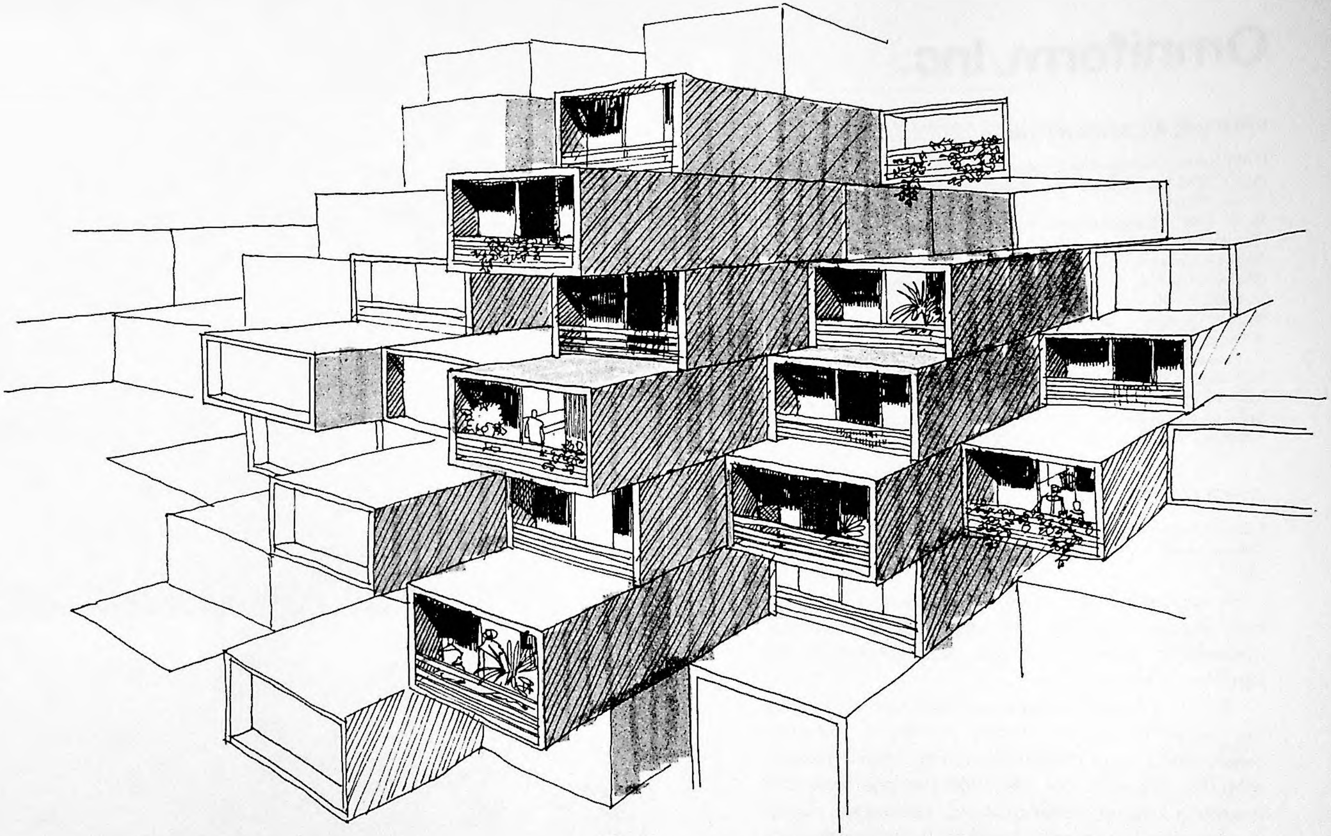
The structural frame for high-rise units consists of high-strength precast concrete members in a post-tensioned assembly. Precast concrete columns are factory-extruded, round sections of reinforced concrete pipe with joints grouted prior to post-tensioning. Circulation cores are of precast concrete elements supported vertically at every fourth story. The basic foundation element is an inverted precast concrete shell. Each column has a motor-driven scaffold for joint grouting and post-tensioning of cables. The living-unit modules are stacked inside the columns by truck-mounted cranes.

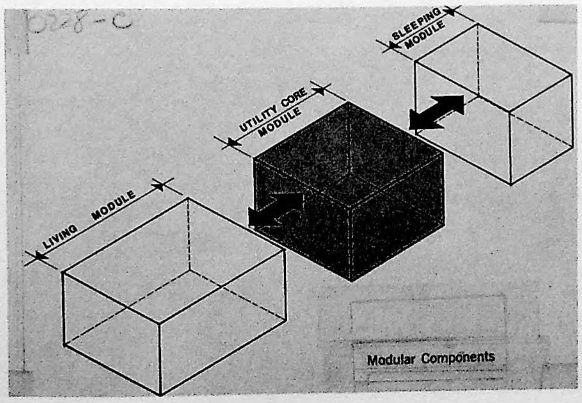
Module floor construction combines a corrugated metal pan with a precast foamed concrete deck, 1 3/4 in. thick. A variety of floor coverings can be applied. Roof construction is similar except that the concrete is only 1 in. thick unless the surface serves as a balcony. Exterior wall finish is a monolithic surface of sprayed polyester resin and natural granules, relatively low in cost. Insulation is a compound weighing about 1 lb. per cu. ft. Interior partitions are at a minimum; open space planning predominates. Much of the module construction will be done under Swedish license.

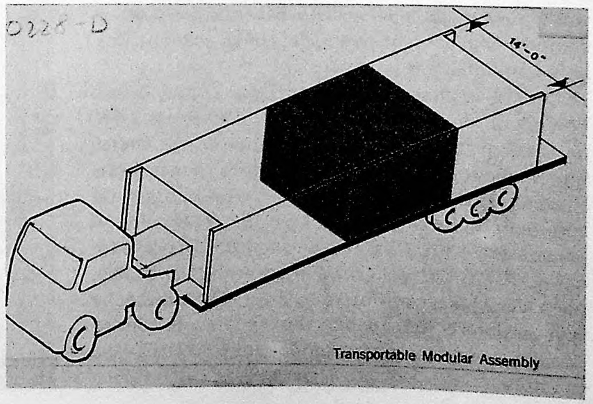
Central mechanical and electrical distribution systems are specified for high-rise complexes. Individual unit systems are factory installed and balanced and tested before shipment. All service risers are in a single utility wall for easy site hookup. In other than high-rise types, each unit has its own forced-air heating and cooling system. The piping system is factory made and assembled, with onsite plumbing work limited to hook-ups. Plastic pipe is specified with metal pipe optional.

Five exterior control modules have been designed as components to be added to the units to provide shade or wind shelter, to screen out undesirable views, to add outdoor space, or to contribute architectural effect. Much emphasis is placed on building configuration and siting.






0228-C
LIVING MODULE
UTILITY CORE MODULE
SLEEPING MODULE
Modular Components


0228-D
14'-0"
Transportable Modular Assembly

Omniform, Inc.

PROPOSER CONSORTIUM

Omniform, Inc., Hartford, Connecticut
ADOR/HiLite, Division of Rusco Industries, Inc., Fullerton, California
A. O. Smith Corporation, Consumer Products Division, Kankakee, Illinois
Cellular Concrete Associates, Old Lyme, Connecticut
Glidden-Durkee, Division of SCM Corporation, New York, New York
Kohler Company, Kohler, Wisconsin
R. & G. Sloane Mfg. Division, The Susquehanna Corporation, Cleveland, Ohio
Square D. Company, Lexington, Kentucky
Sterling Radiator Company, Inc., Westfield, Massachusetts
Stressteel Corporation, Wilkes-Barre, Pennsylvania
Tappan Division of the Tappan Company, Mansfield, Ohio

AFFILIATES

FCH Services Inc., Subsidiary of the Foundation for Cooperative Housing

A multimaterial system, adaptable to low-rise or high-rise mass housing and backed by a 19-member consortium of engineers, architects, contractors and suppliers, is proposed.

The scheme combines a patented system of concrete bearing walls that are precast, reinforced, and post-tensioned to form the structural frame; many available materials are used for infill and frontage walls; and complete kitchen, heating/cooling, lighting and plumbing units are factory-manufactured, requiring little field work. End result is an economical structure that can conform with conventional surroundings and is particularly useful in urban situations.

Central to the proposal is the Sepp Firnkas system of modular elements, already in use in more than 3,000 units completed or under construction in the United States. Basically, the system utilizes precast, prestressed, storyheight bearing walls; concrete hollow-core floor and roof planks; storyheight shear walls and precast stair units. Readily fabricated at local plants (or onsite, if feasible) with little investment in equipment, these elements are assembled by crane, tied together by post-tensioning rods running through them to conventional foundations (spread footings or slab) for a rigid structure.

The system is designed to permit tolerances of up to ±1 in. in the field connections. Dry, pliable plastic channels are used at connecting points to insure watertight joints. Exterior walls can be finished in an almost unlimited number of materials, including applied ceramic tile or brick. Wall sections are cast vertically, with reinforcement cages, door and window frames; lengths can run from 15 ft. to 45 ft., and since the panels are shipped in the vertical position shipment by truck is no problem. Of special interest is the use of 2 1/2-in. to 12-in. in thickness a combination of portland cement and silica sand, with aluminum powder to give the material a cellular structure. Use of this material results in considerably lighter weight for the slabs, which are, with no loss in structural strength or insulating values.

Exterior doors are of heavy steel and as nearly burglar-proof as possible; complete kitchen units, including fixtures and appliances and all necessary plumbing, are made up as single walls for easy shipment and installation. Bath fixtures are also standard, in modular factory units, shipped in assemblies for quick installation as the structure is erected. Sanitary units are prepiped in the factory so that they will slip into the plumbing roughing at the site. Plumbing trees are of plastic pipe, color-coded for easy assembly by even unskilled labor.

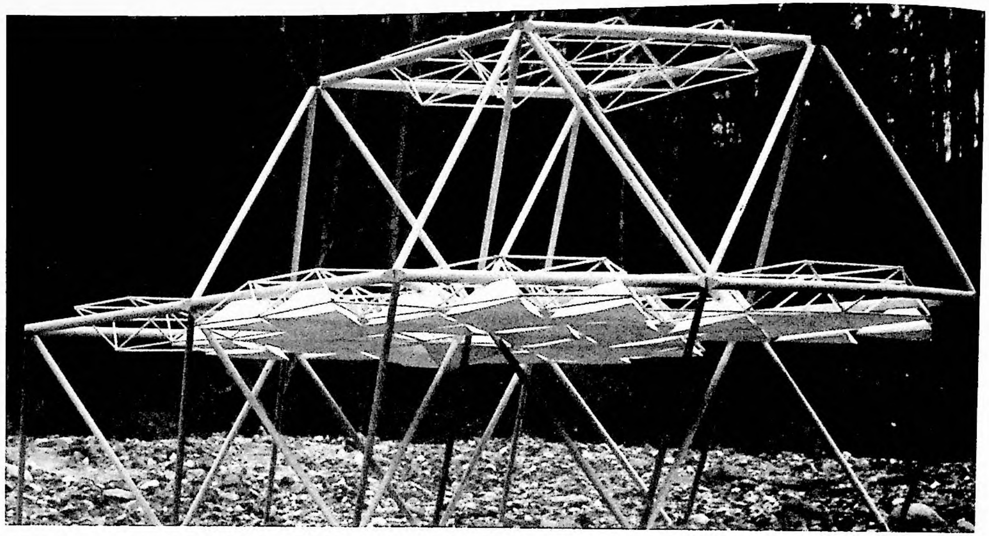
Electrical harnesses are included in the precast wall sections. Heating is provided by electric, window-sill heating-ventilating units, which can also be used as a valance unit. Cooling systems can be installed in the valance areas.

It is contemplated licenses will be granted to local developers and builders, to establish a local network and thus eliminate most problems of transportation distance. It is assumed that a local precaster can readily serve an area of 120 miles in radius. Subcomponents will be supplied to local licencees through the proposer organization and quality will be controlled through rigid inspection from the national headquarters. A volume production of up to 50,000 units per year is anticipated. The proposer would maintain and operate a training center to provide a continuous labor supply.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	8 TO 110 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL CLIMATIC CONDITIONS
5 Planning Concepts	PLANNED UNIT DEVELOPMENT; COMMON OPEN SPACES; GREENBELTS
6 Nonresidential Functions	POOLS, TENNIS, SOFTBALL & SKATING RINK; MARINA; AMPHITHEATRE
7 Circulation	VEHICULAR CIRCULATION; MULTILEVEL, UNDERGROUND TRAFFIC; CUL-DE-SACS
8 Site Planning Services	PROPOSER'S DESIGN TEAM OR LOCAL SELECTED DESIGN TEAM
9 Community Involvement	FREQUENT COMMUNITY MEETINGS TO ASCERTAIN LOCAL NEEDS; SOCIOLOGICAL SURVEYS
10 Utilities	CONVENTIONAL FUELS PER BUILDING; SITE INCINERATION OF SOLID WASTE
BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-WISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEM MARKETED; PRODUCTION PLANT OPERATIONAL
15 Community Involvement	LOCAL PARTICIPATION IN PLANNING; COMMUNITY REVIEW OF PROPOSED DESIGNS
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE SELF SUPPORTED WALL, FLOOR, & ROOF PANELS; POST-TENSIONING TENDONS
17 Exterior Elements	CONVENTIONALLY FINISHED, FACTORY APPLIED
18 Interior Elements	CONCRETE PANEL PARTITIONS; CONCRETE STAIR UNITS; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	ELECTRIC HYDRONIC UNIT HEATING; OPTIONAL COOLING; INTEGRATED IN SUBSYSTEM
21 Plumbing	PLASTIC TREE & PIPING; KITCHEN & BATHROOM MODULES; UNI-VENT WASTE, QUICK CONNECTORS
22 Electrical	ALUMINUM WIRING, LIGHTING, INTEGRATED WITH BUILDING SUBSYSTEMS
23 Furnishings	
PRODUCTION	
24 Offsite Production	WALL, FLOOR & PARTITION PANELS; KITCHEN & BATHROOM MODULES; STAIR UNITS
25 Onsite Production	OPTIONAL WALL, FLOOR, ROOF & PARTITION PANELS ON SITES OF MORE THAN 400 UNITS
26 Onsite Construction	FOUNDATIONS; PANEL ERECTION; KITCHEN & BATHROOM MODULE PLACEMENT
27 Labor	UNSKILLED, SEMISKILLED & SKILLED FOR PLANT PRODUCTION & SITE CONSTRUCTION
28 Labor Training Programs	TRAINING OF UNSKILLED FOR PLANT PRODUCTION; TRAINING FOR SELF-HELP
29 Community Involvement	LOCAL CONTRACTORS; LOCAL DISADVANTAGED & MINORITY GROUPS; SELF-HELP
ECONOMICS	
30 Construction Costs	$14.86 PER SQ. FT. FOR 1,000 2 BEDROOM UNITS
31 Financing Methods	LICENSEE TO FINANCE PLANTS; OTHER METHODS CONVENTIONAL
32 Useful Life	STRUCTURE, FOUNDATION, PLUMBING — 60 YEARS, MINIMUM
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; FRANCHISING; PLANNING; DESIGN; ENGINEERING; SOCIAL RESEARCH
35 External Functions	PANEL & COMPONENT PRODUCTION; CONSTRUCTION & ERECTION; COMMUNITY RELATIONS
36 Market Area	120 MILE SHIPPING RADIUS OF PLANT LOCATIONS
37 Delivery Rate	30,000 — 50,000 UNITS PER YEAR, TOTAL, ALL PLANTS
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	HIGH STRENGTH POST-TENSIONING CONCRETE BUILDING SYSTEM
40 Codes	STRUCTURAL SYSTEM ADAPTABLE TO ALL NATIONAL MODEL CODES

Optor Corporation

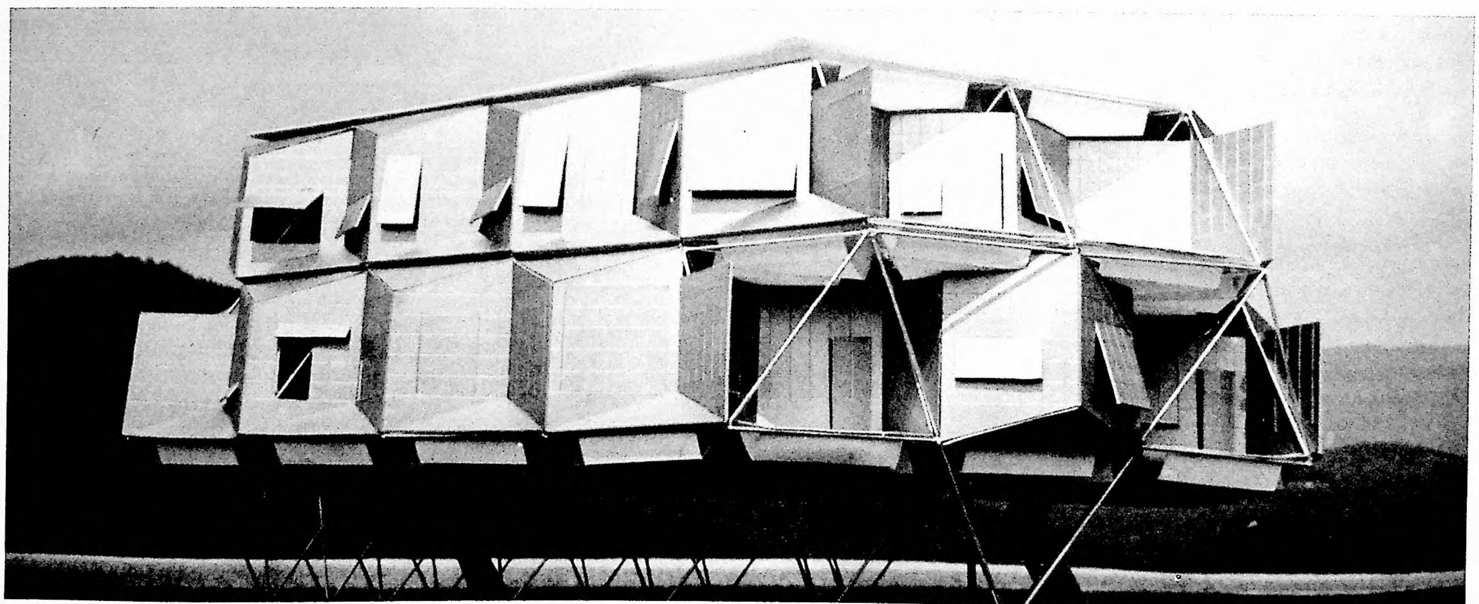


PROPOSER

Optor Corporation, Montreal, Canada

Interlocking tetrahedrons made up of story-high steel tubes and a flooring subsystem of lightweight steel tubes and plywood comprise the major structural components of the housing system proposed. Fitted into the tri-dimensional spaces outlined by the honeycomb framework of tubing, supported on the floor subsystem, are a complete range of coordinated living and service components such as unitized bath and kitchen units, storage units, movable interior walls, movable ceiling units, and flexible exterior walls and openings.

Slotted, hub-like aluminum fasteners, manufactured to precise tolerances, join together the tubing which makes up the 3-way space grid and are key elements in



the unusual structural system. Fastening is accomplished through deformation of each end of the identical 13-ft. (4-in. diameter) lengths of tubing, these flattened ends thus mating securely with the slots in the hub. The structural system resulting from such an assembly of tubing and flooring panels is capable of supporting itself and concommitant housing live loads up to five stories high.

Once the framework has been assembled, the other coordinated components are next installed and connected, with a wide variety of arrangements and layouts being possible due to the flexibility of the system. Contributing to this flexibility is the concentration within the floor subsystem of a complete utility grid. This offers a maximum choice in location within a dwelling unit space of kitchen, bath, and laundry modules. Similarly, with electrical entrance for each unit being via the ceiling, complete flexibility of interior partitioning is offered, with all switches, thermostatic controls and convenience outlets originating above and being brought down where required. The ceiling panels also include electric radiant heating panels.

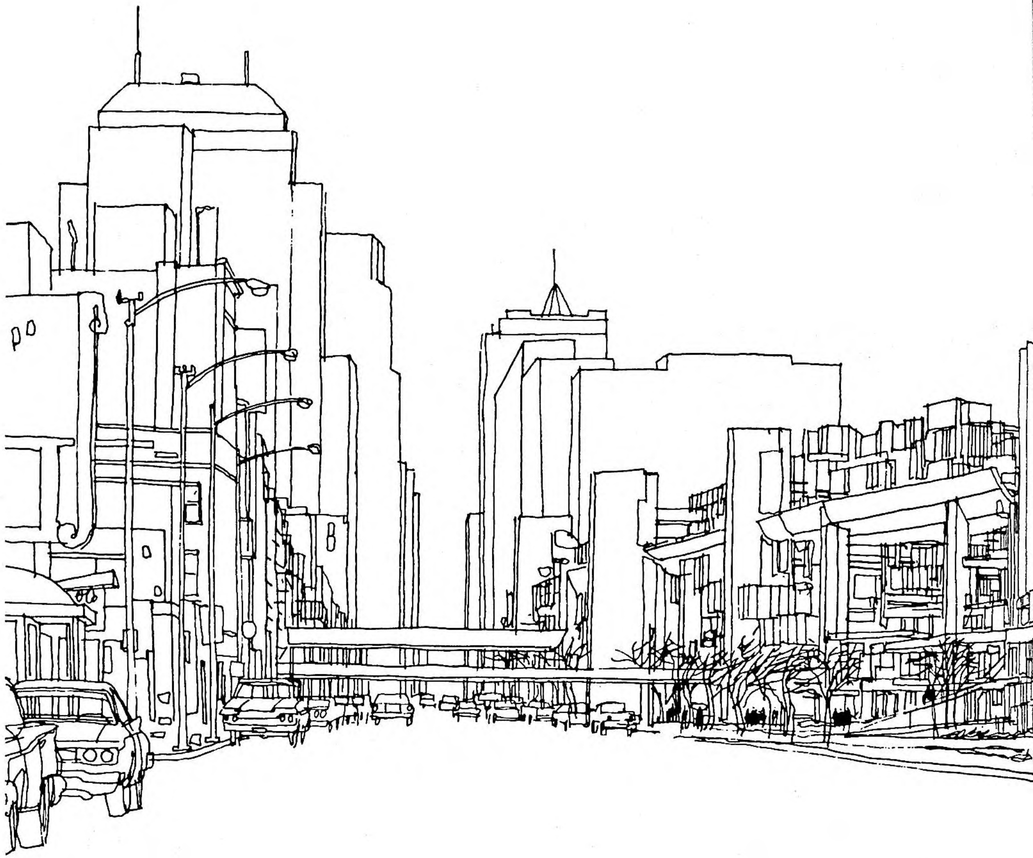
The interior panels, of fire-resistant sandwich panel construction, offer flexibility, in that they may be moved at a later time; in addition, the air space which acts as a sound barrier, may be filled with insulation as a thermal barrier, or with fireproofing. Further modification is available through change of the exterior surface material of the panels, initially a fiberglass product with aluminum trim. Interior finish of the partitions and party walls is gypsum board, ceiling finish is a 1/2-in. particleboard.

Because of the system's potential for speedy erection and possible disassembly and reuse at another site later on, the proposer suggests that the space grid concept might have application as interim housing for transient laborers, refugees and other mobile inhabitants.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN RENEWAL
2 Density Range	1 TO 400 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	INCREMENTAL UNIT GROWTH
6 Nonresidential Functions	LONG SPAN CAPABILITY ALLOWS FOR INCLUSION OF ALL TYPE FACILITIES
7 Circulation	ELEVATED OR SURFACE PEDESTRIAN ROUTES & PARKING
8 Site Planning Services	PROPOSED SERVICES OFFERED TO DEVELOPER
9 Community Involvement	
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCIES; 1 TO 6 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	FURTHER RESEARCH REQUIRED FOR PRODUCTION PLANT & BUILDING SYSTEM
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	TUBULAR STEEL SPACE GRID FRAMEWORK; FLOOR FRAME, FLOOR & ROOF PANELS
17 Exterior Elements	ALUMINUM FRAME WALL PANELS; FIBERGLASS FINISH; ALUMINUM TRIM
18 Interior Elements	GYPSUM BOARD PARTITION PANELS; FIBERGLASS CEILING PANS; STEEL STAIRS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	ELECTRIC RADIANT PANEL HEATING, INTEGRATED WITH MECHANICAL SUBSYSTEM
21 Plumbing	PVC PIPING; BATHROOM, KITCHEN, AND LAUNDRY MODULES
22 Electrical	CEILING ELECTRICAL GRID SYSTEM INTEGRATED WITH MECHANICAL SUBSYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	FRAME ELEMENTS; WALL, FLOOR, CEILING, ROOF PANELS; PARTITIONS; CEILING PANS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; FRAME, PANEL, CEILING PAN ERECTION; MODULE PLACEMENT
27 Labor	UNSKILLED LABOR FOR ERECTION
28 Labor Training Programs	PROPOSER TO TRAIN LOCAL UNSKILLED LABOR
29 Community Involvement	LOCAL, UNEMPLOYED, UNSKILLED LABOR FOR ERECTION
ECONOMICS	
30 Construction Costs	$13.50 PER SQ. FT. (IN VOLUME PRODUCTION)
31 Financing Methods	PUBLIC EQUITY OFFERING
32 Useful Life	DESIGNED FOR PERIODIC REPLACEMENT
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL RESPONSIBILITY; GENERAL MANAGEMENT; FINANCING; MARKETING
35 External Functions	
36 Market Area	NOT LIMITED BY SHIPPING CONSIDERATIONS
37 Delivery Rate	1,000 UNITS PER YEAR PER FACTORY
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM; TEMPORARY, RELOCATABLE HOUSING
40 Codes	

Pantek Corporation



PROPOSER CONSORTIUM

Original Consortium Member: Pantek Corporation, Boulder-Colorado (Ball Brothers Research Corporation, Boulder-Colorado;
Elliott H. Brenner, AIA, Architect, Lafayette, Indiana
Leo E. Zickler, Land Development, Financing and Coordination, Indianapolis, Indiana.

AFFILIATES

American Fletcher Mortgage Company; American Testing & Engineering Company; Applied Decision Systems, Inc.; Ball Corporation; Beryl Bernhard, Attorney; Blyth & Company, Investment Banking; The Board for Fundamental Education; Bolt, Beranek & Newman, Acoustical Consultants; Bradley & Bradley, Architects; Building Officials Conference of America; Floyd E. Burroughs & Associates, Consulting Engineers; George Foley, Labor Relations; The Foundation for Cooperative Housing, Research; Dr. Jack E. Goldberg, P.E., Structural Testing; Harbridge House, Consultants; Ewing Miller & Associates, Architects; The National Urban League; Oxford Development Corporation, Real Estate Contractors; Tectran, Incorporated, Technological Advancements.

Involvement of the people for whom homes are being built is a major factor in this housing system. A complete housing approach, from design through construction, marketing, and financing, the proposed system will create local, minority-owned businesses and will involve the people who will live in and own the completed community.

The system is suitable either for mid-city locations or for suburban areas. A mid-city project would probably take the form of a vertical community achieved by aggregating urban land into superblocks, with dwelling units and their related community facilities clustered to achieve maximum open space as an interface between housing and adjacent commerce.

The system consists of three elements: (1) the structural panel, (2) a kitchen-bathroom mechanical core, and (3) a unique design, franchising, and marketing plan which offers an opportunity for the unskilled to design, construct, own, and manage their own homes. The adaptability of the units for assembly into houses by unskilled labor affords an unusual opportunity for home owners to attain equity in their homes.

The panel, which is lightweight and inexpensive, consists of a 4-ft. x 8-ft. sheet of 1/8-in. hardboard and

Community involvement in the process is an integral part of the system. Local sponsors from the community will be sought for both planning and construction, these sponsors to include minority business, cooperative, and nonprofit groups. Franchises will be negotiated from the local community, no special skills being required on the part of either management or labor. After the franchises have been selected, thorough training in the building system technique will be given all involved.

The formation of locally owned enterprises to serve the community will be encouraged, particularly such necessary services as groceries, barbers, day care centers, clinics, and recreational facilities.

One hundred offsite plant locations are to be established eventually, with Seattle, Los Angeles, Denver, Phoenix, Houston, Atlanta, Chicago, and Philadelphia among the first sites. A volume production rate of from 200 to 400 units per year is projected for each plant. The plants will supply projects within a 250-mile shipping radius.

another of cement asbestos, with low-density polyurethane foam poured between the skins. The total sandwich is framed by aluminum extrusions. The exterior cement asbestos sheet is coated with a mixture of epoxy and stone aggregate. The interior face may be prefinished with paint, wallpaper, or integrally surfaced hardboard. The panels will be used for walls, partitions, roofs, and floors, and, as required, can be made in larger sizes.

The panels will accommodate doors, windows, and other hardware. The aluminum extrusion which binds the edges of the panels, interlocks with other panels and floor and ceiling channels through use of special splines which are then sealed with an elastomeric material. The panel units may be stacked to form two-story housing units, but require a concrete-and-steel megaframe for units of three or more floors.

The central kitchen-bathroom mechanical core is delivered to the site as a unit, requiring only connection of utilities and will provide heating, bathing, air handling, food preparation, and waste handling facilities. The entire core itself is removable and replaceable as are the heating, air conditioning, and water subsystems it incorporates.

Prospective tenants and/or owners will be consulted regarding their wishes and needs on design of the dwelling units and social and service facilities. The "housing game," a Monopoly-like playing board, affords tenants and owners a simple but effective means to participate in the actual design phase of the project. The game further serves the tenant as a means of rating the overall design, construction, and management of the project. This involvement of the tenant-owner continues into the future because repair, maintenance, and modification of the housing units is simple and readily accomplished, even by the unskilled.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	10 TO 30 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	SUPERBLOCKS; HOUSING & COMMERCE INTERFACE; SUBURBAN COURTYARD CLUSTER
6 Nonresidential Functions	PLAY AREAS; COMMUNITY, DAY-CARE, COMMERCIAL, & RELIGIOUS FACILITIES
7 Circulation	PEDESTRIAN & VEHICULAR SEPARATION; CUL-DE-SACS
8 Site Planning Services	BY PROPOSER ORGANIZATION & LOCAL GROUPS
9 Community Involvement	RESIDENTS CONSULTED ON DESIGN; COOPERATIVE HOUSING PROJECT IN PART
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT BUILT & OPERATIONAL; BUILDING SYSTEM COMPLETE
15 Community Involvement	LOCAL SPONSORS INCLUDING MINORITY BUSINESS, COOPERATIVE, & NONPROFIT GROUPS

BUILDING SUBSYSTEMS

16 Structure	ALUMINUM FRAME SANDWICH PANELS (POLYURETHANE CORE), HIGH-RISE CONCRETE & STEEL FRAME
17 Exterior Elements	EXTERIOR PANELS COATED WITH EPOXY & STONE CHIPS
18 Interior Elements	KITCHEN/BATHROOM MECHANICAL CORE; PREFINISHED PANELS
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS AIR FURNACE HEATING; INTEGRATED COOLING OPTIONAL; CENTRAL MECHANICAL CORE
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL
23 Furnishings	

PRODUCTION

24 Offsite Production	SHELL FOUNDATION; CORE, ROOF & WALL PANELS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ASSEMBLY OF PANELS; CONNECTIONS; CORE PLACEMENT; UTILITY HOOK-UP
27 Labor	UNSKILLED & SELF-HELP FOR SITE CONSTRUCTION
28 Labor Training Programs	TRAINING TO BE PROVIDED FOR ALL FRANCHIZED CONTRACTORS & LABOR
29 Community Involvement	COOPERATIVE PROJECT MANAGED BY LOCAL HOUSING AUTHORITY

ECONOMICS

30 Construction Costs	UNRELEASED
31 Financing Methods	
32 Useful Life	

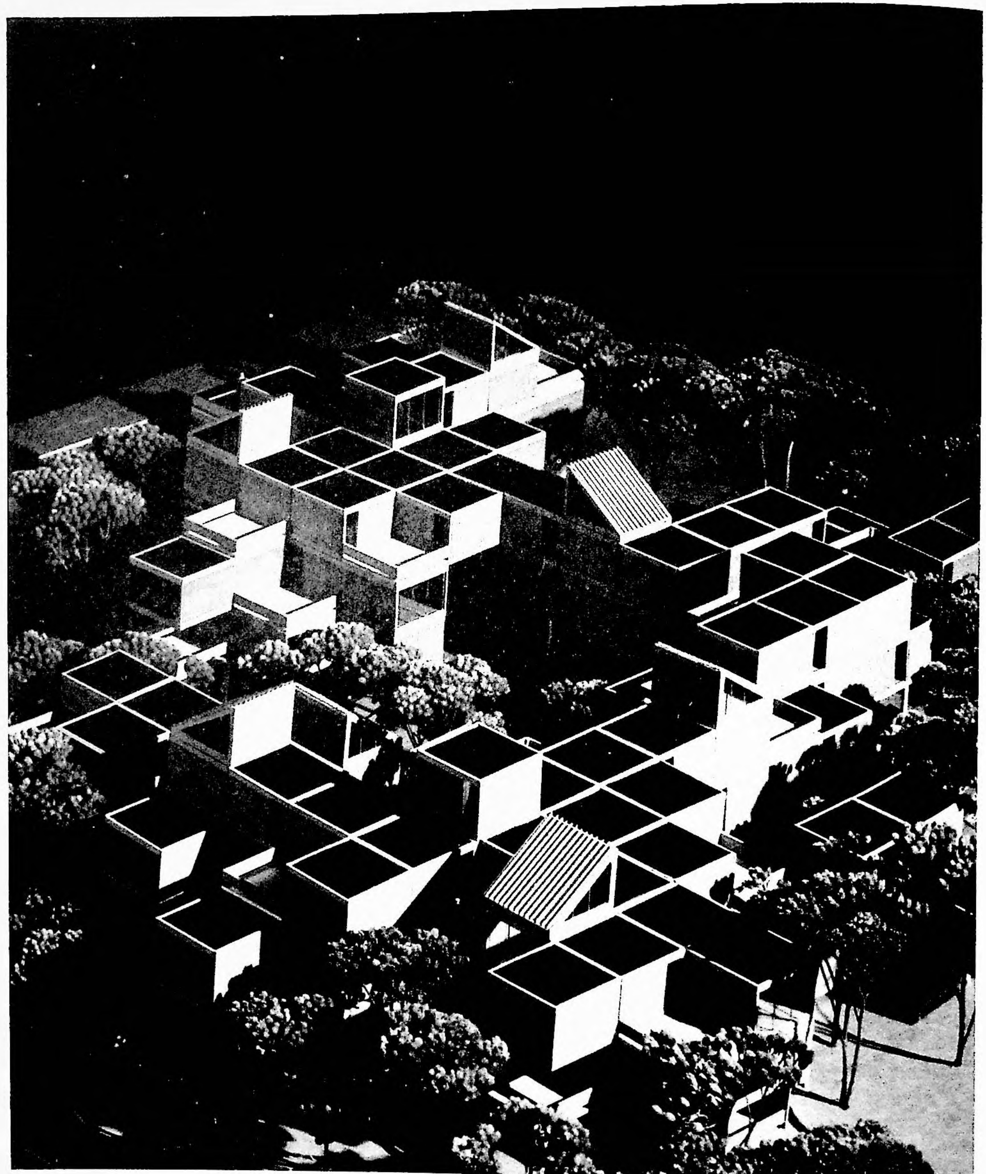
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; PRODUCTION; LAND PLANNING
35 External Functions	TECHNICAL SERVICES
36 Market Area	250-MILE RADIUS OF PLANT; 100 PLANTS PROPOSED
37 Delivery Rate	200 TO 400 DWELLING UNITS PER YEAR PER PLANT
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	TENANT & COMMUNITY INVOLVEMENT; "HOUSING GAME" APPLICATION
40 Codes	

Pemtom



PROPOSER

Pemtom, Inc., Minneapolis, Minnesota.

AFFILIATES

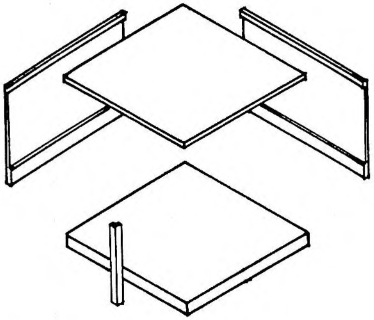
Interdesign, Architectural and Design Consultants; Lorimer, Chiodo and Associates, Economic and Research Consultants; Minnesota and Manufacturing Company, Major Product Supplier.

This system is based upon the use of stressed-skin, plywood panels bonded together with special polymers to form complete modules which are stacked onsite to provide home and apartment designs of various configurations. Each panel is a sandwich of exterior and interior stressed-skin plywood on a core of urethane foam. Module dimensions are 13 ft. 4 in. x 13 ft. 4 in. x 9 ft. 9 in.

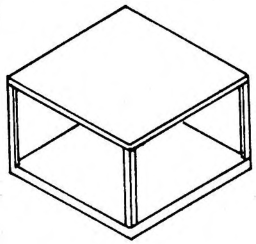
Individual modules provide for particular functions: Living room, dining room, kitchen, bedroom, bath, stairway, and utility room. A typical home or apartment with three bedrooms and 1 1/2 baths would be composed of nine module selections, providing 1,575 sq. ft. assembled onsite. The sections can be stacked two or three high, cantilevered, or assembled up to 15 stories high through use of a free-standing cradle. Accessories available to the basic sections include pitched roofs, room extenders, balconies, decks, garages, and storage units.

Foundation work can be minimal. Auger-drilled 2-ft. concrete post holes to support up to a maximum of 26,500 lb. can be used, or a precast concrete slab with neoprene flaps is acceptable. Onsite labor can be unskilled or semiskilled, with the exception of cabinetmakers and polymer bonders.

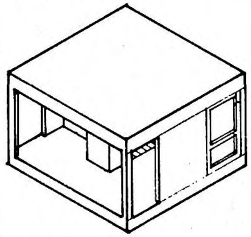
The units will have superior sound-deadening effects, improved life for mechanical components because they will be held rigid in the urethane foam core, and structural rigidity to withstand up to 100-m.p.h. winds. Because similar plywood panels have been tested since 1937, normal structural lifetimes are anticipated.



Factory fabrication of panels, components

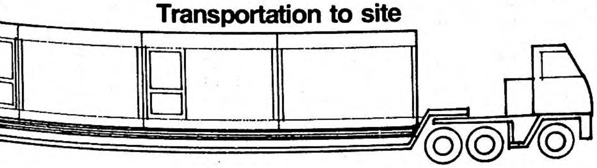


Basic module assembly in assembly plant



Additional walls and built-in equipment

Transportation to site



Summary Information

SITE SYSTEM

1	Site Situation	URBAN, SUBURBAN, RURAL
2	Density Range	6 TO 100 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTER PLANNING; COMMON OPEN SPACES
6	Nonresidential Functions	RECREATIONAL, SOCIAL & COMMERCIAL FACILITIES; POOLS, TOT LOTS
7	Circulation	SEPARATE VEHICULAR TRAFFIC; SIDEWALKS, WALKING PATHS, UNDERPASS/OVERPASS
8	Site Planning Services	
9	Community Involvement	UNDERGROUND SERVICE WIRING
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 5 BEDROOMS—SINGLE FAMILY
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION & BUILDING SYSTEM DESIGN STAGE REQUIRING DEVELOPMENT
15	Community Involvement	PERMITS USER TO MAKE SELECTION OF CHANGES IN ACCORDANCE WITH NEEDS

BUILDING SUBSYSTEMS

16	Structure	PLYWOOD & POLYMER-FOAM SELF-SUPPORTING, CANTILEVERED MODULES; PITCHED ROOF SECTIONS
17	Exterior Elements	BALCONIES; DECKS; NATURAL PLYWOOD OR CONVENTIONAL FINISHES OPTIONAL
18	Interior Elements	PREFABRICATED PARTITIONS; ROOM EXTENDER & ACCESSORY SECTIONS; STAIRS
19	Foundations	DESIGNED FOR SITE CONDITIONS; PRECAST SLAB; CONCRETE OR WOOD COLUMNS OR PIERS
20	Comfort Systems	INDIVIDUAL GAS, OIL, OR ELECTRIC HEATING SYSTEM; INTEGRATED COOLING
21	Plumbing	CONVENTIONAL; PVC PIPING WHEN PRACTICAL; INTEGRAL WITH MODULES
22	Electrical	CONVENTIONAL; INTEGRAL WITH MODULES
23	Furnishings	

PRODUCTION

24	Offsite Production	MODULES, PARTIAL MODULES, DECKS, BALCONIES; STAIRS; ACCESSORY SECTIONS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; JOINING OF MODULES, SECTIONS & ACCESSORIES; MECHANICAL HOOK-UPS
27	Labor	SEMISKILLED; UNSKILLED
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30	Construction Costs	$10,950 (1020-SQ.-FT. 3-BEDROOM SINGLE-FAMILY)
31	Financing Methods	CONVENTIONAL
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT, DESIGN MARKETING, PRODUCTION; CONSTRUCTION/ERECTION
35	External Functions	DESIGN; CONSULTANT CONSTRUCTION/ERECTION (POSSIBLE)
36	Market Area	NATIONAL
37	Delivery Rate	1,000 UNITS PER YEAR PER PLANT
38	Consumer Protection	

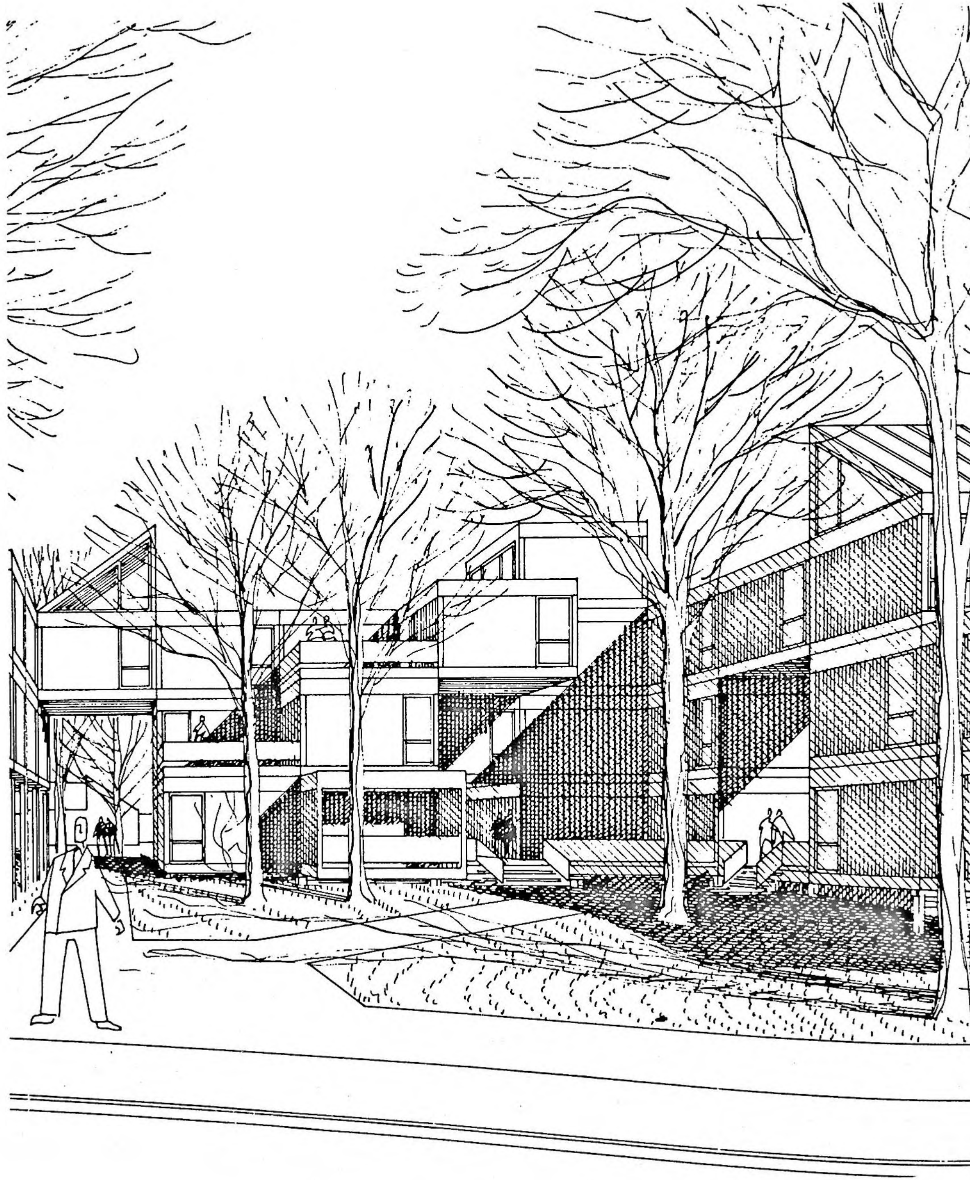
GENERAL

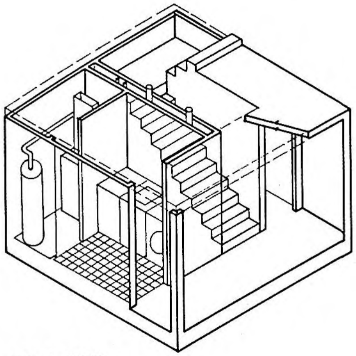
39	Major Innovative Concepts	BUILDING SYSTEM; MODULE CONSTRUCTION AND JOINING METHOD
40	Codes	VARIANCES FROM NATIONAL MODEL CODES

Pemtom (continued)

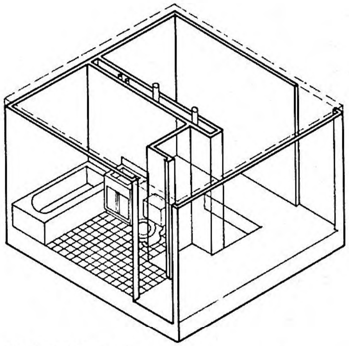
The polymer bonding process employed is advantageous since there is no production requirement for heat, special pressure, or long curing time for onsite construction. Close tolerances in working the plywood are not required since polymer bonding is successful even with gaps of up to 1/8 in. The proposer has been assured of an adequate supply of polymer bonding, and research is currently being conducted to develop a more fire-resistant foam for use in lieu of urethane.

A central production facility is used, usually within 300 miles of the marketing area. Transportation from factory to site is not a major problem, although most states prohibit highway loads wider than 12 ft. Cost is estimated at $1.00 per mile per 1,000 sq. ft.

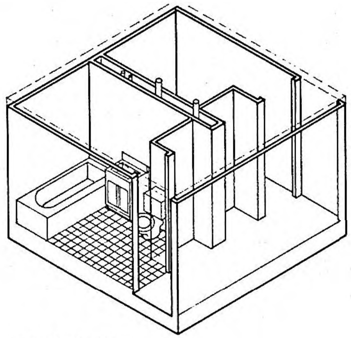




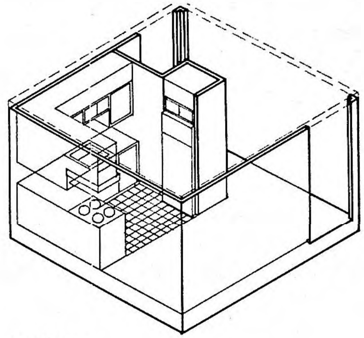
1 Stair/Utility



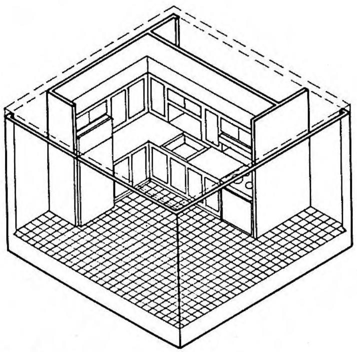
2 Stair/Bath



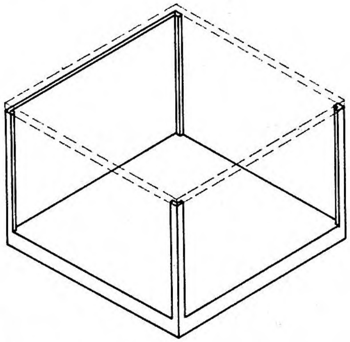
3 Bath/Utility



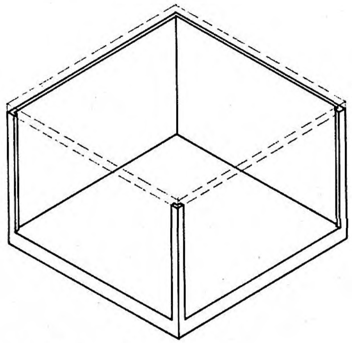
4 Kitchen



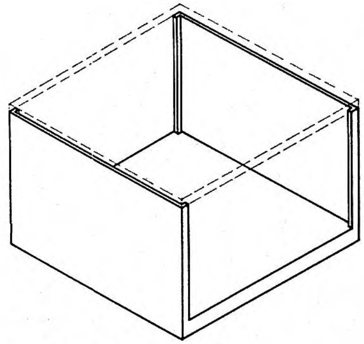
5 Kitchen



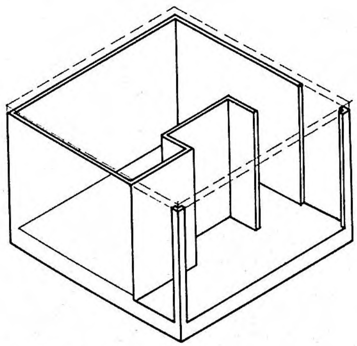
6 Dining/Living



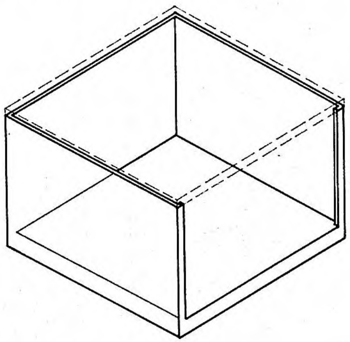
7 Dining/Living



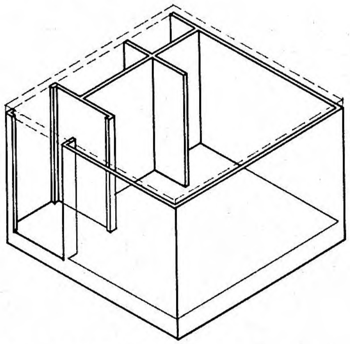
8 Living Room



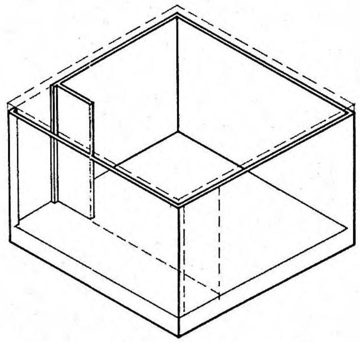
12 Family/Storage



9 Bedroom/Primary



10 Bedroom/Secondary single



11 Bedroom/Secondary double

Perl Mack Companies

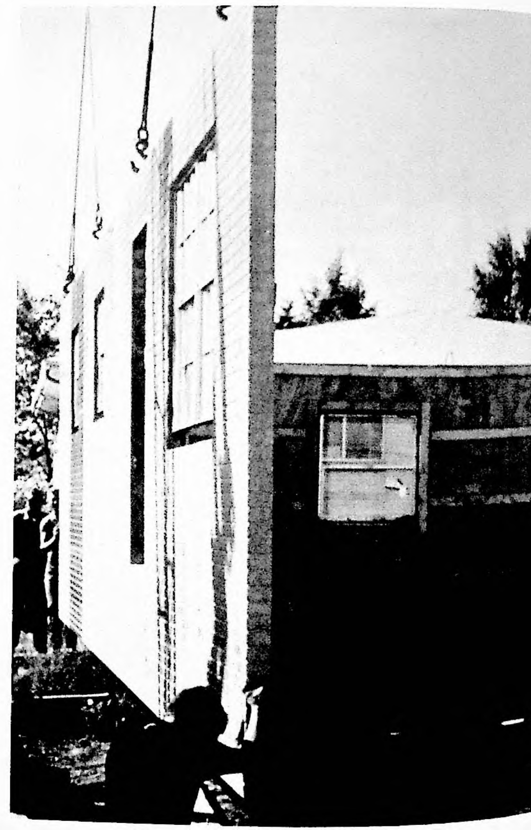
PROPOSER

The Perl-Mack Company, Denver, Colorado.

Two different types of load-bearing wall panels may be used in the housing system proposed for erection of single-family detached housing. Either of the two rationalized approaches to wall panels, in conjunction with prefabricated roof trusses and a site-assembled floor construction system, through maximization of engineered design loads are expected to produce cost reductions of up to 20%, and substantial reductions in erection time.

One type of wall panel is of 4-in. thick precast concrete, textured on the exterior to resemble brick and subsequently painted. Foil-backed gypsum board nailed to factory-applied furring applied to the inside of the wall furnishes thermal insulation and a base for conventional paint-finishing of the wall panels.

The other principal type of wall panel is of steel stud construction. Twenty-gauge steel studs are axially loaded, these members and plywood diaphragms being combined to form composite beams to span all openings in excess of 2 ft. These composite beams then are sheathed with a high density, impregnated nail base which affords the same thermal and sound characteristics as conventional wood framed construction and serves as a base for a choice of prefabricated exterior finishes such as clapboard, shingles, or shakes. As with the concrete panels, the inside walls are clad with gypsum board.



The flooring system, which is common to both types of wall construction, has been engineered to permit its speedy construction by unskilled labor. Along the inside of opposing longitudinal foundation walls (cast in place or precast) are bridles (U-shaped brackets) 36 in. on center. Into these bridles are placed the ends of lightweight "C" channels, spanning the crawl space formed below. Over these channels goes lightweight steel decking, to be covered by 2 1/2 in. of concrete—the concrete being tied to the perimeter foundation by rods protruding from these walls. Floors are finished with vinyl-asbestos tile.

The roof system is also common to both types of panel systems—prefabricated wood trusses covered with plywood and finished with prefabricated, prefinished gable ends. Insulation is blown into the attic space as a thermal barrier, while rigid insulation around the perimeter of the crawl space performs a similar function.

Interior partitions are of prefabricated steel stud construction with gypsum board finish, offering the owner-occupant some flexibility later, since they may be altered, moved, or removed. Ceilings also are of a prefinished, sound absorbent material. All kitchen cabinetry and millwork are prefabricated and prefinished.

Taking advantage of the sealed crawl space created by the onsite floor construction system, heating (and optional cooling) is accomplished by using this space as a plenum. A counterflow, gas fired furnace pumps heated air into the plenum, from which it is released under pressure by way of registers which penetrate the floor at various locations. The use of the crawl space plenum results in fuel economy by keeping the floor always warmed (or cooled) and eliminates the needs of a costly heat distribution system.

Plumbing walls for the system will be prefabricated offside and installed onsite as the partitions are placed. Electric and telephone outlets will be prewired, with electric distribution being by nonmetallic conductor.

A plant for production of all elements of the proposed systems has been built and is operational.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; NEW TOWN; RURAL
2 Density Range	5 TO 8 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	SEPARATE VEHICULAR & PEDESTRIAN CIRCULATION; SIDEWALKS; STREET GRID
8 Site Planning Services	
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	STANDARD PLAN ONLY
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE PANELS OR STEEL STUD CONSTRUCTION; ROOF TRUSSES; GABLE ENDS
17 Exterior Elements	CLAPBOARD, SHINGLES, SHAKES, OR BRICK VENEER FACING
18 Interior Elements	GYPSUM BOARD OR STEEL STUD WITH GYPSUM BOARD FINISH; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; BEARING WALLS, PERIMETER FOOTING; DESIGNED FOR SITE CONDITIONS
20 Comfort Systems	GAS PRESSURIZED DISTRIBUTION; OPTIONAL COOLING; INTEGRATED IN BUILDING SYSTEM
21 Plumbing	CONVENTIONAL; PREFABRICATED PLUMBING WALLS
22 Electrical	CONVENTIONAL; NONMETALLIC CABLE
23 Furnishings	

PRODUCTION

24 Offsite Production	CONCRETE & STEEL-STUD WALL PANELS; ROOF TRUSSES; PLUMBING WALLS
25 Onsite Production	
26 Onsite Construction and Erection	ERECTION OF PANELS—EXTERIOR & INTERIOR WALLS; ROOF TRUSSES
27 Labor	SKILLED; SEMISKILLED; UNSKILLED
28 Labor Training Programs	ON-THE-JOB TRAINING
29 Community Involvement	

ECONOMICS

30 Construction Costs	
31 Financing Methods	
32 Useful Life Structure	40 TO 100 YEARS; MECHANICAL—10 TO 30 YEARS

MANAGEMENT

33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	MANAGEMENT; COORDINATION; ARCHITECTURAL DESIGN; PRODUCTION
35 External Functions	
36 Market Area	
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	SEALED AIRSPACE HEATING PLENUM; PREFABRICATED PLUMBING WALL
40 Codes	

Precision-Built

PROPOSER

Precision-Built Corporation, Cincinnati, Ohio.

AFFILIATES

William H. Mers, Jr., Certified Public Accountant; E. R. Grossheim, Attorney.

Erection and completion of an average single-famil' home in less than a day is a requirement set by th proposer which is satisfied by a combination of factor manufacture of prefinished wood-framed, stressed-skin panels and a custom-designed transportation-erection system. This consists of a crane mounted on a tractor, which tows a trailer upon which are carried all the components for a single house structure including, as well, appliances, hardware, plumbing, lighting fixtures, heating equipment, and wiring.

The use of panels, rather than factory-assembled modules, results in lowered transportation costs. lighter cranes for erection, and reduced manufacturing and warehousing space (therefore lowered overhead). Floor panels, exterior wall panels, interior partitions, and even foundation walls are of stressed-skin construction, resulting in structurally self-supporting members which can be joined to produce houses up to two stories high, plus a basement. Use of stressed-skin panels for foundation walls (set on a conventionally placed concrete basement slab) will permit quicker erection of the house with less of the vulnerable time lag between excavation and backfill. Cast-in-place concrete walls, however, may be substituted.

The roof panels, 3 5/8-in.-thick sandwich panels with a 3-in. polystyrene foam core, span the exterior walls without trusses to form a cathedral ceiling, which is particularly effective over dining, kitchen, and living room areas. Wall panels are varied in configuration, some having a gabled profile to accommodate the cathedral ceiling. Roofing may be seal-down asphalt shingles or sprayed roofing membrane.

Exteriors of the wall panels are prestained, textured plywoods or hardboards, with masonry veneer available as an option. Interiors are 1/4-in. scarfed plywood, glue-nailed to the framing and covered with seamless, heavy vinyl wall fabric or conventional gypsum board.

All plumbing for the house will be concentrated in a preplumbed partition, which will be crane-set (before the roof panels are placed) and will require only hook-up to the site utilities. One side of this partition will be left open for field inspection and closed in later as one of the few site operations required. Other sitework will include placement of carpeting or resilient sheet flooring, installation of the heating-cooling system, and running of electrical conduit in the basement ceiling for distribution to all rooms from the panelboard in the basement. Switch boxes and pull strings, however, will be factory-built in the wall panels to facilitate field wiring.

A plant already exists in Cincinnati for panel manufacture, with shipments being made up to 500 miles from this base, although a 100-mile radius is more economically feasible.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	FLEXIBLE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	PUBLIC UTILITIES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY HIGH-RISE
12 Unit Variations	
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION AND BUILDING SYSTEMS DEVELOPED & BEING MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAMED, STRESSED-SKIN WALL, FLOOR AND ROOF PANELS
17 Exterior Elements	ENDWALLS; TEXTURED PLYWOOD OR HARD BOARD PANELS; OPTIONAL MASONRY VENEER
18 Interior Elements	SCARFED PLYWOOD WALLS; PREPLUMBED PARTITION; STAIRS
19 Foundations	CONCRETE SLAB; PREFABRICATED STRESSED-SKIN PANEL OR SITE CAST FOUNDATION WALLS
20 Comfort Systems	FORCED AIR; ELECTRIC HEAT PUMP HEATING
21 Plumbing	PREPLUMBED WALL; PLASTIC PIPING WHERE PERMITTED; FIBERGLASS TUB-SHOWER
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	PANELS; ENDWALLS; PLUMBING WALL & OTHER COMPONENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ERECTION OF COMPONENTS; MECHANICAL HOOK-UPS; FINISHING
27 Labor	PRIMARILY UNSKILLED
28 Labor Training Programs	
29 Community Involvement	LOCAL BUILDERS, REALTORS, FINANCIAL INSTITUTIONS
ECONOMICS	
30 Construction Costs	$8.50 TO $10.00 PER SQ. FT., 1000 UNITS PER YEAR PER PLANT
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURAL ELEMENTS AND PLUMBING—INDEFINITELY; ROOF—25 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN; PRODUCTION; CONSTRUCTION; MANAGEMENT
35 External Functions	LEGAL ACCOUNTING
36 Market Area	500-MILE RADIUS FROM CINCINNATI; PREFERABLY NOT MORE THAN 100 MILES
37 Delivery Rate	1,000 UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	SHIPMENT OF ALL BUILDING COMPONENTS ON ONE TRUCK; ONE-DAY ERECTION
40 Codes	CONFORMS TO ALL NATIONAL MODEL CODES

George C. Rangel

PROPOSER

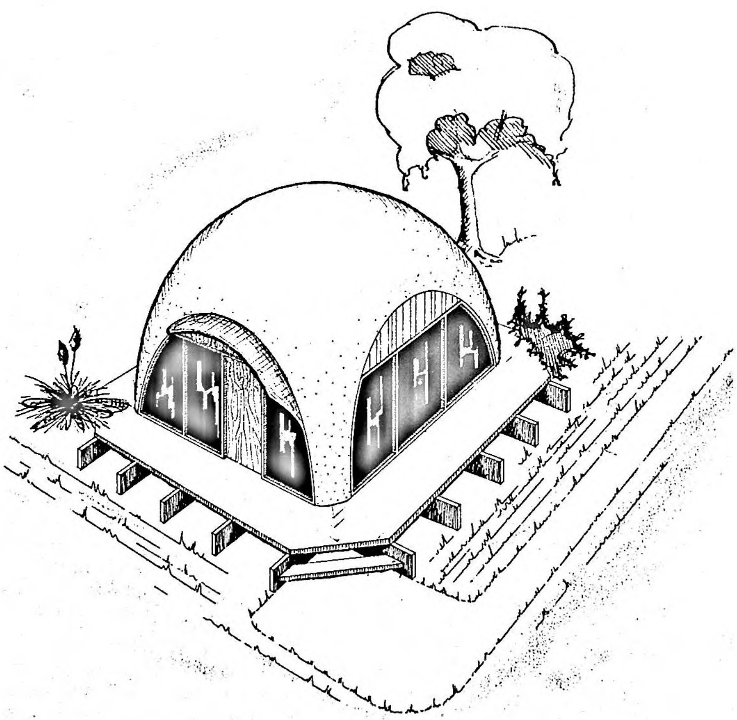
George C. Rangel Associates, San Antonio, Texas

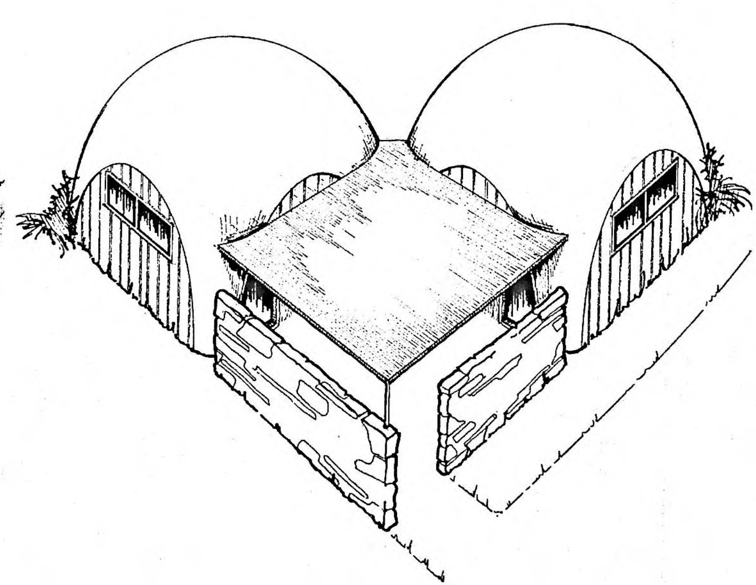
Lightweight concrete and styrofoam are combined in this proposal to produce dwelling units and non-housing construction as well. One prime limitation lies in its suitability for semiarid and low-rainfall areas only; it can, however, be constructed on weak or compressive soils.

This system involves a circular poured-concrete dome with segments sliced away on four sides. A concrete floor slab is poured separately from the domed superstructure in a square 21-ft. x 21-ft. form. The module element is poured over a steel form and cable-lifted from it after curing. The domed module with its four cutouts is then welded to the square slab, which contains anchor plates for the purpose. The entire assembled unit, including floor slab, then is transported to the site.

Diversity of design is achieved by providing lips at the edges of the four openings to frame or interconnect with adjacent modules. The lips are staggered, up and down, on each module to facilitate joining. A 3/4-in. x 2-in. neoprene pad is provided along the joint. The ceiling element is placed on top of the floor before the superstructure is erected, then raised with the same lifting cables used for erection of the cubicle and anchored to the inside wall by use of plates. The ceiling is constructed of styrofoam, stiffened by galvanized wires, and finished acoustically.

Air-conditioning ducts and diffusers are positioned on top of the ceiling element, and the top of the dome is sprayed with epoxy resin, with waterproof paint the final coating. The dome thickness varies from 2 1/2 in. at center to 3 1/4 in. at leg supports. Reinforcing is achieved with wire mesh plus the application of steel bars around the perimeter of module openings. The module and 5-in. thick floor slab are light weight concrete with a compressive strength of 6,000 lb. Partitions and perimeter enclosures will be prefabricated and easily installed.





This system offers the user an unlimited choice of interior framing materials, with the occupant able to do most of this part of the work himself. Very little training is required.

Plumbers and electricians will work as assemblers rather than as traditional tradesmen, with much prefabrication of these subsystems contemplated. Gas is the energy source for an integrated heating-cooling subsystem, delivering through ducts and room registers.

The system has been designed but not yet tested or built. When large numbers of modules are to be combined on one project, it is proposed that the steel form be taken to the jobsite to minimize module transportation costs. A franchise arrangement through local contractors is suggested for merchandising.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	70 DWELLING UNITS PER ACRE
3 Topography	SUITABLE FOR WEAK OR COMPRESSIVE SOILS
4 Climate	SUITABLE FOR SEMI-ARID/LOW RAINFALL REGIONS
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTI-FAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	BUILDING SYSTEM DESIGNED; DEVELOPMENT REQUIRED
15 Community Involvement	OCCUPANT OPTION TO BUILD PARTITIONS & PERIMETER ENCLOSURES
BUILDING SUBSYSTEMS	
16 Structure	LIGHTWEIGHT CONCRETE, MONOLITHIC, SELF-SUPPORTED DOME FRAME
17 Exterior Elements	PAINTED DOME TOP; PREFABRICATED WALL ENCLOSURES IN VARIOUS MATERIALS
18 Interior Elements	PREFABRICATED PARTITIONS; STYROFOAM CEILING
19 Foundations	CONVENTIONAL CONCRETE SLAB
20 Comfort Systems	CONVENTIONAL GAS INTEGRATED HEATING & COOLING
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL
23 Furnishings	
PRODUCTION	
24 Offsite Production	MONOLITHIC DOMES (SMALL QUANTITIES)
25 Onsite Production	MONOLITHIC DOMES (LARGE QUANTITIES)
26 Onsite Construction	DOME ERECTION
27 Labor	
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS
ECONOMICS	
30 Construction Costs	$4,150 PER UNIT FOR 100 UNITS
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ALL
35 External Functions	
36 Market Area	SOUTHWESTERN UNITED STATES
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	DOME TYPE MODULES
40 Codes	MECHANICAL, ELECTRICAL, PLUMBING SYSTEMS — ADAPTABLE TO MODEL CODES

Redman Industries

PROPOSER

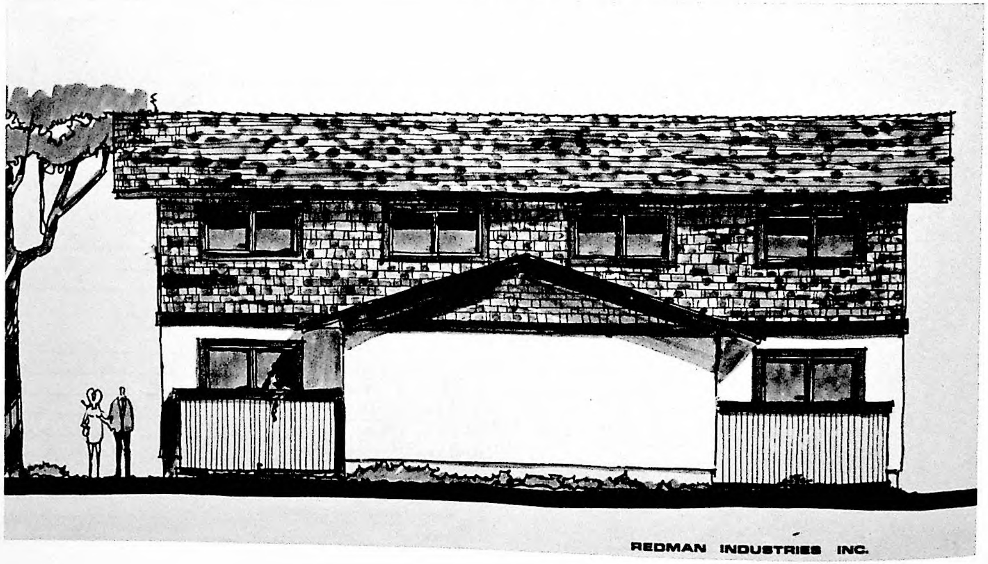
Redman Industries, Inc., Dallas, Texas.

Wood-framed modules, panelized and designed for assembly in a basic cruciform shape as single-family or low-rise dwellings, are the heart of the system proposed. The cruciform assembly plan eliminates many limitations of other systems—particularly those on room widths and excessive roofing costs. It permits individual layout planning, creation of individual private patios, both front and back doors, and separate private entry areas. The system is particularly adaptable for construction of any needed ancillary structures—but special buildings can be fabricated if desired.

The structural system is of wood-frame modules, constructed of 2-in. x 8-in. floor joists, 2-in. x 6-in. ceiling joists, 2-in. x 4-in. wall studs and 2-in. x 4-in. rafters to support the built-up intermediate frames for the gabled roof. It is completely covered with weather-resistant materials and insulated on all exterior walls and roof areas to insure efficient use of heating and/or cooling systems. Acoustical treatment includes fiberglass insulation, carpeting, sound absorbent ceiling material, and complete separation of living units so that no common wall or ceiling-floor exists between apartments.

A feature of the construction is the use of plywood shear plates along the sides of each module, connecting floor, sidewall, and ceiling (or roof). This provides structural stability during transportation and crane erection and makes each module self-supporting. Foundations can be of any conventional type, and can include basement areas.

All interior work is prefinished: partition walls are covered with prefinished plywood or gypsum board; ceiling with vinyl-coated asbestos laminate; and floors with carpet, floor tile, or sheet goods. Stairs are also carpeted, and all built-in cabinetry and trim are prefinished. Exterior finishes, for architectural effect, can be applied at the factory, or can be added at the site, as in the case of brick veneer.



Heating is provided by a gas, forced-air, perimeter-type system, ducts being located either between floors or under the floor for single-story buildings. Where required, air conditioning can be added easily by installing a cooling coil under the furnace and a remote compressor and outside condensing unit.

Drainage plumbing, fabricated and installed at the factory, is of plastic pipe and fittings; fuel supply pipes and fittings are of cast iron; internal hot and cold water lines and fittings are copper.

Electrical supply for each apartment or unit is installed onsite; the distribution system is installed in the modules at the factory, and each unit is supplied with a main disconnect and circuit breaker.

The system does not lend itself to self-help completion. Experience of the proposer group indicates that the unit usually is never completed under such an arrangement. Further, interior rearrangement is not practical (beyond minor items) since a complete unit is delivered to the site and economies would be lost with too much permitted flexibility thereafter.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	1 TO 25 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	COMMON OPEN SPACES; CLUSTERS; PRIVATE PATIOS
6	Nonresidential Functions	PLAY AREA; LAUNDRY
7	Circulation	SEPARATE VEHICULAR & PEDESTRIAN TRAFFIC; NO THROUGH TRAFFIC; WALKING PATHS
8	Site Planning Services	LOCAL SELECTED DESIGN TEAM
9	Community Involvement	
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	1 TO 4 BEDROOMS
13	Design Selection	FROM STANDARD PLANS
14	State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED BUT NOT MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	SELF-SUPPORTED WOOD-FRAME MODULES; CONNECTED BY SHEAR PLATES AT FLOOR & CEILING
17	Exterior Elements	PATIOS; OPTIONAL SCREENING
18	Interior Elements	PLYWOOD OR GYPSUM BOARD PARTITIONS; VINYL-COATED ASBESTOS CEILING; STAIRS
19	Foundations	CONVENTIONAL
20	Comfort Systems	GAS FORCED-AIR HEATING; UNDER-FLOOR DUCTS; OPTIONAL COOLING
21	Plumbing	CONVENTIONAL; COPPER OR PLASTIC PIPING INTEGRATED IN MODULES
22	Electrical	CONVENTIONAL
23	Furnishings	DRAPERIES; BUILT-IN CABINETS & FURNITURE

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PLACING OF MODULES; PATIOS; UTILITY HOOK-UPS
27	Labor	UNSKILLED & SEMISKILLED AT FACTORY
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS, & LABOR

ECONOMICS

30	Construction Costs	\$13.74 PER SQ. FT., 100 UNITS; \$13.19 PER SQ. FT., 1,000 UNITS
31	Financing Methods	CONVENTIONAL; PROPOSER SUPPLIED; BOND ISSUE; COMMUNITY DEVELOPMENT ASSOCIATION
32	Useful Life	STRUCTURAL SYSTEM, INTERIOR, MECHANICAL, ELECTRICAL—40 YEARS; ROOFING—25 YEARS

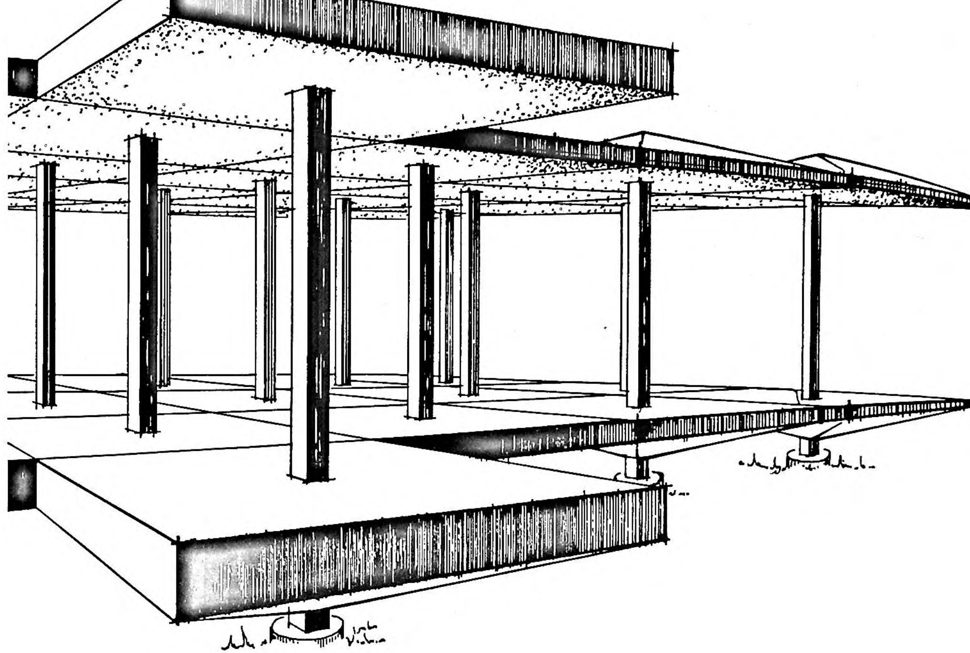
MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	SYSTEM DESIGN; ENGINEERING; COSTING; PRODUCTION; ERECTION
35	External Functions	ARCHITECTURAL DESIGN
36	Market Area	200-MILE RADIUS FROM FACTORY
37	Delivery Rate	435 DWELLING UNITS (BEST RATE); 1,000 DWELLING UNITS (MAXIMUM)
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	COMPLIES WITH NATIONAL ELECTRIC CODE AND NATIONAL MODEL CODE

Reifel Engineering



PROPOSER

Reifel Engineering Company, Houston, Texas

AFFILIATES

Walter P. Moore & Associates, Inc., Structural Engineers; Bovay Engineers, Inc.

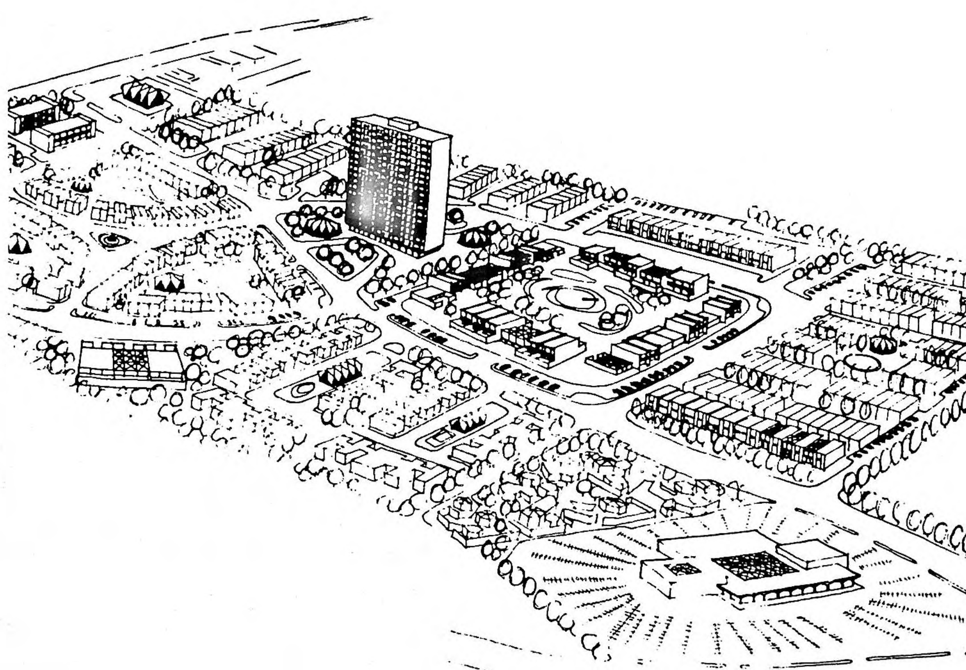
Two systems are proposed, the Geo-Pad and the REC panel, both in advanced design and development and initial production stages. Neither has been employed for housing, although the proposer suggests a volume production rate of 5,000 dwelling units per year.

Geo-Pad system involves pyramidal-shaped 12-ft. X 12-ft. steel element pads supported by hollow square steel columns to form the complete building structure. The addition of preassembled modular wall components and mechanical, electrical, and plumbing subsystems completes the living environment. Erection is on pier foundations adaptable to open water as well as land areas.

REC panel system, less advanced in development, involves prefabricated structural components (shells with hyperbolic-paraboloid shapes) for roof and wall elements. Each component is identical and would be fabricated from wood, reinforced concrete, steel, fiberglass, plastic, or other basic building material. A superior strength-to-weight ratio is inherent in this shape.

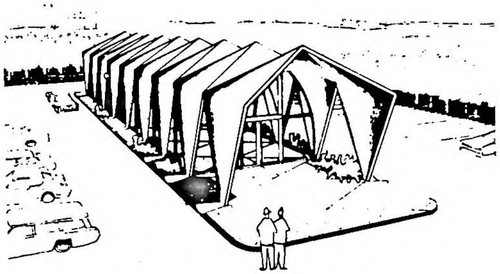
The Geo-Pad concept lends itself to all types of housing construction, the multifamily high-rise housing reaching a 15-story maximum. Exterior wall areas may be wood-framed, steel-framed, precast concrete, stucco, stone, or masonry erected onsite. Functional floor plans are limited only by the column grid. Hub of the pad is a tubular connector, a welding process joining column to pad.

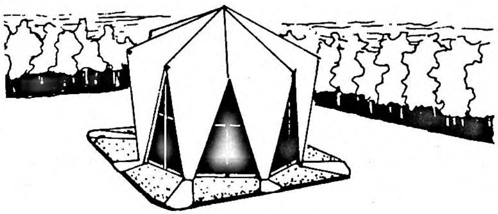
Pad voids contain insulation, electrical conduits, and plumbing runs stubbed off from lines encased in the hollow columns. Underground utility service enters through the columns, which contain vertical venting as well.

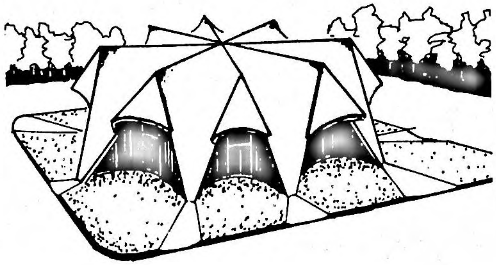


Packaged, prefabricated bathroom and kitchen-utility service modules contain mechanical and electrical appliance and equipment requirements. These are completely plumbed and wired when delivered to the site.

Wall panels in this system can be constructed through self-help programs, with all interior finishing and final hookup done by the occupant. No special skills are required of factory workers.







Summary Information

SITE SYSTEM		
1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	6 TO 100 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT
6	Nonresidential Functions	RECREATION & CLUB FACILITIES; SHADE SHELTERS; COMMERCIAL BUILDINGS
7	Circulation	THROUGH STREETS; CUL DE SACS
8	Site Planning Services	
9	Community Involvement	
10	Utilities	
BUILDING SYSTEMS		
11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	
13	Design Selection	FLEXIBLE; FROM STANDARD PLANS
14	State of Development	
15	Community Involvement	
BUILDING SUBSYSTEMS		
16	Structure	PYRAMIDAL-SHAPED FLOOR & ROOF STEEL PANEL ELEMENTS ON HOLLOW SQUARE STEEL COLUMNS
17	Exterior Elements	PREFABRICATED PANELS; CONVENTIONAL FINISHES
18	Interior Elements	WALL PANELS WITH CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL; CONCRETE COLUMNS OR PIERS
20	Comfort Systems	PACKAGED IN PREFABRICATED SERVICE MODULES
21	Plumbing	PACKAGED IN PREFABRICATED SERVICE MODULE
22	Electrical	PACKAGED IN PREFABRICATED SERVICE MODULE
23	Furnishings	
PRODUCTION		
24	Offsite Production	PANELS & COLUMNS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; FRAMING, PANEL & CORE ASSEMBLY; MECHANICAL HOOK-UP
27	Labor	SKILLED; SEMISKILLED; UNSKILLED
28	Labor Training Programs	ON-THE-JOB TRAINING
29	Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS; SELF-HELP INTERIOR FINISHING
ECONOMICS		
30	Construction Costs	$7.50 TO 11.25 PER SQ. FT., 1,000 DWELLING UNITS
31	Financing Methods	
32	Useful Life	STRUCTURE—30 YEARS; KITCHEN MODULE—15 YEARS; WALL SYSTEM—10 YEARS
MANAGEMENT		
33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT; DESIGN; PRODUCTION
35	External Functions	STRUCTURAL, MECHANICAL & CIVIL ENGINEERING
36	Market Area	250-MILE RADIUS
37	Delivery Rate	5,000 DWELLING UNITS PER YEAR
38	Consumer Protection	
GENERAL		
39	Major Innovative Concepts	BUILDING SYSTEM: HOLLOW STEEL COLUMN & STEEL PANEL
40	Codes	

Relbec

PROPOSER CONSORTIUM

Relbec Corporation, Rio Pierdas, Puerto Rico
Rexach Construction Company, San Juan, Puerto Rico
International Basic Economy Corporation, New York, New York
Larsen & Nielsen, S.A., Lausanne, Switzerland.

CONSULTANTS

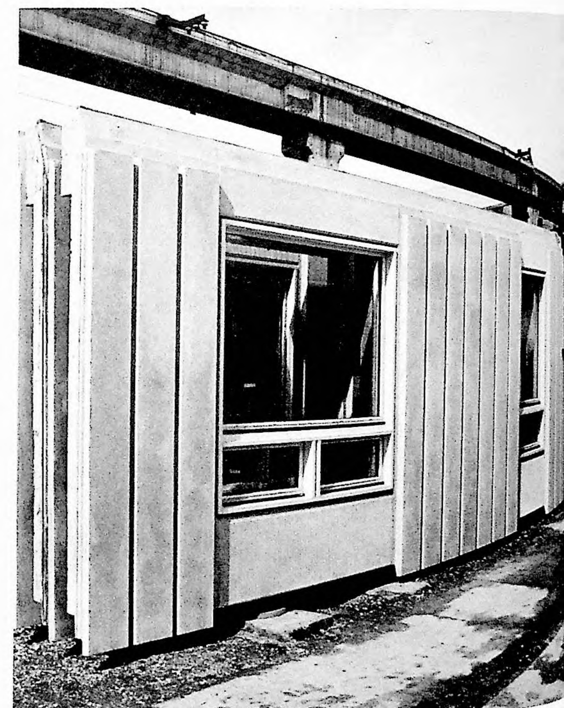
Edvardo Montovlieu, Architect; ABT Associates, Systems Analysis; Jose Guinones & Assoc., Civil, Structural Engineers; Juan D. Figueroa, Engineer; Francisco Viscal, Electrical Engineer; Harry Sobin, Climatologist; Carlos Valencia, Mechanical Engineer; Virginia Vidich, Sociology.

Designed particularly for use in mild climates, the all-precast-concrete system proposed can be adapted to single-family residences, but is aimed at multifamily occupancy by providing great flexibility in initial interior arrangement.

The system is one that has been tested extensively in Puerto Rico, the Virgin Islands, and other areas. It is designed in such a way that contractors other than the proposer can build housing by this means, through licensing arrangements.

Basically, the system consists of a precast concrete shell of floor and wall units (including interior partitions), with 7-in.-thick, hollow-concrete, floor slabs. Interior bearing wall sections are 6 in. to 7 in. thick; for nonbearing areas, partitions are 2 1/2 in. thick plain concrete; and exterior walls are 8 in. to 12 in. thick. Because the system was developed for mild climates, exterior walls are not of sandwich-type insulated construction, although they can be constructed in this manner for colder climates. Endwalls—again in consideration of climatic conditions, where air circulation is the most effective comfort-producer—are planned as jalousied or windowwall units which have no structural function. Wall-to-floor and all other connections between elements are dry-packed or grouted with reinforcing ties for proper load and stress transference.

Innovations of special interest include the fact that floor panels need not be of room size and can be manufactured in sizes up to 40 ft. long x 9 ft. wide, and thus can span over several walls. Wall panels can also be manufactured to much larger than normal sizes. Result is that very large uninterrupted spaces can be created, to give considerable interior layout flexibility. Thus the same space can accommodate as many as eight small,



low-rent apartment units, or two or three larger luxury-type apartments. Additionally, the large available space makes possible large open areas for communal activities such as meeting rooms, laundries, or play areas.

In low-rise configurations, the system is planned for single-loading of access spaces—apartments running through the structure—in order to provide maximum ventilation for tenants. Higher rise structures, though still holding to "through" apartments, are planned with elevator stops at every fourth floor, with adequate stair communications up and down from elevator stops, to contribute to greater efficiency and lower costs.

Electrical and plumbing distribution lines are built into the concrete wall and floor elements as required by initial design, with feeder lines for all services running in vertical chases. Plumbing and electrical trees, for installation at each floor, are fabricated in a factory (either onsite or nearby) in which the concrete elements are also manufactured in horizontal concrete molds. Wood doors, frames, and trim are prehung and prefinished in the same factory; kitchen and bath equipment and cabinetry, as well as laundry equipment and appliances, are also factory-produced or installed as walls go up on the site.

Interior finish, over the smooth, dense concrete of the floor and wall slabs, can be paint, paper, or almost any other material; floors are initially covered with vinyl sheet applied with adhesive on the concrete ground floor units.

Unlike some other systems—which depend on the quality of infill front and rear nonbearing walls—esthetic treatment is the result of functionally shaping parapet walls, access to apartments from the walks by stairs, use of balconies and projections, and, in general, shaping the basic elements of the structures along their most utilitarian lines and functions. There is no attempt to superimpose decoration over functionally expressed elements; concrete is left in raw state as it comes from the casting—though exposed aggregate can be used (at greater expense) as an alternative.

No unusual foundation systems are required, and the system can be adapted to almost any site. Ancillary service facilities are provided in every development area—either outside the structures or on scattered floors in a high-rise configuration.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	26 TO 60 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	ESPECIALLY SUITABLE FOR SOUTHERN CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	RECREATIONAL FACILITIES; LAUNDRY; ADULT MEETING ROOMS
7 Circulation	SEPARATE VEHICULAR & PEDESTRIAN TRAFFIC; WALKING PATHS; SIDEWALKS
8 Site Planning Services	
9 Community Involvement	FIELD RESEARCH AND INTERVIEWS
10 Utilities	CONVENTIONAL; UNDERGROUND WIRING

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	BUILDING SYSTEM FULLY DEVELOPED
15 Community Involvement	FIELD RESEARCH & FULLY DEVELOPED INTERVIEWS

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE WALL, FLOOR & ROOF PANELS OR SECTIONS
17 Exterior Elements	PREFABRICATED WINDOW & ENDWALLS, BALCONIES, PARAPET WALLS
18 Interior Elements	PRECAST CONCRETE PARTITIONS; BATHROOM/KITCHEN MODULES; STAIRS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	ELECTRIC & OTHER CENTRAL HEATING SYSTEMS EASILY INTEGRATED IN SYSTEM
21 Plumbing	PIPING CAST IN FLOOR AND WALL PANELS; PREFABRICATED PLUMBING TREES
22 Electrical	DISTRIBUTION LINES CAST IN FLOOR AND WALL PANELS; PREFABRICATED ELECTRICAL TREES
23 Furnishings	

PRODUCTION

24 Offsite Production	PRECAST CONCRETE PANELS, ENDWALLS; WET MODULES; BALCONIES, PARAPET WALLS
25 Onsite Production	POSSIBLE PRECAST CONCRETE PANELS, ENDWALLS; PLUMBING & ELECTRICAL TREES
26 Onsite Construction	FOUNDATIONS; ERECTION OF PANELS & ELEMENTS; MECHANICAL INSTALLATIONS
27 Labor	UNSKILLED LABOR FOR FACTORY & SITE; SKILLED FOR UTILITY HOOK-UP
28 Labor Training Programs	TRAINING OF HARD CORE UNEMPLOYED
29 Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	$12,000 AVERAGE COST PER UNIT (1,000 SQ. FT.)
31 Financing Methods	CONVENTIONAL
32 Useful Life	FOUNDATIONS—150 YEARS; STRUCTURAL FRAME—100 YEARS; ROOF, WALLS, CEILING—100 YEARS

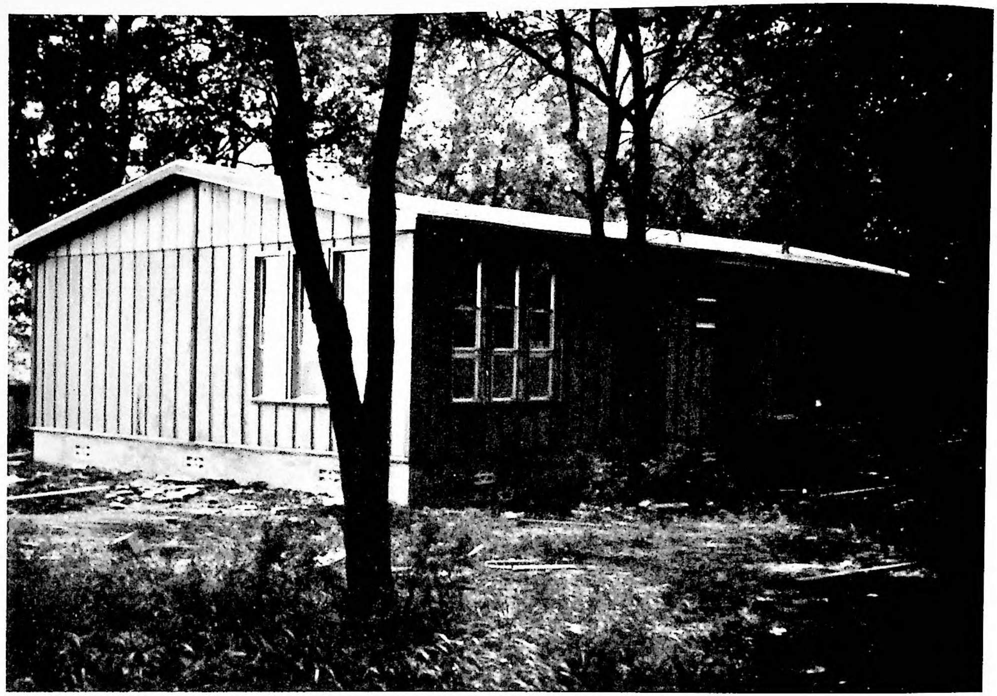
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	COORDINATION; PRODUCTION; CONSTRUCTION
35 External Functions	PLANNING; ENGINEERING; SYSTEMS ANALYSIS; OPTIONAL PRODUCTION, CONSTRUCTION
36 Market Area	
37 Delivery Rate	1,500 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM; POSSIBLE CASTING OF VERY LARGE SECTION ON OR NEAR SITE
40 Codes	ADAPTABLE TO NATIONAL ELECTRIC CODE, PUERTO RICO BUILDING CODE

Republic Gypsum



PROPOSER

Republic Gypsum Company, Dallas, Texas
Republic Modular Homes, Inc., Arlington, Texas

AFFILIATES

Clovis Heimsath Associates, Architects, Houston, Texas

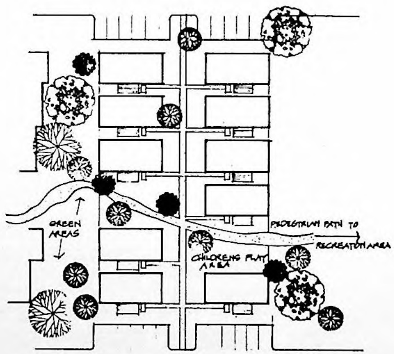
Factory-to-site delivery of a completely furnished module, with unitized bathroom and kitchen components, is a feature of this proposal. Carpet is laid and furniture and accessories are placed at the plant; thus a full packaged unit is shipped, minimizing site preparation costs. The finished modules are crane-lifted into place and can be stacked for two-story design. A prepared pier or spread footing foundation is specified.

Modules are produced in 12-ft. widths with length varying from 34 ft. to 57 ft. Modules for first floor assembly are 8 ft. 1/4 in. high, for upper floor assembly, 9 ft. 5 1/4 in. high.

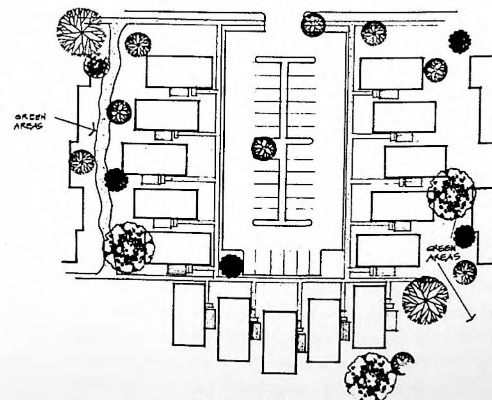
The production system employs conventional wood stud and joist construction. Prefinished materials are used exclusively. The roof subassembly consists of 2 in. x 4 in. trusses with plywood gusset plates, 1/2 in. prefinished gypsum board ceiling, 1/2 in. plywood decking, composition roofing, and a plywood facia plate at the mating line. Fiberglass or mineral wool insulation is provided. Multistory construction is designed to satisfy the additional loadings encountered.

Individual unit heating is by updraft furnace with overhead ducting. Plastic piping is specified for waste runs, copper for pressure lines. Central heating and cooling facilities are prescribed for large housing complexes.

The proposal is based on the mobile home manufacturing concept throughout. Plant investment costs are described as moderate with skilled and semiskilled labor adequate for production of the modules. Manufacturing plants will be located near major population centers, preferably in low-income areas to provide a labor source for the disadvantaged.



SYSTEM 1



SYSTEM 2

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN
2	Density Range	3 TO 18 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTERS; DEVELOPMENT OF LAND-USE INTENSITY CHARTS; TOTAL LIVING ENVIRONMENT
6	Nonresidential Functions	RECREATIONAL & MEETING AREAS; SHOPPING CENTER; DAY CARE FACILITY
7	Circulation	PEDESTRIAN PATHS; CUL-DE-SACS; SEPARATE PROVISION FOR VEHICULAR TRAFFIC
8	Site Planning Services	COMPUTER USED AS AID TO SITE DESIGN ANALYSIS THROUGH PLANNING & CONSTRUCTION
9	Community Involvement	STUDIES & SURVEYS TO DETERMINE USER NEEDS & PREFERENCES
10	Utilities	PUBLIC UTILITIES; CENTRAL HEATING, COOLING, & WATER SYSTEM FOR ENTIRE SITE

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	1 TO 4 BEDROOMS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION FACILITIES OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	SELF-SUPPORTING WOOD-FRAME MODULE
17	Exterior Elements	PLYWOOD, HARDBOARD &/OR BRICK VENEER FINISHES
18	Interior Elements	VINYL-SURFACED WALLS; GYPSUM BOARD PANELS
19	Foundations	PERIMETER GRADE WALL WITH PIERS AT MATING LINE
20	Comfort Systems	OVERHEAD UPDRAFT FURNACE: INTEGRAL AIR CONDITIONING
21	Plumbing	UNDERFLOOR PLASTIC PIPING; CONVENTIONAL APPROVED FIXTURES
22	Electrical	CONVENTIONAL
23	Furnishings	FURNITURE & MOST FURNISHINGS; STORAGE UNITS

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES COMPLETE & FURNISHED
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOK-UPS
27	Labor	SEMI-SKILLED & UNSKILLED
28	Labor Training Programs	SUPPLIED THROUGH PRIME CONTRACTOR
29	Community Involvement	LOCAL SEMISKILLED & UNSKILLED LABOR

ECONOMICS

30	Construction Costs	$10,397 PER 1,152 SQUARE FOOT UNIT, 780 UNITS; ($9.00 PER SQ. FT.)
31	Financing Methods	CONVENTIONAL FINANCING
32	Useful Life	TOTAL UNIT — 30 YEARS

MANAGEMENT

33	Proposer Organization	PRIVATE COMPANY
34	Internal Functions	SYSTEM DESIGN; PRODUCTION; ERECTION; OVERALL MANAGEMENT
35	External Functions	ARCHITECTURE; PLANNING
36	Market Area	WITHIN 800 MILES OF PLANT; NATIONWIDE BASIS
37	Delivery Rate	
38	Consumer Protection	MANUFACTURER'S WARRANTY ON STRUCTURAL DEFECTS & APPLIANCES

GENERAL

39	Major Innovative Concepts	TOTAL LIVING ENVIRONMENT APPROACH; USE OF COMPUTER FOR SITE PLANNING
40	Codes	

Republic Steel

PROPOSER

Republic Steel Corporation, Youngstown, Ohio.

AFFILIATES

Bob Schmidt Homes, Inc., Builder; American Standard, Inc.; The Tappan Company; Climatrol Industries, Inc.; Emerson Electric Company.

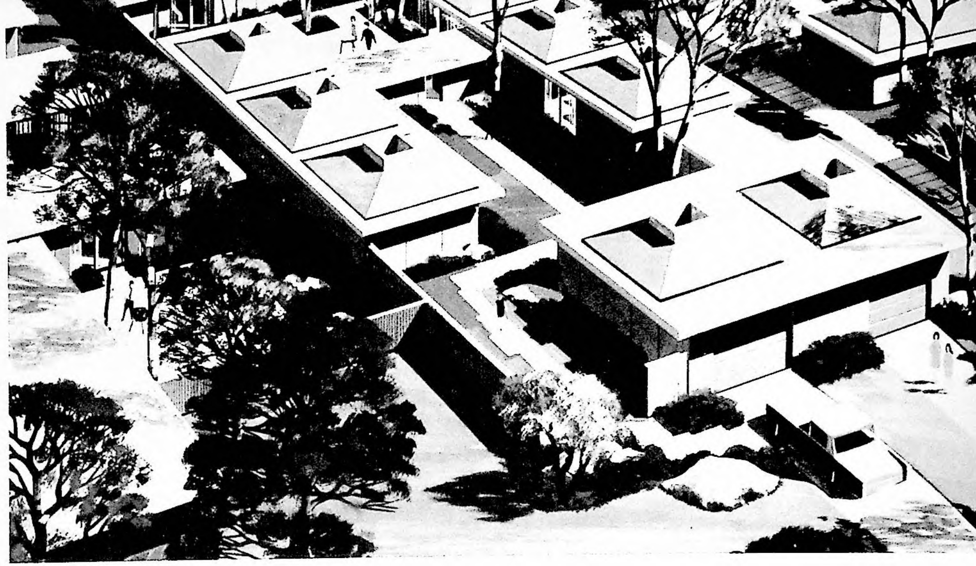
A housing system, designed to provide single-family residences that offer privacy in high-density neighborhood groupings, is the heart of this proposal. The housing system is made up of basic wall and roof panels consisting of steel sheet sandwiches with a core of foam plastic and insulated paper, which provides structural, thermal, and acoustical properties. These load-bearing panels are used for both exterior and interior walls and in some cases are combined with interior storage closets.

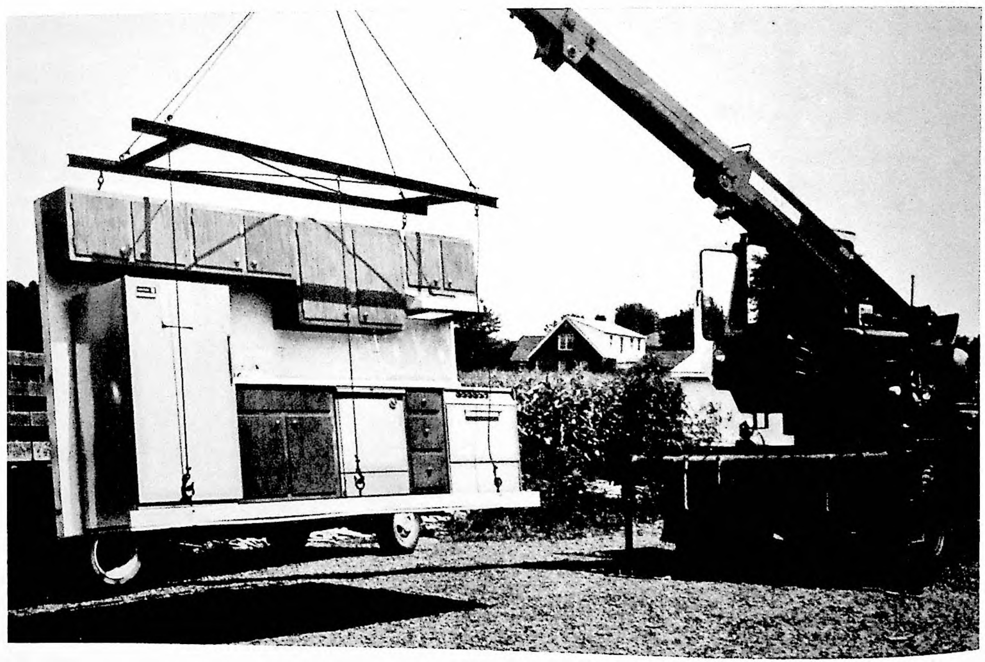
Specifically, the system is designed for use in one-story homes, though design can be developed for two-story units. However, the one-story configuration offers ample space in the basic three-bedroom, one-bath home. A 1,000-sq.-ft. house, consisting of two planning modules plus a connecting entry module and garage, can be erected on a minimum lot of about 50 ft. by 100 ft. Optimum production for the system is projected at 30,000 units per year.

Considerable variation in appearance is possible, through varying treatment of exterior panels as to color or texture, variations of roof lines, and careful site planning. With such careful site planning, as many as five homes can be built on an acre, each with patio court and other amenities.

Panels, supporting structure, and some completed subassemblies, such as kitchen-appliance walls and bathroom sections, are delivered to the site where they are quickly assembled. Interior panels are delivered painted, but other materials—including wallpaper or plywood paneling—can be attached to suit the homeowner's desires.

Wall panels are attached to and supported by steel





box-type grade beams which can rest directly on the ground, with a tie-down arrangement where soil conditions are suitable, or they can rest on piers. For permanence and resistance to wind and other loading, the basic box beams are fixed to the concrete piers with anchor bolts and clips. Floor and panel sections are joined with clips and blind rivets or self-tapping screws, and joints are covered with double-faced tape. Wall-to-wall carpeting covers a plywood subfloor which is laid over steel supports. The floor panel is offset from the walls on the outer perimeter by a wide, wire raceway, the cover of which is flush 4 ft. x 8 ft., floor panels are 4 ft. x 11 ft., and roof panels are 4 ft. x 16 ft. Panels vary in thickness from 1 3/4 in. (for interior walls) to 3 in. (for floors, roof and exterior walls).

The electrical subsystem is based in part on experience with manufacturing and installation of prefabricated aircraft wiring assemblies. Complete factory fabrication of the house wiring system includes receptacles, switches, and even door chimes, so that site installation requires only connecting wires to other subsystems, and final connection to numbered and color-coded points at the breaker panel. With the wiring raceway on the perimeter of each module, manufacture of wall, floor, and roof panels is simplified, without need for provision of wiring. Vents from the heating-cooling ducts and vents for the return-air into this system are adjacent to the raceways.

Swag ceiling lighting fixtures are used extensively. Specifically designed units handle heating, cooling, filtration, and ventilation requirements for each 12-ft. x 40-ft. housing module at temperature and ventilation settings selected by the occupant. A perimeter duct distribution system is contained in each housing module floor grade beam, so that conditioned air can be supplied on the side of the module having the glass door openings. The return system along the solid wall (used to obtain complete interior privacy in small-lot situations) gives even distribution and positive circulation of air.

Kitchen-and-laundry system consists of one assembled wall. Somewhat similarly, the bathroom system includes floor, walls, plumbing fixtures, fittings, and water supply systems, including a hot water heater. The design and fabrication of these systems offer numerous economies.

Summary Information

SITE SYSTEM

1 Site Situation	SUBURBAN, RURAL
2 Density Range	3 TO 5 DWELLING UNITS PER ACRE; 10 TO 50 DWELLING UNITS PER SITE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER GROUP MODULES, NEIGHBORHOOD MODULES; PATIOS; PRIVATE COURTS
6 Nonresidential Functions	
7 Circulation	CUL-DE-SACS WITH SHORT, INTERMEDIATE & LONG ENTRANCE STREETS
8 Site Planning Services	PROPOSER LAND PLANNER; PLAN REVIEW & CONTROL PROCESS
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED; ADAPTABLE TO SINGLE-FAMILY ATTACHED, MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION PLANT DEVELOPED; COMPONENTS, SUBSYSTEMS & TECHNIQUES MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STEEL-FACED FLOOR, WALL & ROOF PANELS COMBINED WITH HORIZONTAL STEEL ANGLE FRAME
17 Exterior Elements	CONVENTIONAL FINISHES POSSIBLE; ENTRY MODULES; GARAGES
18 Interior Elements	STEEL-FACED FOAM CORE PARTITION PANELS; STORAGE CLOSETS; OPTIONAL FINISHES
19 Foundations	STEEL BEAM & CONCRETE PIER
20 Comfort Systems	EXTERIOR HEATING-COOLING MODULE; PERIMETER DUCTWORK IN FOUNDATION BEAMS
21 Plumbing	COMPONENT BATHROOM & KITCHEN-LAUNDRY WALL SYSTEMS; VENTLESS SYSTEM (SINGLE-STORY)
22 Electrical	PREFABRICATED WIRING HARNESS & RACEWAY POWER DISTRIBUTION
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL, FLOOR & ROOF PANELS; MECHANICAL, PLUMBING & ELECTRICAL SUBSYSTEMS
25 Onsite Production	
26 Onsite Construction	PANEL ASSEMBLY, ADD-ON MODULES; UTILITY HOOK-UPS
27 Labor	SKILLED TO SET ROLLS, DIES, PUNCHES & MAKE CHANGES; BALANCE IN-PLANT UNSKILLED
28 Labor Training Programs	TECHNICAL COURSES AT PROPOSER INDUSTRIAL EDUCATION INSTITUTIONS
29 Community Involvement	UNSKILLED, LOCAL LABOR FOR SITE ERECTION; SELF-HELP LABOR POSSIBLE

ECONOMICS

30 Construction Costs	$16,250 PER UNIT, 1000 UNITS PER YEAR; $15,570 PER UNIT, 30,000 UNITS PER YEAR
31 Financing Methods	NOT REQUIRED FOR PROTOTYPE OR PRODUCTION FACILITIES; CONVENTIONAL WHEN REQUIRED
32 Useful Life	STRUCTURAL SYSTEM—50 YEARS; MECHANICAL SUBSYSTEM—8 TO 10 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	PROJECT MANAGEMENT, DEVELOPMENT, PRODUCTION, COORDINATION
35 External Functions	DESIGN & PLANNING; BATHROOM & LAUNDRY SUBSYSTEM
36 Market Area	PLANTS CENTRALLY LOCATED TO SERVE 200 TO 250 MILE RADIUS, SPECIFIC MARKET AREAS
37 Delivery Rate	30,000 UNITS PER YEAR, BEST RATE
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	STRUCTURAL PANEL SYSTEM; MECHANICAL, PLUMBING & ELECTRIC SUBSYSTEM
40 Codes	ADAPTABLE TO NATIONAL MODEL CODES EXCEPT PLUMBING (VENTING REQUIREMENTS)

Ring Brothers Consortium

PROPOSER CONSORTIUM

Ring Brothers Corporation, Los Angeles, California
Modular Concepts, Inc., Gardena, California
The Flintkote Company, Sealzit Division, Riverside, California
Formica Corporation, Los Angeles, California
Pratt & Lambert, Inc., Orange, California
R & G Sloane Manufacturing Division, Susquehanna Corporation, Sun Valley, California
Day & Night Manufacturing Company, La Puenta, California
Simpson Timber Company, Seattle, Washington
I.T.E. Imperial Corporation, Ardmore, Pennsylvania

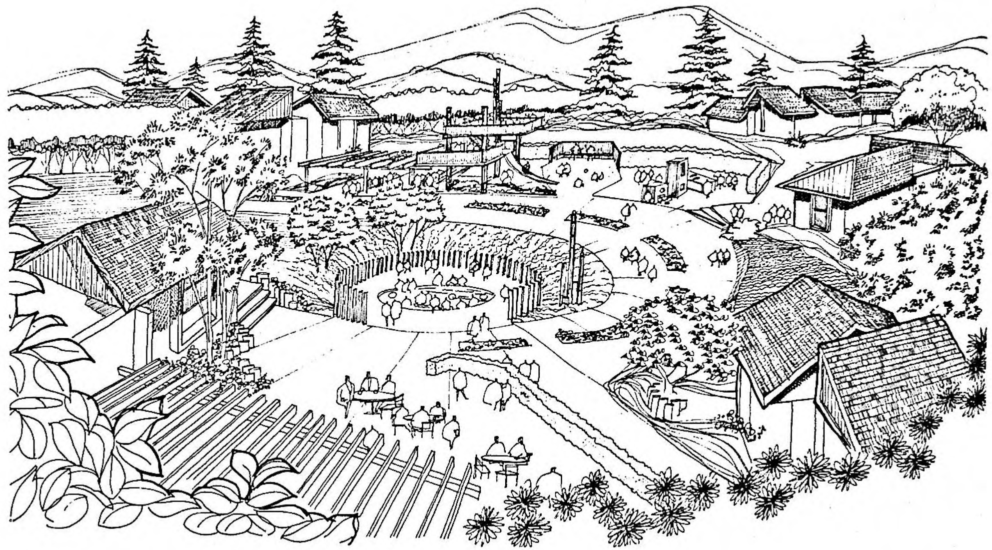
AFFILIATES

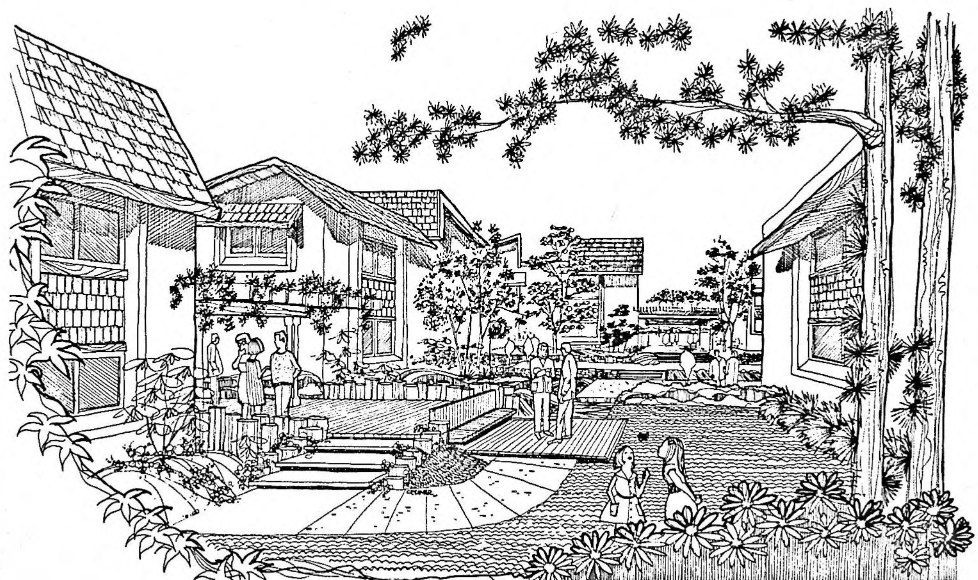
Joes Nemoy and Associates, Architects

A temporary, onsite factory producing wood-framed panels for field erection and finishing, is the centerpiece of this system for producing low-rise housing. The factory is set up in an inflatable-membrane building for weather protection, and requires only the early extension of utilities and paving of a parking lot—in addition to normal site preparation at the housing location.

With the factory in operation, the construction sequence can move rapidly: Essentially conventional foundations are placed. Then jig-built, panelized drop-in floors of plywood over 2-in. x 8-in. joists are placed with underfloor insulation where climate requires. The floor panels are finished with shaped plates, to which walls are specially nailed. Rigid, modular, plywood-polyurethane sandwich panels then are positioned; permanent headings and tieplates are secured so that the walls can stand without other support. Windows and doors are installed in the production plant; a prefabricated 8-in. wood-stud plumbing wall is also included.

Using the same drop-in floor panels, a second-story platform is then constructed, and the same sequence is followed in installing walls and partitions—with the exception that prefabricated roof trusses replace the first-floor ceiling joists. If additional stories are planned, the same procedure is repeated.





As work progresses, drywall ceilings are installed with continuous, gypsum board runs since interior partitions are non-bearing and only the wet wall has been set. Interior gypsum board-polyurethane sandwich panels are installed, complete with prehung doors; installation packaged systems for mechanical equipment and plumbing, prefabricated cabinetry and bathroom components follow.

Electrical network is installed—based on a surface-mounted, nonmetallic receptacle strip with integral wiring; and final interior finishing of paint, plastic coating or paper can proceed. A major advantage is that the units are closed in two at a time to permit interior work to continue regardless of weather conditions.

Buildings of similar construction can be used as schools and other ancillary structures.

The heating-ventilating-air conditioning system, an adaptable modular unit for each apartment, allows sidewall ventilation or exhaust, or roof exhaust if desired. Plumbing will consist of plastic piping wherever possible, which will include both hot and cold water systems, and drain, waste, and vent pipes.

Actually, the basic panels can be economically produced off-site as well, and shipped to serve a market area, if individual project size does not seem to justify an onsite plant. Weight of the basic sandwich panel is substantially less than a conventionally framed and insulated panel of the same size, hence shipping problems are eased.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	41 TO 47 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER; GARDEN COURTS; COMMON OPEN SPACES; CONTROLLED INTERNAL ENVIRONMENT
6 Nonresidential Functions	GREENBELT; TOT LOT; NURSERY; COMMUNITY CENTER; DAY CARE CENTER
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; WALKING PATHS
8 Site Planning Services	GENERALIST EXECUTIVE-COORDINATOR
9 Community Involvement	STUDY OF COMMUNITY ATTITUDES
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	2 TO 5 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED
15 Community Involvement	PARTICIPATION OF COMMUNITY ORGANIZATIONS
BUILDING SUBSYSTEMS	
16 Structure	STRUCTURAL WOOD FRAME SANDWICH WALL PANELS; FLOOR PANELS; ROOF TRUSSES
17 Exterior Elements	BALCONIES; URETHANE COATING, STAIN, & ENAMEL FINISHES
18 Interior Elements	GYPSUM BOARD PARTITION; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	GAS OR OIL HEATING SYSTEM; INTEGRATED COOLING FOR INDIVIDUAL DWELLING UNITS
21 Plumbing	TREE ASSEMBLY PREFABRICATED & ATTACHED TO UTILITY WALL; PLASTIC PIPING
22 Electrical	NONMETALLIC CABLE INTEGRATED WITH BASEBOARD; CONDUIT IN URETHANE SANDWICH PANEL
23 Furnishings	
PRODUCTION	
24 Offsite Production	POSSIBLE FABRICATION OF WALL & FLOOR PANELS, TRUSSES; KITCHEN/BATH CORE
25 Onsite Production	PORTABLE FACTORY: WALL & FLOOR PANELS; ROOF TRUSSES; PLUMBING & ELECTRICAL TREES
26 Onsite Construction	FOUNDATIONS; ERECTION OF FLOOR & WALL PANELS; ROOF TRUSSES
27 Labor	SKILLED; SEMISKILLED; UNSKILLED
28 Labor Training Programs	ONSITE TRAINING OF LOCAL UNSKILLED
29 Community Involvement	LOCAL CONTRACTORS & COMMUNITY ORGANIZATIONS
ECONOMICS	
30 Construction Costs	$5,873 TO $9,229 PER DWELLING UNIT (696 UNITS OR MORE); ($8.74 PER SQ.FT.)
31 Financing Methods	CONVENTIONAL
32 Useful Life	BUILDING UNIT—40 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; FINANCIAL; COORDINATION; ARCHITECTURAL DESIGN
35 External Functions	EMPHASIS ON INVOLVEMENT WITH SURROUNDING COMMUNITY
36 Market Area	
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	RIGID PLYWOOD-URETHANE STRUCTURAL PANEL; PORTABLE FACTORY; PLASTIC PIPE
40 Codes	ADAPTABLE TO UNIFORM BUILDING CODE

Rouse-Wates

PROPOSERS

The Rouse Development Company, Columbia, Maryland
Wates Systems, Inc.

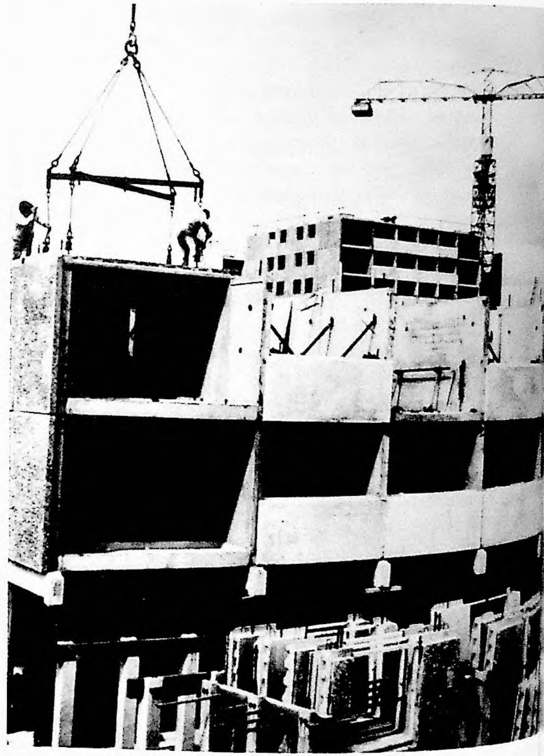
Intended entirely for multifamily low- and high-rise structures, this system is based on precast concrete panels which are bedded one atop the other, forming a series of monolithic, rigid wall tables. The weight of the panels and the joint connections assure structural integrity for buildings up to 24 stories.

Foundations and ground floor slabs are built by conventional methods with specially designed leveling devices cast in, to provide connections for the precast walls. At structural joints, the appropriate edges of wall and floor panels have projecting loops of reinforcing steel, which are laced together by steel rods and concreted to provide monolithic connections. The vertical joints are made by concreting into purpose-formed grooves. Waterproofing is by open drained joints incorporating neoprene baffles.

Exterior appearance of the concrete panels can be varied considerably by the use of exposed aggregate, and sculptured or bush-hammered finishes. Brick, stone, wood, or other materials may also be used to provide further variety of appearance.

Floor panels of dense concrete, weighing 150 lb. per cu. ft., allow for spans up to 22 ft. Panels are smooth-finished to receive flooring, normally a tile with resilient underlay, but which can be wood blocks, asphalt or vinyl tile, carpet, or mosaic tile in bathrooms. Ceiling finishes may be sprayed acoustical material, paint, paper, vinyl fabric, or acoustical tile. Similar materials, including wood paneling, may be used for walls. Trim is precast and parceled, generally of extruded plastic.

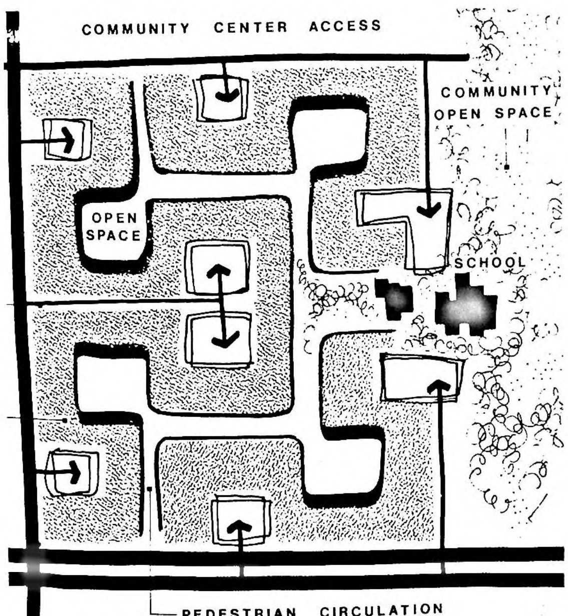
Acoustical privacy is assured due to the sound transmission loss of the heavy concrete floors and structured walls (7 in. thick), rated at 51 decibels. Other dividing partitions, if not of concrete (usually gypsum board assemblies or prefabricated panels, precast to re-



quired size and with all holes and cutouts), are rated up to 47 decibels. This is superior to transmission losses normally found in apartments.

The concrete panel system reduces the number of trades necessary for onsite erection and thus saves time and energy. Because most of the electrical and plumbing lines are prefabricated, further labor savings are achieved. Although heating, ventilating, and air-conditioning systems are conventional, piping, wiring and other elements may be prepackaged at the factory, if circumstances indicate feasibility, requiring only connections in the field.

An estimated volume production of from 500 to 2,000 dwelling units per year per site is projected for the system.



Urban Neighborhood Concept

Summary Information

SITE SYSTEM		
1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL; NEW TOWNS
2	Density Range	33 (OR MORE) DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	COMMUNITY CONCEPT: NEIGHBORHOODS CLUSTERED AROUND COMMUNITY CORE
6	Nonresidential Functions	PLAY SPACES; TOT LOTS; POOL; RECREATION AREAS; SCHOOLS; HOSPITAL; LIBRARY
7	Circulation	SEPARATE PEDESTRIAN, VEHICULAR, AND SERVICE VEHICULAR TRAFFIC
8	Site Planning Services	BY PROPOSER ORGANIZATION BASED ON SURVEY & ANALYSIS OF EXISTING CONDITIONS
9	Community Involvement	
10	Utilities	CONVENTIONAL; UNDERGROUND ELECTRICAL SERVICE
BUILDING SYSTEMS		
11	Housing Types	MULTIFAMILY LOW-RISE, MID-RISE & HIGH-RISE
12	Unit Variations	1 TO 5 BEDROOM UNITS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION PLANT DESIGNED; BUILDING SYSTEM MARKETED
15	Community Involvement	TENANT SURVEY
BUILDING SUBSYSTEMS		
16	Structure	PRECAST CONCRETE FLOOR & WALL PANELS (EXPANDED POLYSTYRENE CORE)
17	Exterior Elements	PRECAST CONCRETE OR PREFABRICATED WOOD-FRAME NONBEARING WALLS
18	Interior Elements	THIN PRECAST CONCRETE OR BUILT-UP PARTITIONS
19	Foundations	CONVENTIONAL; DESIGNED TO SITE CONDITIONS
20	Comfort Systems	GAS OR OIL CENTRAL HEATING & COOLING SYSTEM; INTEGRATED DISTRIBUTION
21	Plumbing	SINGLE-STACK VENT SYSTEM; INTEGRATED IN PANEL SYSTEM WHERE POSSIBLE
22	Electrical	PLASTIC BASEBOARD OR CORNICE DISTRIBUTION SYSTEM; POSSIBLE WIRING HARNESS
23	Furnishings	
PRODUCTION		
24	Offsite Production	WALL, FLOOR, & PARTITION PANELS; STAIR TREADS
25	Onsite Production	WALL, FLOOR, & PARTITION PANELS POSSIBLE
26	Onsite Construction	ERECTION OF WALL & FLOOR PANELS; FINISHING; MECHANICAL HOOK-UP & INSTALLATIONS
27	Labor	SKILLED, SEMISKILLED, & UNSKILLED FOR PLANT & ONSITE CONSTRUCTION
28	Labor Training Programs	PROGRAM TO CREATE MARKETABLE SKILLS FOR QUALIFIED UNSKILLED LABOR
29	Community Involvement	
ECONOMICS		
30	Construction Costs	$13,594 TO $21,706 PER UNIT
31	Financing Methods	CONVENTIONAL & INNOVATIVE PROPOSER-SUPPLIED
32	Useful Life	
MANAGEMENT		
33	Proposer Organization	JOINT VENTURE
34	Internal Functions	CENTRAL RESPONSIBILITY
35	External Functions	
36	Market Area	
37	Delivery Rate	500 TO 2,000 DWELLING UNITS PER YEAR PER SITE
38	Consumer Protection	
GENERAL		
39	Major Innovative Concepts	SPECIAL JOINTING SYSTEM IN HIGH-RISE ELIMINATING FRAMING
40	Codes	ADAPTABLE TO NATIONAL MODEL CODES

Scholz Homes

PROPOSER

Scholz Homes, Inc., Toledo, Ohio.

AFFILIATES

Stiles-Hatton Co., Housing Producer.

This proposal describes a completely factory-fabricated system of modules, designed to produce individual family units or to be combined into apartment units. The concept results in completed housing units conventional in appearance, but allows considerable variation in arrangement. A key point in the concept is greater utilization of available land; for instance, through the sale of single-family homes on a condominium basis, open space is created despite small lots and relatively high density.

The materials used are basically conventional: wood studs and sheathing, maintenance-free siding, built-in plumbing, electrical, and mechanical items, bearing walls and partitions in single-family housing, and box beams in apartments. Maintenance is held to a minimum. Because of the completed nature of the modules as delivered, erection is rapid and nearly error-proof, but there is little opportunity for self-help except in interior decoration and arrangements. The careful, comprehensive planning of the entire community to meet the divergent needs of all residents is stressed, however, as being basic to the concept.

Exterior walls are based on conventional 2-in. x 4-in. wood framing 16 in. on center, with plywood sheathing and aluminum horizontal siding (field-applied after the sections have been set.) For apartments, second-floor exterior siding is vinyl-finish plywood, with prefinished aluminum battens.

Roof construction consists of trusses set 24 in. on center, plywood sheathing, surfaced with asphalt shingles. Apartment roofs are framed with plywood box beam-type rafter trusses, with 28-ga. galvanized standing-seam roofing applied over felt underlayment.

Floor framing consists of 4-in. x 10-in. laminated beams around the perimeter of each section, with 2-in. x 8-in. joists; decking is 5/8-in. shiplap subflooring glued and nailed to framing members.

Interior walls also are based on 2-in. x 4-in. framing; central partitions are 2 in. x 3 in., so that joined sections form a 6-in. wall. All interior ceiling and wall surfaces are gypsum board. Stairways are included in the package for units of more than one story.

Bathrooms are complete with fixtures and plumbing. Sections are prewired, preplumbed, and complete gas-fired furnaces, ductwork, plenum, cold-air return and registers are included.

Materials for foundations—including footings or walls, sill plates and bolts, stanchions, basement windows, vents, waterproofing, and perimeter insulation—are supplied for field construction. In addition, for split-foyer models, lower-level partitions, patio doors, wall covering, and other items are provided. Garages and other ancillary buildings (where not included in basic house plans) are also supplied with complete walls and roof systems for site installation.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; URBAN RENEWAL; RURAL
2 Density Range	6 TO 25 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PLANNED UNIT DEVELOPMENT; CONDOMINIUM CLUSTERS; COMMON OPEN SPACES
6 Nonresidential Functions	PARKS; RECREATIONAL FACILITIES; SHOPPING FACILITIES
7 Circulation	PEDESTRIAN & VEHICULAR TRAFFIC SEPARATION; WALKING PATHS; CUL-DE-SACS
8 Site Planning Services	
9 Community Involvement	COMPREHENSIVE COMMUNITY PLANNING TO MEET COMMUNITY NEEDS
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1, 2, AND 3, BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	CONVENTIONAL WOOD-FRAME VOLUMETRIC MODULE
17 Exterior Elements	PORCHES; GARAGES
18 Interior Elements	PREFABRICATED WOOD STUD & GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	INTEGRAL WITH MODULES
21 Plumbing	CONVENTIONAL INTEGRAL WITH MODULES
22 Electrical	CONVENTIONAL INTEGRAL WITH MODULES
23 Furnishings	

PRODUCTION

24 Offsite Production	VOLUMETRICAL MODULES; PORCHES; GARAGES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ASSEMBLY OF MODULES; UTILITY CONNECTIONS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	LOCAL SUBCONTRACTORS; SELF-HELP IN DECORATING

ECONOMICS

30 Construction Costs	$7,700 TO $12,840 PER UNIT
31 Financing Methods	
32 Useful Life	60 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	SYSTEM DESIGN; PRODUCTION; ERECTION; LAND PLANNING; DESIGN; MANAGEMENT
35 External Functions	
36 Market Area	300-MILE RADIUS FROM GALLION, OHIO
37 Delivery Rate	40 TO 85 DWELLING UNITS PER MONTH
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES (WITH ACCEPTABLE FACTORY INSPECTION)

Sectra America

PROPOSER CONSORTIUM

Ecodesign, Inc., Architects and Systems Designers, Cambridge, Massachusetts
Gilbane Building Company, General Contractor, Providence, Rhode Island
John Laing Construction Ltd., Systems Technologists, London, NW7, England

AFFILIATES

Greenleaf Engineering; Bingham, Dana and Gould; Arthur Anderson and Company; B.T. Equipment Company

The proposer of this system makes the point that use of conventional cast-in-place concrete techniques, and conventional appliances and equipment eliminates many problems that arise when normal onsite work is moved into a factory. By the same token, local contractors and subcontractors can be licensed to do the actual work and thereby can provide local employment.

Centered around the use of movable, heated steel forms for quick onsite construction of a monolithic reinforced concrete frame, with infill walls and other factory-produced elements, the system proposed is aimed at medium- to high-rise structures, not individual dwellings. The three-member consortium, covering the range of capabilities desired for a major development, indicates a volume production rate of 150 to 2,400 units per year, with a projected potential of 15,000 units per year.

Because of the flexibility of the forming system, the scheme can be applied to ancillary buildings (such as schools, hospitals, hotels, dwellings for the elderly, and community facilities). It is particularly suited to mixed land-use programs where several types of housing, commercial buildings and other facilities may be desirable.

The basic formwork—extensively tested in European projects—is an inverted U-shaped assembly, hinged and retractable for easy stripping, which rides on a pair of rails. To induce quicker and better curing, electric blankets or hot water in the forms are employed to make possible the use of concrete in any temperature range or climate and to accelerate the curing process.

Forms are used to build open-ended structures, so that the forms or combinations of them can be pushed through from one side of the building to the other as the concrete cures. Facade openings can then be filled in with almost any desired nonbearing material, from masonry to glass window walls or sandwich panels of traditional materials. Prebuilt reinforcing cages are placed as soon as the forms are in position, eliminating site work. Foundations for the structures are conventional.

All major service lines are prefabricated in a vertical service duct, which provides casing for the plumbing tree, gas, electric, telephone and television lines, and hot and cold water lines for heating or cooling and household service. Access panels are provided in the floor-height sections of concrete frame as cast on the site, and casing of the service duct (in lightweight concrete) provides support during transport, as well as acoustical and fire insulation when grouted into place.

Through-the-wall heating/cooling units, placed in voids created during forming, provide these services, being fed directly from straight-run plastic lines, utilizing void tubes (less than 3 in. in diameter) that can be placed in the wall forms or in the slab reinforcing mat before it is hoisted into position. The electrical conduit system is also prefabricated and integrated with the reinforcing steel assembly and can be extended by running through interior or exterior nonbearing partitions and walls.

Applicances and equipment are standard items, readily available, and can be installed quickly, since only connection is required in all cases.

Interior finish can be applied directly to the cast-concrete walls and ceilings, since the use of the steel forms and heating devices produces a smooth surface. Floors can be finished with any desired material, from tile to carpeting.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	34 TO 250 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; COMMON OPEN SPACES; PLANNED UNIT DEVELOPMENT
6 Nonresidential Functions	GAME COURT; TOT LOT; NURSERY, MEETING & COMMERCIAL FACILITIES
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION; WALKING PATHS; SIDEWALKS
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	SOCIAL SCIENCE TEAM WILL GATHER INFORMATION ON NEEDS OF COMMUNITY MEMBERS
10 Utilities	CONVENTIONAL; OPTIONAL VARIETIES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCIES & 1 TO 8 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION FACILITIES BUILT & OPERATIONAL; SYSTEM CURRENTLY MARKETED
15 Community Involvement	RESIDENTS TO ASSIST IN ESTABLISHING NEEDS & EVALUATING COMPLETED DWELLINGS
BUILDING SUBSYSTEMS	
16 Structure	REINFORCED-CONCRETE MONOLITHIC WALL, FLOOR & ROOF SLABS
17 Exterior Elements	BALCONIES, CORRIDORS, DECKS & BRIDGES; CONCRETE, METAL OR WOOD WALLS
18 Interior Elements	ACCESS SHAFTS, CORRIDORS & STAIR UNITS; PARTITIONS; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	UNIT ELECTRIC HEATING; COOLING OPTIONAL, INTEGRATED WITH BUILDING SYSTEM
21 Plumbing	PLASTIC & NON-FERROUS METAL PIPING; INTEGRATED WITH BUILDING SUBSYSTEMS
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	WALLS; PARTITIONS; WIRING & PLUMBING ASSEMBLIES; REINFORCING MATS WITH CONDUITS
25 Onsite Production	STAIR UNITS; ACCESS SHAFTS; SERVICES DUCTS
26 Onsite Construction	FOUNDATIONS; CASTING OF WALL, FLOOR, & ROOF SLABS; ERECTION OF PARTITIONS
27 Labor	UNSKILLED, SEMISKILLED, & SKILLED FOR PRODUCTION & ERECTION
28 Labor Training Programs	FILMS; ONSITE TRAINING; FAMILIARIZATION OF FOREMAN WITH SYSTEM
29 Community Involvement	LABOR, CONTRACTORS & SUBCONTRACTORS
ECONOMICS	
30 Construction Costs	$15.95 PER SQ. FT. FOR 120 UNITS
31 Financing Methods	CONVENTIONAL; OR, MAJOR CORPORATION TO BE FINANCIAL PARTNER
32 Useful Life	STRUCTURAL SYSTEM-65 YEARS; MECHANICAL SYSTEM—35 YEARS; ELECTRICAL-30 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; CONSTRUCTION; ARCHITECTURAL; ENGINEERING; PLANNING; URBAN DESIGN
35 External Functions	EQUIPMENT SUPPLY; ACCOUNTING
36 Market Area	
37 Delivery Rate	150 TO 2,400 DWELLING UNITS PER YEAR; POTENTIAL 15,000 UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	HEATED CURING OF CONCRETE; UNIQUE "SHUTTERING" FORMWORK
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Shelley System

PROPOSER CONSORTIUM

Shelley Systems, New York, New York
Shelley Engineering Corporation, San Juan, Puerto Rico
Hampton Development Corporation of Puerto Rico, San Juan, Puerto Rico
Shelley Equipment and Finance Corporation, New York, New York
Caribilt Construction Company, Inc., New York, New York
Shelga Corporation, New York, New York

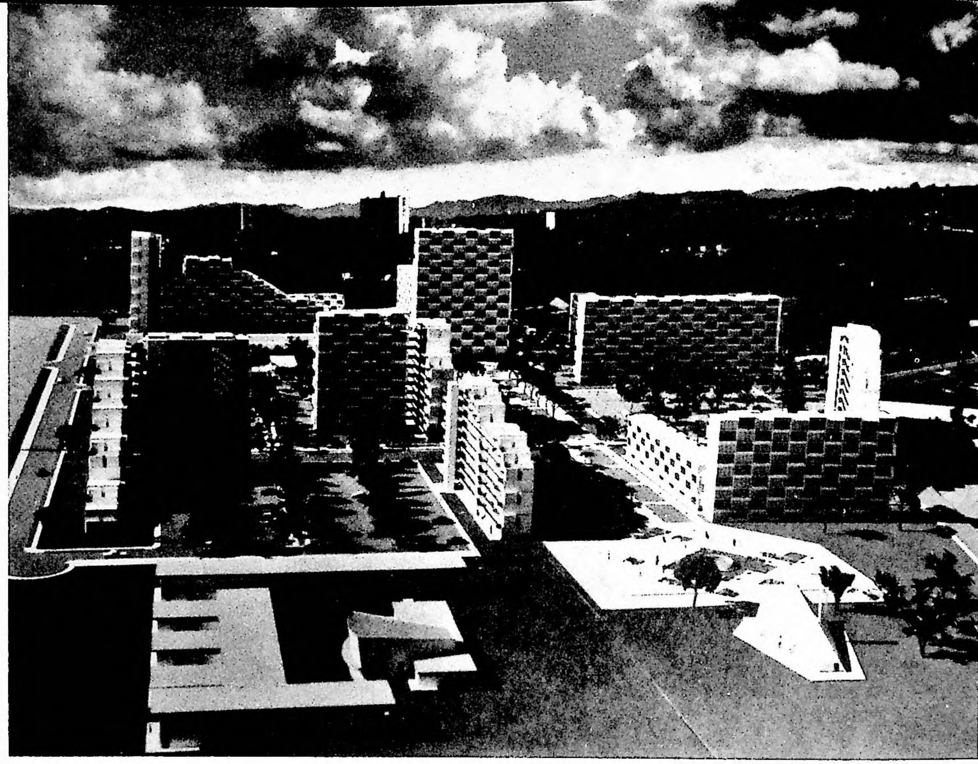
AFFILIATES

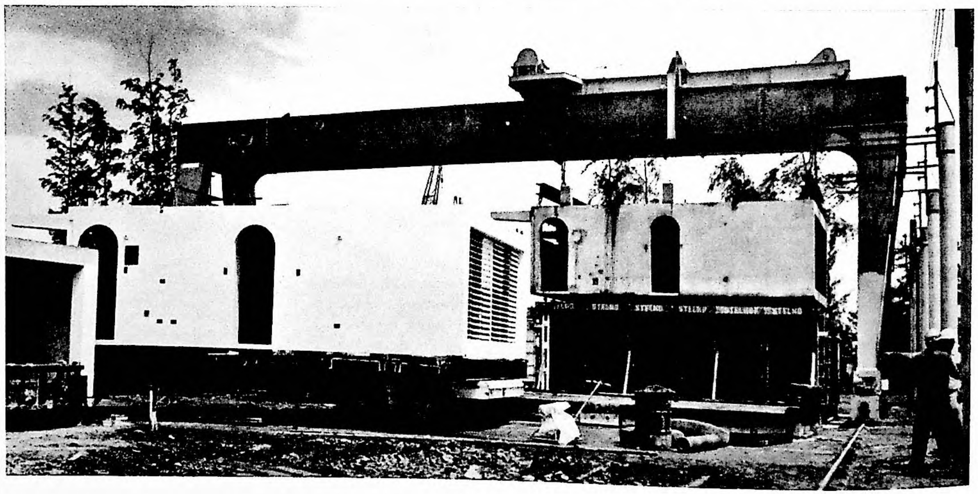
Dr. August Komendant, Professor Advanced Concrete Structures, University of Pennsylvania; Dr. Howard Stanton, Chairman of the Department of Sociology and Anthropology, Clark University; Dr. Sheldon K. Schiff, M.D., Co-Director of the Woodlawn Mental Health Center, Chicago, Illinois; Mr. Carlos M. Alvarado, President of Carlos M. Alvarado & Associates, Puerto Rico; Dr. Narendra P. Loomba, Professor of Management, City College

Space, additional created space between concrete modules stacked in checkerboard fashion, is the hallmark of this system. Unlike other concrete modular systems, there is no duplication of walls or floors. The area of every module is matched with an equal area of adjacent space thus doubling the usable area.

The precast concrete modules consist of reinforced concrete walls, floor and ceiling slabs, and integral columns. The stacked modules are structurally supported by the columns cast into the modules. No independent structural support is required. Modules may be stacked as high as 25 stories. The module's three-dimensional rigidity and torsion-resisting qualities are valuable protection against earthquakes and hurricanes. The boxes are inherently rigid so as to preclude special wall positioning, temporary bracing, or guy-wiring during erection. Where necessary for high buildings, post-tensioning tendons anchored to the foundation can be placed in vertical ducts running through the center of the exterior columns.

Elastomeric bearing pads are placed at the contact surface of the columns between adjoining modules. They contribute to the flexibility and ductility of the structure.





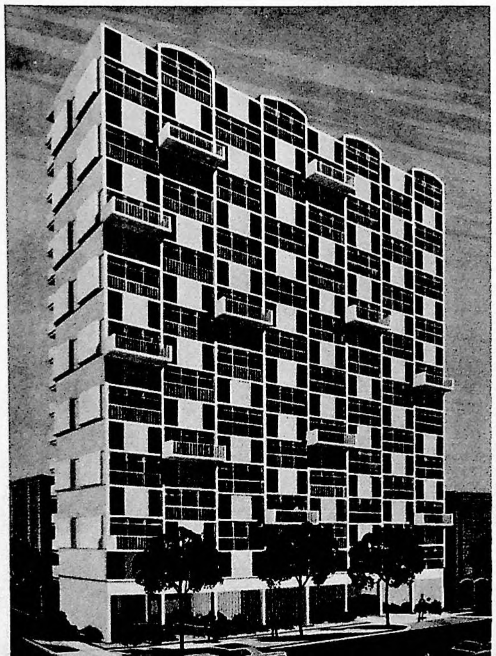
No specific architectural constraints or design arrangements are required by the system. Conventional interior work, standard plumbing, electrical, and heating/air conditioning facilities are planned, usually to be installed at the factory to reduce costs. Because the system is lighter than conventional construction, it is more adaptable to various soil conditions. The system is suitable for almost all terrains. The only requirement is that there must be access for the erecting crane.

Since the ground floors of buildings using the Shelley System may be of conventional construction, community facilities, such as nurseries, laundry rooms, and recreation areas, may be easily provided, as well as commercial facilities.

The system is capable of integrating high-rise and low-rise structures and large and small apartments for a diversity of needs, including those of the elderly, the young, and families with children.

Very high densities may be achieved with the system, creating a concentrated demand for various goods and services and for recreational activities. Pedestrian malls for walking, shopping, and informal community gatherings will enrich the environment.

Some 500 three-bedroom units have been built and sold in Puerto Rico.



Summary Information

SITE SYSTEM	
1 Site Situation	URBAN
2 Density Range	8 TO 220 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; COMMUNITIES OF CLUSTERED HOUSES TO HIGH-RISE BUILDINGS
6 Nonresidential Functions	RECREATION AREAS; NURSERIES; LAUNDRY ROOMS; COMMERCIAL FACILITIES
7 Circulation	
8 Site Planning Services	THROUGH JOINT VENTURE OR LICENSING ARRANGEMENTS WITH LOCAL GROUPS
9 Community Involvement	PROPOSER SOCIAL SCIENCES & HOUSE MANAGEMENT GROUPS TO WORK WITH COMMUNITY
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	ONE TO 3 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION, DESIGN STAGE; BUILDING SYSTEM BUILT & MARKETED (PUERTO RICO)
15 Community Involvement	PROPOSER SOCIAL SCIENCES & HOUSE MANAGEMENT GROUPS TO WORK WITH COMMUNITY
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE MODULES; STAIRWAYS; POST-TENSIONING TENDONS FOR HIGH-RISE
17 Exterior Elements	BALCONIES; CORRIDOR BRIDGES
18 Interior Elements	ELEVATORS WHERE APPLICABLE; STAIRWAYS; CONVENTIONAL INTERIOR SPACES
19 Foundations	CONVENTIONAL; DESIGNED FOR SITE CONDITIONS
20 Comfort Systems	ELECTRICAL BASEBOARD HEATING; COOLING OPTIONAL, INTEGRAL WITH MODULES
21 Plumbing	CONVENTIONAL; INTEGRAL WITH MODULES
22 Electrical	CONVENTIONAL; INTEGRAL WITH MODULES
23 Furnishings	
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES; STAIRWAY, ELEVATOR SHAFT, & CORRIDOR BRIDGE MODULES
25 Onsite Production	POSSIBLE ONSITE PRODUCTION OF ALL MODULES THROUGH A LOCAL PRECASTING PLANT
26 Onsite Construction	ERECT VOLUMETRIC MODULES; COMPLETE INTERIORS; FOUNDATIONS
27 Labor	SKILLED & SEMISKILLED FOR BOTH OFF & ONSITE PRODUCTION
28 Labor Training Programs	UNSKILLED WORKERS TO BE TRAINED FOR OFF & ONSITE LABOR
29 Community Involvement	LOCAL ARCHITECTS, PLANNERS, SUBCONTRACTORS & CONSULTANTS
ECONOMICS	
30 Construction Costs	$7,789 PER DWELLING UNIT FOR PROGRAM OF 8 UNITS PER DAY
31 Financing Methods	JOINT VENTURE WITH LARGE CORPORATION
32 Useful Life	100 YEARS FOR ENTIRE BUILDING
MANAGEMENT	
33 Proposer Organization	CONSORTIUM WHICH WILL EVENTUALLY TEAM WITH A LARGE MANUFACTURING FIRM
34 Internal Functions	TECHNICAL OPERATIONS; MANAGEMENT; COORDINATION
35 External Functions	FINANCING; SOCIAL SCIENCES; HOUSING MANAGEMENT; PLANNING; MARKETING; PRODUCTION
36 Market Area	AS LIMITED BY TRANSPORTATION CONSTRAINTS
37 Delivery Rate	360 TO 1,500 DWELLING UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	COMPLIES WITH NATIONAL BUILDING CODE, NATIONAL ELECTRIC CODE & OTHERS

Skycell Modular Cell System

PROPOSER

Skycell Ltd., Montreal, Canada

AFFILIATE

Robert Hughes Associates Ltd., Management.

Large, but relatively lightweight volumetric modules of steel, plastic and other contemporary materials are assembled onsite to form the basic building blocks of the housing system proposed. Incorporated within the 10-ft. x 20-ft. x 40-ft. modules, but structurally independent of the modules, are four tubular steel columns through which are resolved all loads of both the unit itself and of all units stacked above it, theoretically up to a height of 14 stories.

The module consists essentially of three parts—top and bottom shells and central volume created by enclosing the space between shells. From a framing standpoint, the top and bottom shells are similar, consisting of two longitudinal pairs of main beams—6-in. x 10-in. steel channels—each pair rigidly connected to the two vertical columns which it straddles. The vertical columns being 16-ft. 8-in. on center, the pairs of nearly 40-ft. long main beams cantilever 11 1/2 ft. at each end. Open-web steel joists span between the pairs of main beams and in turn are longitudinally braced. These joists and bracing support the floor system, including subfloor and the ceiling.

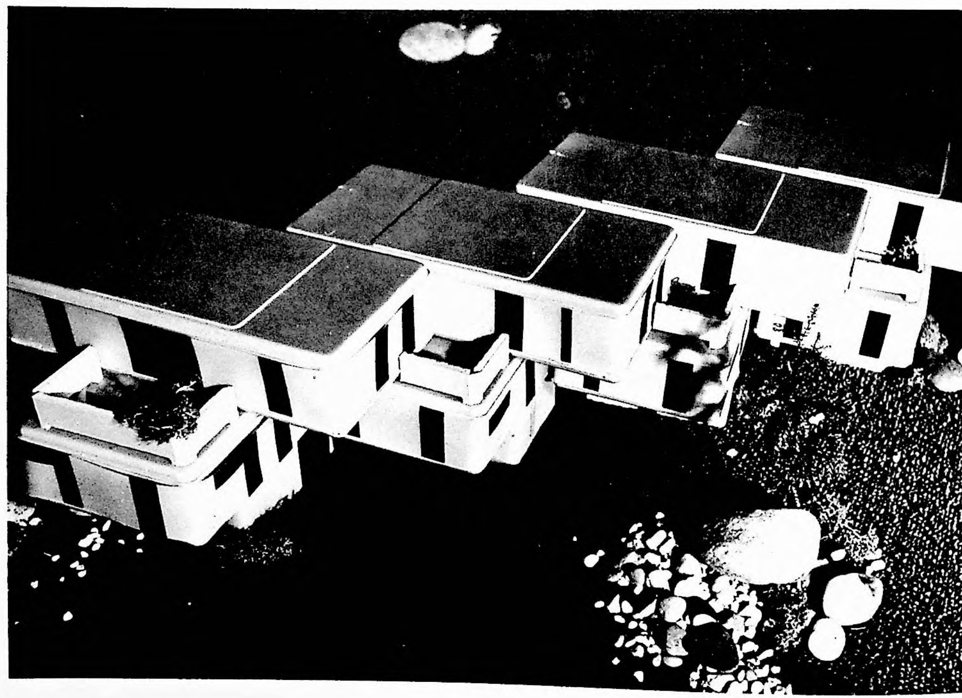
Asbestos cement, 1/2-in. thick, is molded about the framework of the shells to form the top and bottom exterior surfaces of the modules, with rounded or coved edges on all four sides. Urethane insulation, 1-in. to 1 1/2-in. thick, backs up the asbestos cement. Although each of the four 8-in. x 8-in. tubular columns is a structural entity, it is made up of three sections within each module—stub ends in both top and bottom shells, and a room-high section which is connected to the stub ends and which spaces the top and bottom shells apart and thus creates the central living space volume.

This central volume is closed in with an interior-exterior skin made in a single or double foaming operation as a sandwich panel, with aluminum sheet, steel, or asbestos cement being among the optional exterior finishes; the inside being paper, wallboard, vinyl or other plastic surface. Panels are full 7-ft. wall height and are made in single lengths broken only to accommodate shorter lengths embodying doors and windows.

All components for the modules are to be manufactured offsite, to close tolerances, and shipped to a site-located module assembly line in finished form ready for joining together into the module by semiskilled or unskilled labor. The completed module, because of its lightweight, can be readily moved from its assembly site to the prepared foundation or previously placed modules and positioned by only two men using a 75-ton crane. Guide cones included as part of the design of the column connectors, assures precise placement and the seating level of the units is accurate within 1/16 in.

Because the four structural columns are on identical centers in each direction, the modules may be rotated 90 degrees relative to each other, affording balcony and terraces on one level or sheltered patio or open space below the cantilevered unit above. Flexibility and variety of floor plans and added exterior architectural interest result. Modules may be stacked and connected vertically, as well as horizontally at the same level, a 1-in. gasket completing the joint between vertical faces, and doors or openings can be cut or formed in the two adjoining vertical skins.

Prefabricated stair units will tie typical two- and three-story dwelling units together, with the stairway penetrating the shell near the center of the floor plan. A ring path around this central stairwell will be incorporated in the shell through which plumbing and wir-

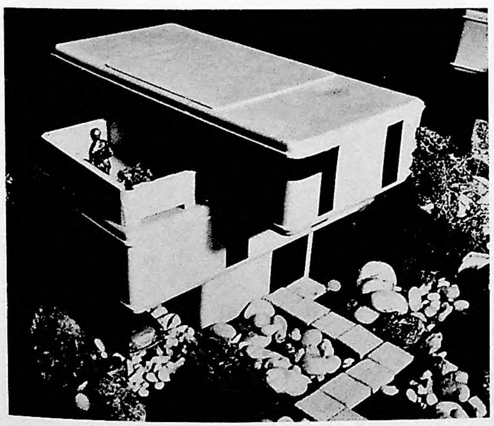


ing will be conducted with only vertical connections being required as each module is placed. Wiring will be further distributed to the rooms from the ring path via extruded plastic trim for the inside walls and partitions, with door frames carrying wiring for switches.

Vertical ductwork from a packaged mechanical module located in the entrance unit of each dwelling will feed services from below to the ring path and supply pressurized heated or chilled air to the plenum formed by the sealed bottom shell of the module.

Modification of dwellings is considered to be relatively simple because all partitions are nonbearing; addition or subtraction of modules vertically or horizontally also is possible. The fact that all loads are carried by column also permits leaving more surface land below the modules for common use, with only an enclosed entrance to the stairway necessary at ground level.

The proposer intends to sell or rent plants and equipment to assembly contractors. The contractors will receive components from the proposer on consignment, will turn over erected dwellings to owners, and will receive compensation directly from the proposer.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2	Density Range	7.25 TO 120 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY; HIGH-RISE UNSUITABLE FOR UNSTABLE SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	FLEXIBLE ORIENTATION; PROPORTIONATE OPEN SPACE; PRIVATE SPACE SEPARATED
6	Nonresidential Functions	
7	Circulation	VEHICLE PARKING BELOW GRADE; SEPARATION OF VEHICULAR TRAFFIC
8	Site Planning Services	
9	Community Involvement	LOCAL ARCHITECTS, REAL ESTATE, LEGAL & FINANCING
10	Utilities	UNDERGROUND ELECTRICAL SERVICE

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 6 BEDROOMS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	BUILDING SYSTEM DESIGN COMPLETELY DEVELOPED BUT, BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	STEEL COLUMNS SUPPORTING MODULES OF LIGHTWEIGHT STEEL, PLASTIC OF OTHER MATERIAL
17	Exterior Elements	MODULE EXTERIOR MOLDED ASBESTOS URETHANE CORE
18	Interior Elements	STAIRCASE; ADJUSTABLE PARTITION SYSTEM
19	Foundations	CONCRETE FOUR-POINT SUPPORT FOR STEEL DOWELS
20	Comfort Systems	HEATING-COOLING UNIT; UNDER-FLOOR PLENUM DISTRIBUTION VIA FLOORTRIM DIFFUSERS
21	Plumbing	VERTICAL CONNECTIONS TO A RING PATH AROUND CENTRAL STAIRCASE INTEGRATED FIXTURES
22	Electrical	MAIN PANEL IN ENTRANCE MODULE; VERTICAL DUCT TO RING PATH, PERIMETER WIRING RACEWAY
23	Furnishings	

PRODUCTION

24	Offsite Production	COMPONENTS OF MODULE; SERVICE COMPONENTS
25	Onsite Production	ASSEMBLY OF MODULES COMPLETE WITH FURNISHING
26	Onsite Construction	FOUNDATION; PLACING OF MODULES; CENTRAL STAIR & UTILITY DISTRIBUTION SYSTEMS
27	Labor	PRIMARILY UNSKILLED OR SEMISKILLED
28	Labor Training Programs	TRAINING AT PROPOSER PLANT
29	Community Involvement	LOCAL BUILDING OR CONTRACTING FIRMS

ECONOMICS

30	Construction Costs	$20,424 PER 3-CELL UNIT; $10.60 PER SQ. FT., 1000 UNITS
31	Financing Methods	
32	Useful Life	STRUCTURAL SYSTEM—100 YEARS; INTERIOR WORK—40 YEARS; MECHANICAL/ELECTRICAL—60 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	DESIGNING; MANUFACTURING; BUILDING; MARKETING
35	External Functions	U.S. MANAGEMENT; CONTRACTORS; MANUFACTURERS; SUPPLIERS
36	Market Area	UNITED STATES & CANADA
37	Delivery Rate	300 MODULES PER YEAR PER PLANT
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	UNDER-FLOOR PRESSURE PLENUM HOT-COOL AIR CIRCULATION; UTILITY RING SYSTEM
40	Codes	

A.G. Smith

PROPOSER

A. G. Smith & Associates, Developers, Clearwater, Florida.

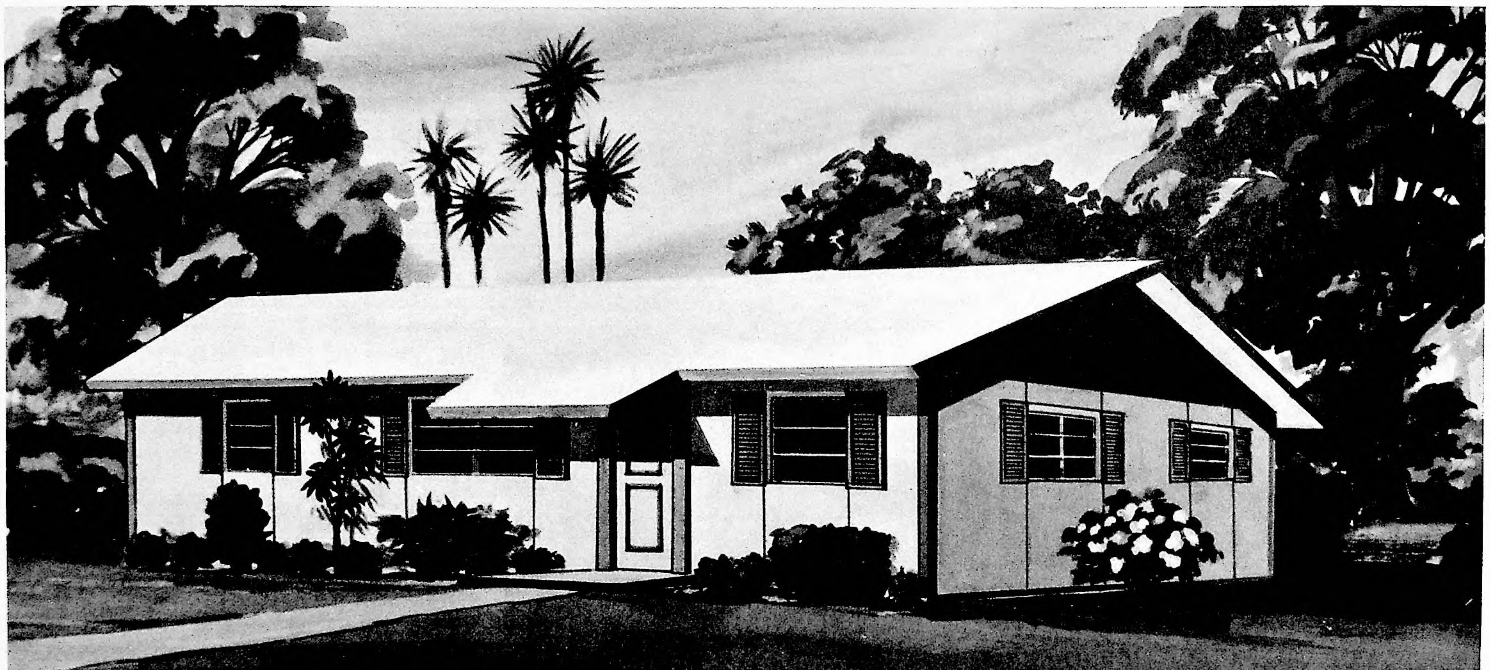
The center of this proposal is an all-panel system, using aluminum panels that form walls, partitions, and roof and also serve as bearing elements. The building system can be used for single-family detached or attached structures, and buildings of up to two stories in height. It is easily adaptable for use for community or communal facilities and recreational areas.

The panels can be manufactured in any size, with a standard size of 4 ft. by 8 ft. selected as most usual, since it can be handled easily by one man. They consist of a 3-in. polystyrene core, bonded as a sandwich to stressed aluminum skins, finished on the outside with a baked enamel and on the inside with vinyl sheets. Though the exterior finish can be supplied in any color or texture, it can also be further enhanced for architectural purposes with masonry or other materials, bonded to the aluminum with an epoxy material. Wall panels are equipped with raceways reaching from the bottom to receptacle slots for later installation of electrical wiring.

Roof sections are of similar construction, but utilize a honeycomb core rather than polystyrene, to give added strength when spanning large areas. Spaces within the honeycomb are filled with polystyrene balls to impart added insulation value. Both interior and exterior finish on roof sections is painted, stressed aluminum.

Floors may be of wood, concrete, or any other material suitable to the project. A slab or wood floor is fitted with aluminum channels along the edges and at points where partition walls are planned, to form a base for the wall panels.

Erection then can proceed rapidly: Panels are placed in the channel and raised, locked together at edges with a vinyl cleat, which is also designed as a structural member to add strength and rigidity to the wall. The full wall is thus erected completely around the foundations (windows and doors are placed in the proper panels in the factory), and both interior and exterior of the wall are now complete. Then an aluminum-channel base plate is placed atop the walls as a cap plate. Roof panels may be placed horizontally across the wall section and an I-beam, with each panel bolted to the cap plate and the I-beam, and adjoining sections tied together with vinyl cleats. A cap plate at the peak completes the roof installation. Interior partitions are placed in the same manner as the walls.



Standard plumbing methods are used, with a prefabricated bath unit which may be placed directly against the vinyl-covered interior walls without requiring tile or other finish. Plumbing pipes are installed through the floor. Electrical service is brought in under the floor, up through the raceways in the panels to wall outlets. The proposer points out that holes can be cut easily in the panels for additional wiring installations, if required. The structures are designed ideally for all-electric appliances and heat, but gas-fired units can also be used. Final work includes installation of equipment, lighting, and cabinetry.

The light weight of the panels and the simplicity of erection make the system amenable to self-help work by owners or tenants; and there is the added advantage that damaged panels can be replaced entirely, from stock, if required. A volume production rate of 2,000 units per year per plant is projected.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; SUITABLE FOR HIGH WINDS AND CLIMATE EXTREMES
5 Planning Concepts	PLANNED RESIDENTIAL COMMUNITY; COMMON OPEN SPACES
6 Nonresidential Functions	RECREATIONAL AREA & 4,000-SQ.-FT. BUILDING; SHOPPING FACILITIES; CHURCHES
7 Circulation	
8 Site Planning Services	BY PROPOSER
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED
15 Community Involvement	USER NEEDS DETERMINED

BUILDING SUBSYSTEMS

16 Structure	ALUMINUM SANDWICH WALL & ROOF PANELS; WOOD FRAME OR CONCRETE SLAB FLOOR
17 Exterior Elements	POLYSTYRENE-CORE, ALUMINUM WALL PANELS WITH BAKED-ENAMEL EXTERIOR
18 Interior Elements	VINYL-COVERED ALUMINUM PANEL WALLS; INTERIOR PARTITIONS
19 Foundations	CONCRETE FOOTINGS
20 Comfort Systems	CENTRAL HEATING & COOLING
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL RACEWAYS INTEGRATED IN PANEL SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	ALUMINUM SANDWICH WALL AND ROOF PANELS; INTERIOR PARTITIONS; OTHER COMPONENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATION; WOOD FLOOR; ERECTION OF PANELS; INSTALLATION OF UTILITIES
27 Labor	TWO UNSKILLED MEN CAN ERECT A HOME WITHOUT ADDITIONAL ASSISTANCE
28 Labor Training Programs	
29 Community Involvement	SELF-HELP BY OWNERS OR TENANTS; LOCAL LABOR & CONTRACTORS

ECONOMICS

30 Construction Costs	$8.23 TO $9.63 PER SQ. FT.
31 Financing Methods	COMMITMENTS FROM PENSION FUNDS
32 Useful Life	30 TO 50 YEARS

MANAGEMENT

33 Proposer Organization	PARTNERSHIP
34 Internal Functions	DESIGN, PRODUCTION, CONSTRUCTION, AND MARKETING OF COMPLETE HOUSING SYSTEM
35 External Functions	
36 Market Area	NATIONWIDE AND INTERNATIONAL; PRIMARILY SOUTHEASTERN U. S.
37 Delivery Rate	2,000 UNITS PER YEAR PER FACTORY
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	CONFORMS TO NATIONAL MODEL & REGIONAL CODES

Eugene R. Smith and Associates

PROPOSER

Eugene R. Smith and Associates, Architects, Tampa, Florida

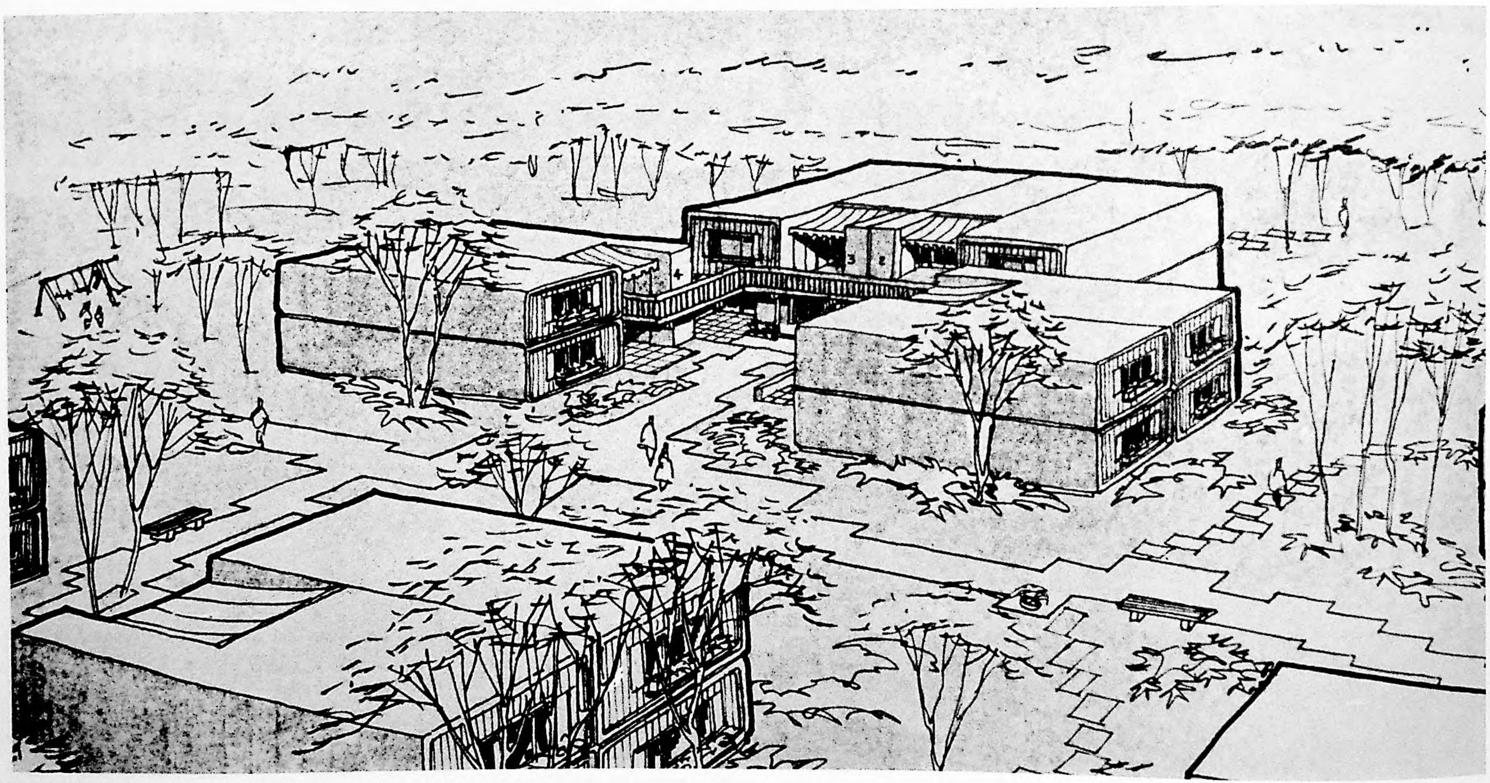
A weather envelope, factory-made of urethane foam panels sprayed with fiberglass reinforced plastic, ready for occupancy after utility connection at the site, comprises the basic concept of the housing system proposed. The volumetric modules are self-supporting, approximately 8 ft. high and 12 ft. wide, in varying lengths as required and may be joined vertically or horizontally to form a variety of low-rise housing configurations.

The modules are constructed by assembling urethane foam panels into a box-like structure and then spraying the entire assembly with fiberglass-reinforced plastic to form a rigid, homogeneous shell. Both thermal and acoustical insulation properties are excellent for the completed shell. Lightweight plastic doors set in vinyl frames and standard windows are built into the shell, where required. The urethane panels, which are a single thickness, 6 in. for top and bottom, and 3 in. for sidewalls, form both interior and exterior surfaces.

The modules are of varying types: type A, which includes both kitchen and bathroom facilities; and types B, C, D, and E, which provide a variety of living-sleeping floor plans. Premolded bathroom and kitchen facilities and cabinetry are installed in the type A modules at the factory, along with the common plumbing wall, which minimizes plumbing and requires only connection of stub-outs at the site. A water heater is included as part of the packaged bathroom facility.

Interior partitions for the modules are 2-in.-thick foam panels, with both partitions and inside walls being finished with vinyl surface or paneling. Floors will be covered with carpeting and pad or vinyl tile, on a 3/4-in. plywood subflooring supported by stringers.

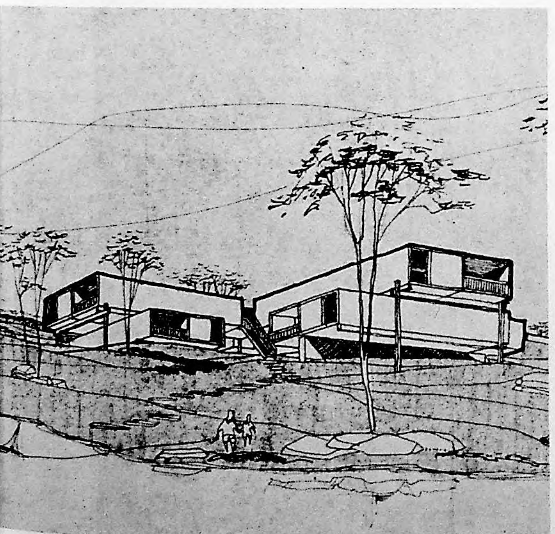
The modules are delivered to the site by truck, where a minimal amount of work, mainly digging of



footing voids and provision of utility services, has been accomplished. Once the modules are placed over the voids and hooked up with both utilities and adjoining components (using an epoxy cement), urethane is foamed in to fill the voids and thus provides a uniform, homogeneous footing.

With the modules in place, the exterior finish is applied, consisting of a gel coating containing sand of a texture and color indigenous to the local area. Final operations then consist of placing stairs, wooden decks, and awnings as required.

Although proposed primarily for low-rise configurations, the units could be adapted to high-rise construction by installing them in a primary structural framework.



Summary Information

SITE SYSTEM	
1 Site Situation	SUBURBAN
2 Density Range	14 to 19 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN AND VEHICULAR TRAFFIC
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1, 2, AND 4 BEDROOMS
13 Design Selection	
14 State of Development	
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	FIBERGLASS REINFORCED PLASTIC & URETHANE FOAM MODULES
17 Exterior Elements	GEL COAT CONTAINING SAND EXTERIOR FINISH; DECKS, AWNINGS; STAIRS
18 Interior Elements	PREFABRICATED NONSTRUCTURAL INTERIOR FOAM PANELS; VINYL FINISH
19 Foundations	MEDIUM DENSITY URETHANE FOAM IN FOOTING VOID; UNCONVENTIONAL
20 Comfort Systems	
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	URETHANE FOAM PANELS; ASSEMBLY OF PANELS INTO MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; MODULE JOINING; UTILITY HOOK-UPS
27 Labor	UNSKILLED ONSITE AND AT FACTORY
28 Labor Training Programs	
29 Community Involvement	LOCAL LABOR EMPLOYED
ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ARCHITECTURAL DESIGN
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Southwest Research Institute

PROPOSER CONSORTIUM

Southwest Research Institute, San Antonio, Texas
H.B. Zachry Company, San Antonio, Texas
Planning Research Corporation, Washington, D.C.
Provident Life & Accident Insurance Company, Chattanooga, Tennessee

AFFILIATES

Bryant Air Conditioning; Square "D" Systems Company; E. I. dePont de Nemours; L.C.K. & Associates, Inc.; B.F. Goodrich Industrial Products; Panelfab, Inc.; PPG Industries, Inc.; G.A.F. Corporation

Room-sized reinforced concrete modules are the literal building blocks of the housing system proposed. Capable of sustaining their own weight and those of 20 stories above, the 35-ton modules are 13 ft. wide, 9 ft. high and up to 36 ft. long. Modules are placed like concrete blocks in stack-bond fashion, to form, in effect, an immense load-bearing wall, with each of the courses of the wall being one story high.

In typical high-rise configuration, the modules are stacked in two rows, back-to-back, with the inner faces being closed by nonbearing partitions through which an exterior fire door opens onto common corridor space with stairwell and elevators. The outer end of the module may be closed by a sliding glass door, often opening onto a balcony with a wrought iron railing. The modules are connected to each other and to shared building elements by a combination of weldments and grouting, with the reinforcing protruding from the inside edge of the bottom slab of each module being tied to that of the common corridor slab.

The modules are manufactured in assembly line procedure beginning with monolithic casting of the open-ended, four-sided lightweight concrete channel forming top, bottom, and two side walls; partitions then are installed; and heating, hot water, kitchen and bath equipment are placed and hooked-up to cast-in-place plumbing lines. Finally interior finishing and trim are applied. The modules are completely ready for occupancy as they leave the factory, requiring only place-

ment at the site and utility hook-up. Even furniture and furnishings can be preinstalled down to towels on the racks.

Although there is an apparent duplication of structural members where the bottom slab of one module rests on the top slab of the module below, this duplication is considered acceptable in terms of the greater stability and rigidity which it affords the resultant structure. These slabs being bonded together, the building is monolithic and resists any tendency to cracking or internal movement due to soils subsidence.

Mechanical equipment installed in the modules will be standard with the options such as air conditioning, being available to the occupant. Only cold water supply is planned, with compact, high recovery hot water units being located at each fixture or group of fixtures, at a saving in piping and returns. Interior finishes will be sprayed on the concrete or partitions in a variety of colors and textures. Floors will be sheet vinyl or tile or carpeting; while ceiling finishes will be sprayed acoustical material.

A plant for production of the modules already exists in San Antonio, Texas, having been set up for manufacture of the concrete modules used in building the Palacio del Rio-Hilton Hotel, the first major testing of the proposed concept.

Summary Information

SITE SYSTEM		
1	Site Situation	URBAN; SUBURBAN
2	Density Range	
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	
6	Nonresidential Functions	RECREATIONAL SPACES; HOBBY CENTERS; COMMERCIAL FACILITIES ON FIRST LEVEL
7	Circulation	
8	Site Planning Services	
9	Community Involvement	USER PREFERENCES DETERMINED BY STUDY
10	Utilities	
BUILDING SYSTEMS		
11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 5 BEDROOMS
13	Design Selection	STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
15	Community Involvement	SELECTION OF FINISH MATERIALS
BUILDING SUBSYSTEMS		
16	Structure	PRECAST REINFORCED CONCRETE VOLUMETRIC MODULES
17	Exterior Elements	BALCONY & WROUGHT IRON RAILING
18	Interior Elements	CARPET, TILE OR VINYL FLOORING; HONEYCOMB CORE INTERIOR PANELS & PARTITIONS
19	Foundations	CONVENTIONAL
20	Comfort Systems	PREINSTALLED COMPLETE HEATING/VENTILATING/AIR CONDITIONING CORE
21	Plumbing	COLD WATER ONLY WITH ELECTRIC HEATER AT FIXTURES; PLUMBING LINES FACTORY-INSTALLED
22	Electrical	JUNCTION BOXES, CONDUIT, & PRIMARY PANELS CAST INTO CONCRETE MODULE SHELLS
23	Furnishings	
PRODUCTION		
24	Offsite Production	MODULES WITH PARTITIONS, HEATING, KITCHEN, & BATH EQUIPMENT; INTERIOR FINISHES
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PLACEMENT OF MODULES; INSTALLATION OF PLUMBING FIXTURES
27	Labor	UNSKILLED FOR PRODUCTION & ONSITE ERECTION; HARDCORE UNEMPLOYED CAN BE USED
28	Labor Training Programs	ON-THE-JOB TRAINING AT THE PLANT; TRAINING OF DISADVANTAGED
29	Community Involvement	LOCAL CONTRACTORS; LOCAL UNSKILLED LABOR
ECONOMICS		
30	Construction Costs	$8,700 PER 800 SQ.FT. LIVING UNIT (TWO MODULES); 1,000 UNITS PER YEAR
31	Financing Methods	PROPOSER SUPPLIED (THROUGH CONSORTIUM MEMBERS)
32	Useful Life	
MANAGEMENT		
33	Proposer Organization	CONSORTIUM
34	Internal Functions	MANAGEMENT; RED; EVALUATION; PRODUCTION; CONSTRUCTION; PLANNING; FINANCE
35	External Functions	MECHANICAL CONSULTANTS
36	Market Area	WITHIN 300 MILES OF PLANT
37	Delivery Rate	1,000 UNITS PER YEAR (BEST RATE)
38	Consumer Protection	
GENERAL		
39	Major Innovative Concepts	COMPUTER PROGRAM FOR EVALUATION & DESIGN OF SITE UTILITY LINES
40	Codes	

Spancrete Industries, Inc.

PROPOSER

Spancrete Industries, Inc., Milwaukee, Wisconsin

AFFILIATES

Lorenz & Associates; Schousboe & Seidentsticker, Engineers; Lowry, Hunter & Tikalsky; Hinshaw, Culbertson, Moelmann, Hoban & Fuller

The structural element of this proposal is referred to as a gravity system based on the early wall-bearing principle. It employs precast reinforced-concrete wall and floor and ceiling slabs bolted together for necessary rigidity. The solid concrete panels are factory-fabricated and transported to the housing site. Highly skilled labor is not required to produce the structural components. First-floor erection walls are crane-lifted into place and bolted to the finished foundation. Bearing crosswalls then are placed and bolted to the erection walls; these crosswalls extend one-half story above the previously placed perimeter erection walls.

The second erection cycle involves placement of a second tier of erection walls bolted to the upper half of the bearing crosswalls. Another tier of crosswalls is placed and, in turn, bolted to the erection walls. This alternate method of wall erection is repeated until full building height is reached. A roof deck, also concrete slab, is secured to the final tier of wall units and finished conventionally.

This building process requires no temporary bracing and no site storage of components, since the slabs are erected as they are delivered. All keyways are grouted with nonshrinking portland cement, the grout itself forming an interlocking joint. Floor decks on opposite sides of bearing walls are tied together with reinforcing bars in the grout keys between floor elements, the bars running continuously through the wall and mechanically locked to a crossbar in the wall.

Optional curtainwall systems can be used with the structural plan. The basic curtainwall unit consists of a one-story modular frame fitted between structural elements. Each modular opening is designed to receive a solid prefinished insulated wall panel, or an operable sash panel. A combination of these can be accommodated. Exterior joints are sealed with snap-in weather stripping and inside joints are calked. Rigid insulation is field installed on the exterior walls. Outside finishes can be exposed aggregate, brick-face panels, or formed patterns. Interior walls are paneled, papered, or painted. The proposer is experimenting with casting the unit against vinyl mats to produce embossed patterns. Floor surfaces are carpeting or tile; ceiling finishes, sprayed paint or sprayed acoustical material.

All mechanical and electrical service is designed into a vertically aligned utility core with branch services extending horizontally. Electric heat is specified in the multifamily low- and high-rise structures, with electric raceways cast in the interior wall units. The method employs a plumbing tree, and kitchens are factory-fabricated for packaged field installation with plastic or alternate copper plumbing runs specified.

Summary Information

SITE SYSTEM

1	Site Situation	SITES OF 5 ACRES, MINIMUM
2	Density Range	28 TO 45 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; COMMON OPEN SPACES
6	Nonresidential Functions	RECREATION AREAS; NURSERY SCHOOLS; MARINA; GOLF; OFFICES; SHOPPING CENTER
7	Circulation	SEPARATE PEDESTRIAN CIRCULATION; CUL-DE-SACS
8	Site Planning Services	PROPOSER'S TEAM SOLICITS COMMUNITY PARTICIPATION & APPROVAL
9	Community Involvement	
10	Utilities	SEPTIC TANKS; PUBLIC (OR) SITE-SUPPLY WATER DISTRIBUTION

BUILDING SYSTEMS

11	Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	1 TO 6 BEDROOMS
13	Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14	State of Development	PRODUCTION FACILITIES UNDER CONSTRUCTION; BUILDING SYSTEM DEVELOPED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	PRECAST CONCRETE WALLS; PRESTRESSED FLOOR & ROOF SLABS
17	Exterior Elements	PREFABRICATED CURTAIN WALLS; OPTIONAL BRICK-VENEER FACING; BALCONIES
18	Interior Elements	PRECAST CONCRETE WALLS; CONVENTIONAL FINISHES; UTILITY CORE
19	Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20	Comfort Systems	ELECTRICAL HEATING SYSTEM; FACTORY-FABRICATED UTILITY CORE
21	Plumbing	PREFABRICATED PLUMBING TREES, PLASTIC OR COPPER PIPING; PACKAGED KITCHEN-UTILITY CORE
22	Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
23	Furnishings	

PRODUCTION

24	Offsite Production	PRECAST CONCRETE WALLS, FLOOR & ROOF SLABS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; COMPONENT ASSEMBLY; MECHANICAL INSTALLATIONS AND HOOK-UP
27	Labor	UNSKILLED LABOR AT FACTORY AND SITE
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS

ECONOMICS

30	Construction Costs	$12,000 PER UNIT
31	Financing Methods	CONVENTIONAL; PROPOSER'S LEGAL COUNSEL TO ARRANGE INTERIM FINANCING
32	Useful Life	75 YEARS

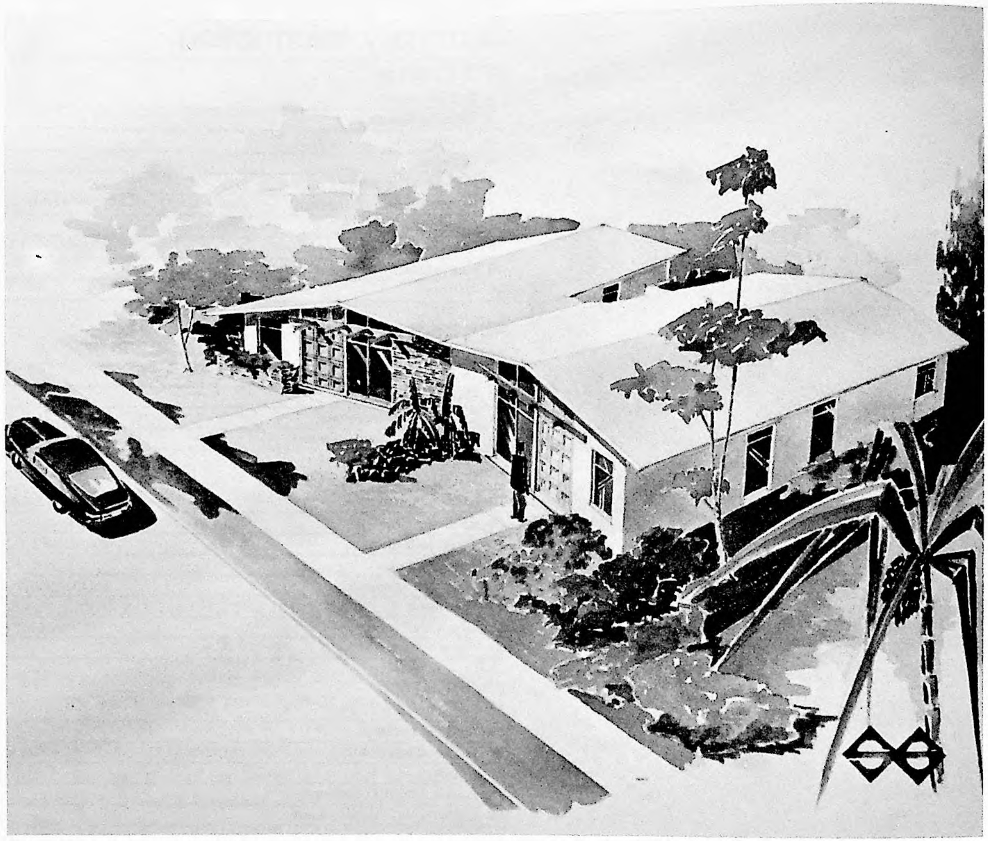
MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	SITE DEVELOPMENT; INTERIM FINANCING; COMMUNITY RELATIONS
35	External Functions	MANUFACTURING; ARCHITECTURAL DESIGN; ENGINEERING; LEGAL COUNSEL
36	Market Area	
37	Delivery Rate	1,000 PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	BUILDING SYSTEM
40	Codes	IN COMPLIANCE WITH EXISTING MODEL ELECTRIC CODES

Spaw-Glass Inc.



PROPOSER CONSORTIUM

Spaw-Glass Inc., Houston, Texas
Richmond Road and Engineering Company, Houston, Texas
Paisan Construction Company, Houston, Texas
Spaw-Thompson Plumbing Company, Houston, Texas
Friedrich Refrigerators, Inc., Houston, Texas
Guaranteed Electrical Contractors, Houston, Texas
Architectural Concrete Consultants, Inc., Houston, Texas

Modified onsite construction is the concept which underlies the housing system proposed. The economy and durability of what is essentially a reinforced-concrete structure is combined with the savings inherent in the use of many prefabricated components.

The basic housing structure is considered as particularly effective in lowering maintenance costs, and offers high resistance to hail, hurricane winds and moisture intrusion. It is put forward as being particularly suited for construction in the South and the Southwest.

A longitudinal center wall, side walls and a sloping roof, all of reinforced lightweight concrete, are poured monolithically (on a slab-and-beam reinforced concrete foundation) to form the shell of the dwelling. Flat, ribbed, or patterned outside formwork adds variety and architectural interest to the exterior of the side walls. Closing in this shell are two nonbearing end walls of wood-stud framing, 24 in. on center. Thermal insulation, 4-in. thick, is sandwiched between 1/4-in. prefinished paneling inside and sheathing board, brick, or stucco on the outside.

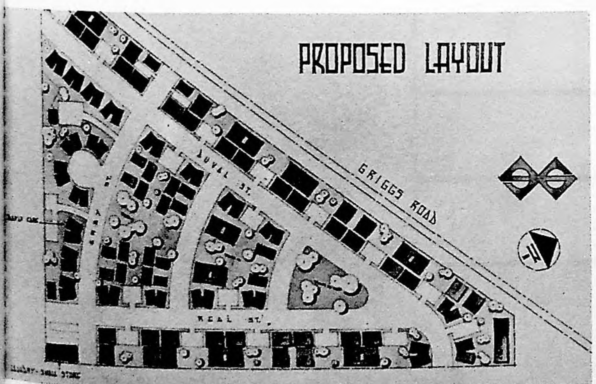
All four exterior walls are pierced for openings by standard-sized factory-built sections, 3 ft. wide by 6 ft. 8 in. high, for either doors or windows, with insulated panels sealing the openings below the aluminum sash.

Use of prefabricated elements to complete the house not only achieves economies of time and costs, but also serves to involve the local community more fully, in that the many elements utilized may be manufactured by small businessmen in the area and are installed by local contractors. Among these prefabricated elements are unitized half-kitchens, bathrooms, heating modules, plumbing modules, and partial wall panels for interior partitions. These partitions are of soundboard, covered with finish board or vinyl paper. The kitchen and bath modules similarly are prefinished, including vinyl asbestos flooring.

The exterior of the concrete walls (in addition to the cast-in texture) will be painted; the inside walls also can be painted, often by the owner as a self-help measure. Other self-help inherent in the proposed system includes cabinet and closet setting, interior trim work, and floor finishing.

Heating for the home is a gas-fired, upflow furnace, situated in the central hall closet, from which it feeds to a central plenum formed by furring down the ceiling in the hallway. Diffusers from this plenum supply the rooms along the long axis of the floor plan. Optional air conditioning may be added to the system.

Design of the concrete mix, reinforcement, layouts, and the forming system has been completed, and the system, although not presently being marketed, could be brought into production in a relatively short time. Most of the prefabricated components proposed for the housing concept are in production and are ready for use.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	8 TO 18 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; ESPECIALLY SUITABLE TO SOUTHERN GULF CLIMATES
5	Planning Concepts	
6	Nonresidential Functions	RECREATIONAL; EDUCATIONAL; DAY CARE; SHOPPING FACILITIES
7	Circulation	SEPARATE PEDESTRIAN AND VEHICULAR CIRCULATION; MODIFIED GRID
8	Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12	Unit Variations	2 TO 4 BEDROOMS
13	Design Selection	
14	State of Development	BUILDING SYSTEM—DEVELOPED BUT NOT BEING MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	MONOLITHICLY CAST LIGHTWEIGHT CONCRETE WALLS & ROOF
17	Exterior Elements	WOOD FRAME AND WALLS; OPTIONAL FRONT PORCH
18	Interior Elements	PLYWOOD PANEL PARTITIONS; CONVENTIONAL FINISHES; OPTIONAL CARPETING
19	Foundations	CONVENTIONAL—SLAB-ON-GROUND
20	Comfort Systems	FACTORY-FABRICATED HEATING MODULE; INTEGRATED COOLING SYSTEM OPTIONAL
21	Plumbing	PREFABRICATED KITCHEN/BATH UNIT
22	Electrical	INTEGRATED IN PANEL
23	Furnishings	

PRODUCTION

24	Offsite Production	BATH/KITCHEN; HEATING MODULES
25	Onsite Production	CENTER WALL; SIDE WALLS; SLOPING ROOF
26	Onsite Construction	FOUNDATIONS; WALLS; ROOF CONSTRUCTION
27	Labor	UNSKILLED
28	Labor Training Programs	TRAINING FOR UNSKILLED LABOR
29	Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS; SELF-HELP

ECONOMICS

30	Construction Costs	$7,000 TO $9,000 PER DWELLING UNIT
31	Financing Methods	
32	Useful Life	ELECTRICAL, HEATING—20 YEARS; COOLING—10 YEARS; STRUCTURE—40 YEARS

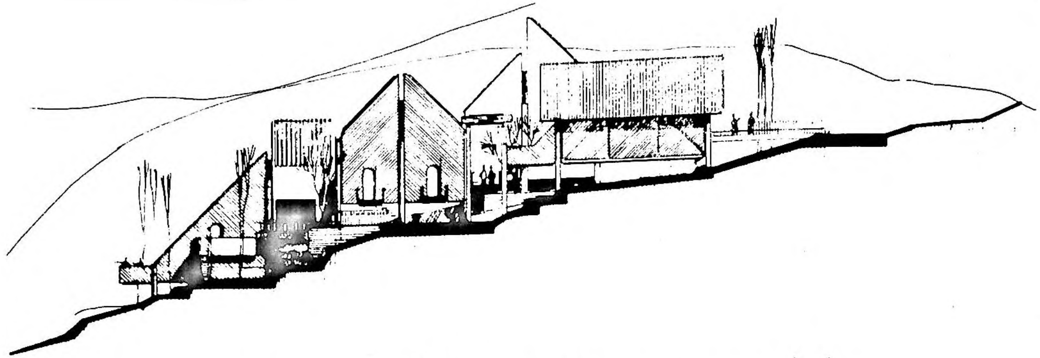
MANAGEMENT

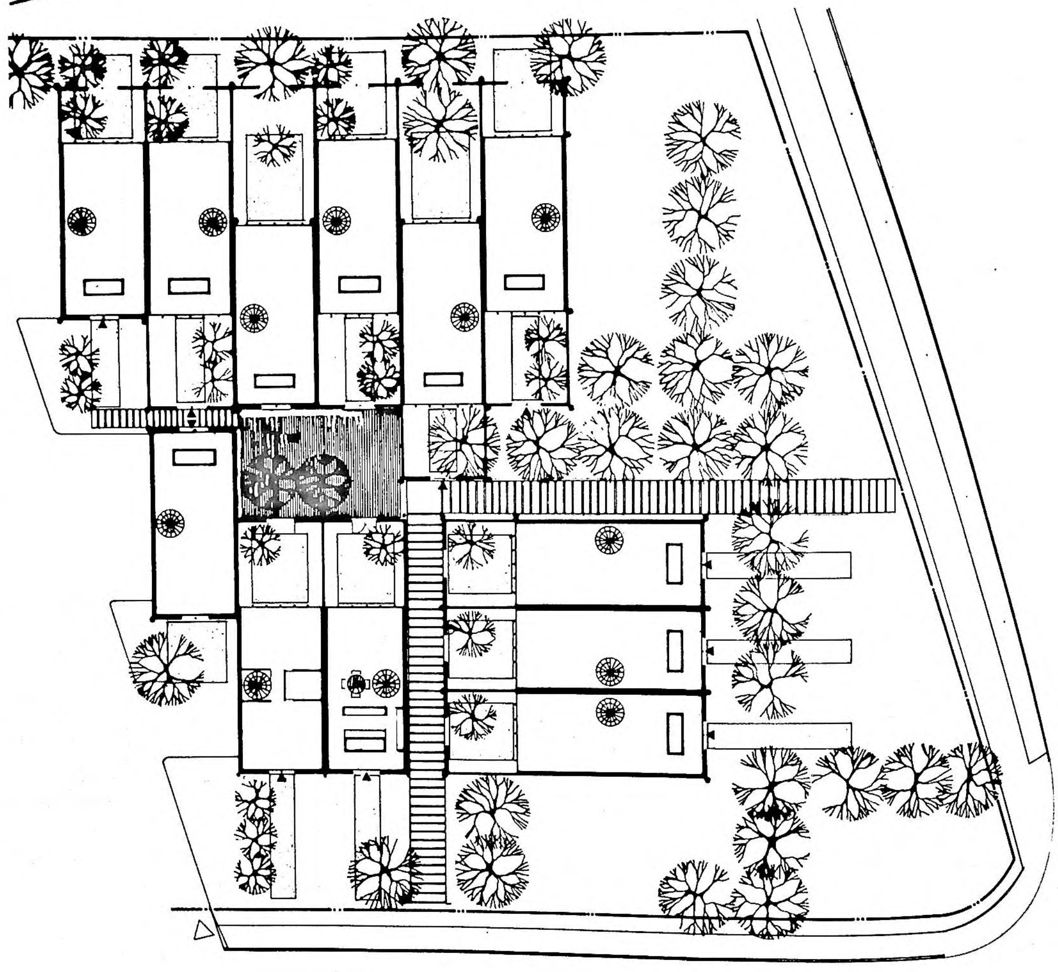
33	Proposer Organization	CONSORTIUM
34	Internal Functions	
35	External Functions	
36	Market Area	25-MILE RADIUS
37	Delivery Rate	1,000 DWELLING UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Sprout Construction Corporation





PROPOSER

Sproul Construction Corporation, Orange, California
National Environment Corporation, Orange, California

AFFILIATES

Textel, Inc., Architecture, Design and Engineering; Rem Supply Company, Supply, Research and Development; Urban Management, Inc., Apartment Management; Environment Building Components, Production Technology

Portable assembly plants for the near-site manufacture of wall, floor, and roof-truss sections for wood-framed housing projects are expected to effect 15- to 25-percent cost reductions from conventional site framing, according to this proposer.

These savings are expected to result from the use of unskilled labor in assembly-line, controlled production of the major framing components of a house and through elimination of the enormous costs often associated with long-distance transportation from plant to site of completed dwelling units or subcomponents.

The portable assembly plants, transported on one or more 8-ft. X 20-ft. trailers, will consist of three major lines: wall assembly, floor assembly, and roof-truss assembly. These assembly tables will be steel frame, covered with 1/8-in. plywood, and equipped with air-actuated clamps for securing the framing members during nailing, with nailing being accomplished by air-actuated nailing guns. A subassembly table for making up door and window rough framing sections will feed its output to the wall-assembly table.

One such assembly plant, manned by a superintendent, a prefabrication foreman, and an erection foreman and 10 local, unskilled workers, can produce components for 5 apartment units a day. This output is transported from the portable plant to the nearby housing site on flatbed trailers, where a skilled crew plus semiskilled or trainee personnel using a forklift or crane join the components together into a framed-in house, with exterior walls clad in siding, or lathed, ready for plaster or other finish. Prefinished cabinetry, millwork, and, where permitted, prefabricated bathroom cores will be utilized to speed the erection process further.

To assure market acceptance, interiors will be finished on site, using conventional, prefinished materials. The building system for all components is based on the standard 16-in. module, thus assuring flexibility to accommodate new or modified designs at a later time.

A subsidiary but important part of this concept of portable assembly plants is the network of regional cutting plants, which would be set up as required. Here, skilled craftsmen would turn out tees, corners, sills, and other close-to-tolerance parts that constitute part of the raw material for the assembly plants. One regional plant is expected to supply the needs of seven portable plants; no severe limitations would be placed on shipping radii with these readily transportable parts.

The proposer expects that community and local involvement in its housing system should be relatively great, principally because the portable plant concept brings a need for unskilled labor right down to site, with a potential for self-help existing for the prospective occupant-buyer. Furthermore, since all site preparation, installation of components, mechanical installation and connection, and inside finishing is done by local subcontractors, the community has a further opportunity to share in the work.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN, RURAL
2 Density Range	10 TO 30 DWELLING UNITS PER ACRE
3 Topography	SUITABLE FOR FLAT AND UNDULATING TOPOGRAPHY
4 Climate	
5 Planning Concepts	COMMON OPEN SPACES
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; THROUGH STREETS; CUL-DE-SACS; SIDEWALKS
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	MAXIMUM COMMUNITY INVOLVEMENT DURING ALL STAGES OF PLANNING
10 Utilities	UNDERGROUND WIRING

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1, 3, 4 BEDROOMS
13 Design Selection	
14 State of Development	PRODUCTION FACILITIES BUILT & OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	COMMUNITY INVOLVEMENT IN ALL STAGES OF PLANNING

BUILDING SUBSYSTEMS

16 Structure	WOOD FRAME AND WALL FLOOR PANELS; WOOD ROOF TRUSSES
17 Exterior Elements	NONSTRUCTURAL WALLS; STEEL & CONCRETE STAIRS
18 Interior Elements	WALLS; CONVENTIONAL FINISHES; BATHROOM CORE UNIT
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	CONVENTIONAL
21 Plumbing	CONVENTIONAL; PLASTIC PIPING WHERE APPROPRIATE; POSSIBLE CORE UNIT
22 Electrical	CONVENTIONAL
23 Furnishings	

PRODUCTION

24 Offsite Production	MILLWORK COMPONENTS; POSSIBLE KITCHEN/BATH CORE UNITS
25 Onsite Production	WALL, FLOOR AND ROOF COMPONENTS (PORTABLE FACTORY NEAR SITE)
26 Onsite Construction	FOUNDATIONS; ERECTION OF PANELS; UTILITY HOOKUPS
27 Labor	UNSKILLED AT FACTORY
28 Labor Training Programs	ON THE JOB TRAINING
29 Community Involvement	LOCAL SUBCONTRACTORS; LOCAL LABOR

ECONOMICS

30 Construction Costs	$9.75 PER SQ. FT., SINGLE-FAMILY DETACHED UNIT
31 Financing Methods	
32 Useful Life	TOTAL STRUCTURE—55 YEARS

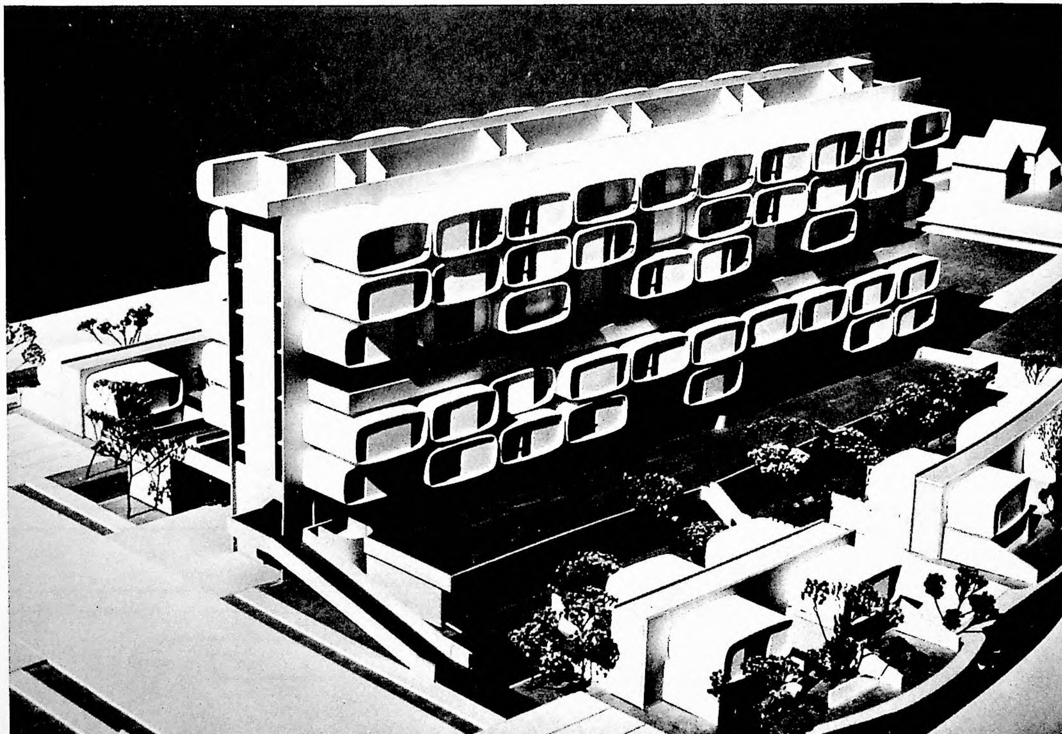
MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	CONSTRUCTION; FINANCE; ADMINISTRATION; MANAGEMENT
35 External Functions	ARCHITECTURAL DESIGN; ENGINEERING; ASSEMBLY; PROPERTY MANAGEMENT
36 Market Area	PORTABLE ASSEMBLY PLANTS NEAR SITE, NO LIMITATIONS
37 Delivery Rate	900 UNITS PER YEAR PER FACTORY
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	COMPLIES WITH ALL NATIONAL CODES

Spuntech Housing Corporation



PROPOSER

Spuntech Housing Corporation, Ann Arbor, Michigan

Self-supporting, dwelling-sized modules of plastic sandwich construction, covered inside and out with filaments of fiberglass spun cocoon-type onsite, constitute the housing system proposed. An offshoot from the aerospace industry, the monocoque-type shells are said to be strong, lightweight, weatherproof, and readily transportable.

In addition to use in single-family and multi-family low-rise configurations, the modules may be utilized for high-rise construction by cantilevering them out from a reinforced concrete structural framework.

Savings on floor and roof material result from the monocoque shape itself (because load moments are transferred around the rounded corners of the shell), and other savings result through the onsite concept of manufacturing these rigid shells. A mobile production plant for spinning of 100 or more modules is economically feasible and eliminates transportation time and costs. The large modules (36 ft. long, 10 ft. high, and up to 22 ft. wide) are spun on electrically driven mandrels. After curing and being fitted out with prefabricated components, they are shipped to the site and set into place on foundations previously prepared to receive them.

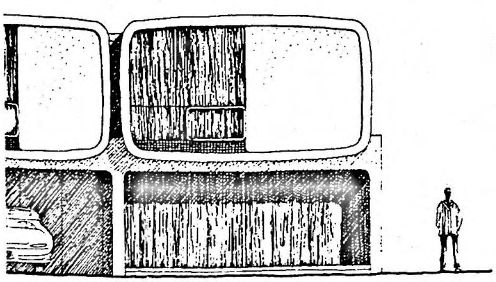
Spinning of the modules involves several steps in arriving at the composite, sandwich construction that gives the unit both its structural strength and its efficient sound and thermal insulation properties. First, a thin layer of impregnated glass fiber filaments, coated with a binding resin, is spun onto the mandrel. This constitutes the inner surface of the shape. Next, panels of fiber honeycomb, built up to an 8-in. thickness, are added to the mandrel or form, with 1-in. layers of polyurethane foam intruded top and bottom of the honeycomb. Finally, another layer of glass fibers is wound around the circumference of the shape, the net thickness totaling approximately 10 in., the filament layers being only 0.01 in. or 0.02 in. thick.

The monocoque module, which is spun in a vertical position, is cured, removed from the mandrel and rotated 90 degrees to a horizontal position. Preassembled floor panels are inserted, and cutouts are made for ducts, pipes, and stairways. Piping and wiring connections between floor panels are made, and prefabricated bathroom units are installed and connected.

At the next station in the portable assembly plant, precut, prewired interior partitions are installed, along with prehung doors and frames. Installation of fixtures follows, and wiring is completed, incorporating raceways at the base of the partitions. Next comes unitized kitchen installation and connection. An electric resistance heating unit (with optional air conditioning) is then installed at the open end of the shell, and is connected to raceways and ducts built into the floor assembly for distribution of forced air by diffusers in the floor.

At the last station in the plant, precast concrete supports and precut skirt panels are attached to the bottom of the shell, end-wall enclosure panels are inserted and connected, and aluminum operating sash and exterior door and frame installed. The completed unit is then lifted onto a trailer for transport to nearby prepared foundations.

The proposer expects a production of five complete shells each two-shift day in the portable site-located plants, with the dimensional stability of the spun modules assuring close tolerances and quick fitting and connecting of the prefabricated component parts. The portable plant is expected to consist of mandrels, other equipment, and a quickly set up, reusable building (on adjustable pad footing) 5 ft. wide, 200 ft. long, 35 ft. high. The plant building will be vandal-proof, and can be sited in a roped-off city street.



Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	12 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL CLIMATES
5 Planning Concepts	CLUSTERS; CUL-DE-SACS; COMMON OPEN SPACES
6 Nonresidential Functions	RECREATIONAL FACILITIES
7 Circulation	SEPARATE VEHICULAR TRAFFIC; CURVILINEAR & DEAD-END STREETS; WALKS ACROSS GREENS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	UNDERGROUND POWER LINES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE, POSSIBLE HIGH-RISE
12 Unit Variations	UP TO 4 BEDROOMS (FLEXIBLE)
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION PLANT & BUILDING SYSTEM IN DESIGN STAGE; FURTHER RESEARCH REQUIRED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTING VOLUMETRIC MODULES OF FILAMENT WOUND FIBERGLASS/PLASTIC CONSTRUCTION
17 Exterior Elements	GLASS FIBER/PLASTIC EXTERIOR
18 Interior Elements	PREFABRICATED VINYL-FACED GYPSUM PARTITION PANELS; PREFABRICATED STORAGE UNITS
19 Foundations	PRECAST OR CAST-IN-PLACE CONCRETE
20 Comfort Systems	MECHANICAL CORE UNIT WITH ELECTRIC AIR HEATING SYSTEM; ELEMENTS INTEGRATED
21 Plumbing	PIPING IN FLOOR ASSEMBLY; MOLDED PLASTIC BATHROOM UNITS
22 Electrical	WIRING IN FLOOR ASSEMBLY
23 Furnishings	
PRODUCTION	
24 Offsite Production	
25 Onsite Production	MODULES, CORE UNITS, INTERIOR PARTITIONS COMPLETED IN PORTABLE ASSEMBLY PLANT
26 Onsite Construction	FOUNDATIONS & SUPPORTS; PLACING OF MODULES; UTILITY HOOK-UPS; FINISHING
27 Labor	UNSKILLED FOR FABRICATION AND ASSEMBLY; SEMISKILLED FOR FINISHES & FOOTINGS
28 Labor Training Programs	WILL TRAIN LOCAL SUPERVISORS, WORKERS & HARD-CORE UNEMPLOYED
29 Community Involvement	FRANCHISED LOCAL BUILDERS OPERATING PORTABLE FACTORIES
ECONOMICS	
30 Construction Costs	$9,400 PER UNIT AT BEST RATE OF 1,000 UNITS PER YEAR
31 Financing Methods	CONVENTIONAL METHODS: PLACEMENT OF LOCAL CAPITAL THROUGH FRANCHISE OPERATIONS
32 Useful Life	NO LIMIT
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	OVERALL DESIGN, DEVELOPMENT & CONSTRUCTION
35 External Functions	VARIOUS CONSULTANT WORK
36 Market Area	
37 Delivery Rate	5 UNITS PER DAY PER PLANT OPERATING TWO SHIFTS
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	SPACE AGE STRUCTURAL SYSTEM; INTEGRATED HEATING AND COOLING SYSTEM
40 Codes	

Stahl-Ashland Building Systems

PROPOSER

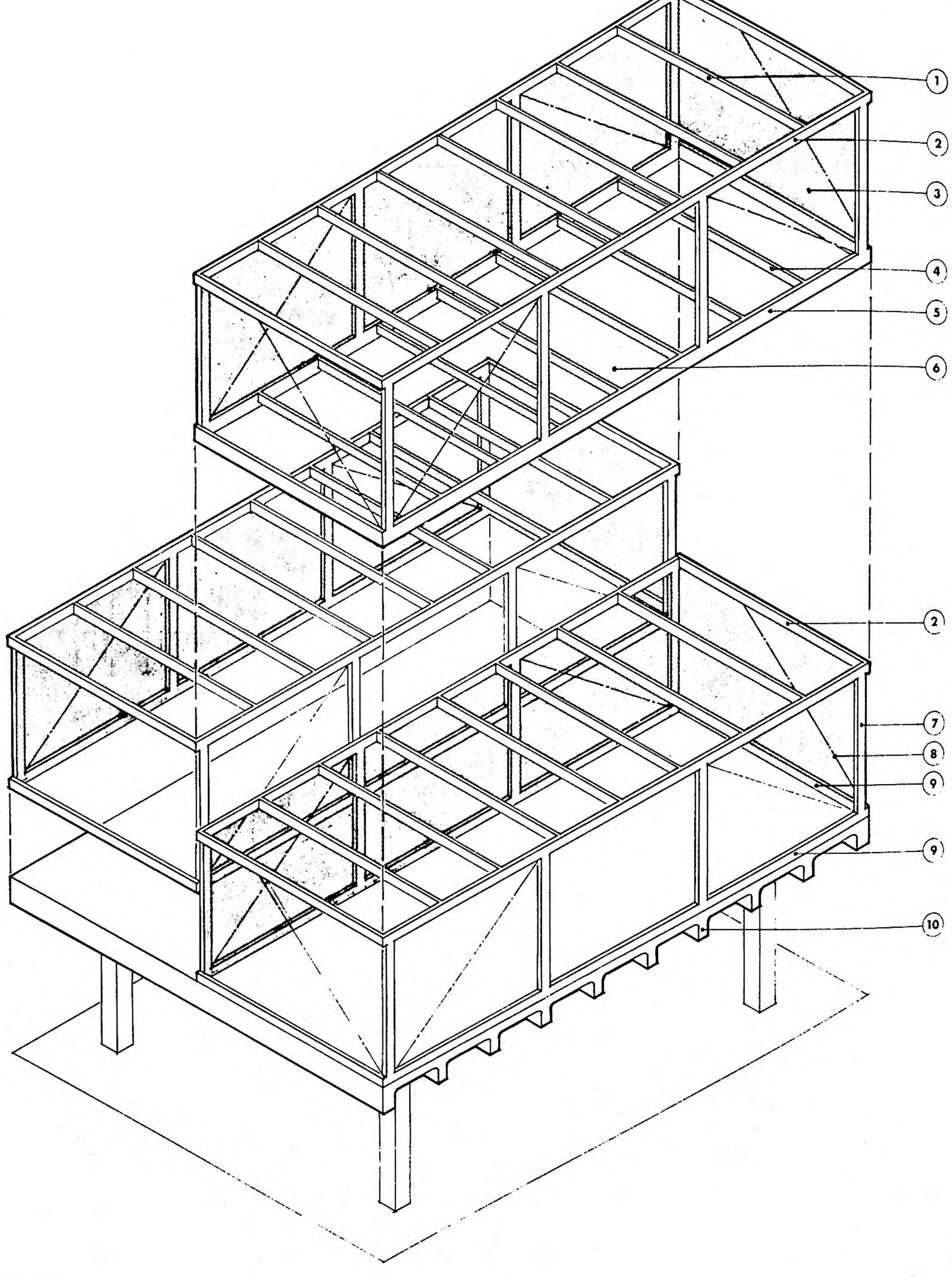
Stahl Industries, Inc., Youngstown, Ohio
Ashland Oil & Refining Company, Ashland, Kentucky

AFFILIATES

Republic Steel Corporation, Production; North American Rockwell, Production/Land Development; B. F. Goodrich Company, Mechanical Core Systems; Litton Industries, Inc., Investment/Production; McDonnell Automation Company, Computerize Plant & Layout/Land Development; American Electric Power Service Company, Land Development; Howard Greene & Associates; Hirshen & Van Der Ryn, Architects and Planners; Vincent E. Shogren & Associates, Building Systems; Implas Ltd. (Shutewade & Associates); Battelle Memorial Institute, Computerization/Market Studies; Thiokol Chemical Corporation, Home Ownership Training; Social Planning Association, Inc., Merchandising/Finance Administration/Market Studies; The Ohio State University

Load-bearing sandwich panels are the basic modules of this building system. The panels may be erected individually on the site to form a one- or two-story free-standing dwelling, or they may be used as infill panels for multifamily structures, having masonry bearing party walls, or they may be factory-assembled into volumetric modules for erection into a steel framed structure.

The panels are essentially asbestos on a foamed core, without frame but structurally sound, embodying



ISOMETRIC OF STACKING SYSTEM

1 ceiling structure: 4 x 2 x 16 ga Z-section
2 ceiling structure: 4 x 2 x 16 ga C-section
3 gypsum wall
4 floor structure: 6 x 2 x 12 ga Z-section
5 floor structure: 6 x 2 x 12 ga C-section
6 2" gypsum plank floor
7 column: 4 x 2 x 10 ga C-section
8 diagonal bracing
9 base frame: 4 x 2 x 16 ga C-section
10 concrete slab

piping, wiring, and prefitted windows and doors, and have completely finished interior and exterior surfaces, with no additional site finishing required. They may be furnished in 4 ft. x 8 ft. size, easily erected by one man; or they may be supplied in full length wall panels for erection by several men. Both panelized walls and roof sections are conventional in appearance, as is the resultant housing. Nonstructural interior partitions also are to be prefabricated in the factory.

The panel system is considered open-ended and suitable for use with a variety of materials and designs to which it is readily matched. For some applications, as required for certain high-rise designs, structural elements also may be incorporated in the plastic sandwich within the panel structure.

Principal of the innovative approaches to mechanical and electrical systems is the proposer's use of a subcore or service wall in which will be included water, waste, heating, cooling and ventilation facilities all as part of a packaged subsystem. Kitchen, bathroom, and all wiring also are unitized and prepackaged. Hot water baseboard heating is planned for the units, with cooling to be added optionally by integration with the heating system, or by through-the-wall units.

Special provision is made for coordinating site planning and maintaining liaison between contractor and community in matters of interest to owner-tenants. To be considered especially are the needs of the elderly. An attitudinal study is proposed to assure that the community's needs and desires truly are known. Efforts will be made to obtain local technical people to staff the panel assembly plants. For erection, local contractors and hiring in the community will be utilized to the maximum extent possible. Local management will be recruited to manage the continuing rental administration.

A plant for manufacture of the panels with computerized, highly automated assembly lines has been built and is operational and the complete building system has been developed and is being marketed. Since plant investment for the system is not considered high, plants may be suitably located in various parts of the country, with shipments being made to every state, including Alaska and Hawaii.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	12 TO 40 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES
6 Nonresidential Functions	PLAY AREAS, SCHOOLS, MEDICAL FACILITIES, DAY CARE FACILITIES, SHOPPING
7 Circulation	
8 Site Planning Services	AFFILIATE TO DESIGN & COORDINATE CONTRACTOR & COMMUNITY PLANNING GROUPS
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 3 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
15 Community Involvement	STUDY TO DETERMINE NEEDS INCLUDING ACOUSTICS, DECOR, LIGHTING, THERMAL

BUILDING SUBSYSTEMS

16 Structure	ASBESTOS & FOAM CORE PLASTIC LOAD BEARING WALL & ROOF PANELS
17 Exterior Elements	
18 Interior Elements	PARTITION PANELS; PACKAGED SUBSYSTEMS SERVICE WALL
19 Foundations	
20 Comfort Systems	HYDRONIC BASEBOARD HEATING INTEGRATED WITH BUILDING SUBSYSTEM
21 Plumbing	UNITIZED KITCHEN AND BATHROOM; COPPER AND CPVC PIPING INTEGRATED IN WALLS
22 Electrical	
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL AND ROOF PANELS; KITCHEN, BATHROOM
25 Onsite Production	
26 Onsite Construction	PANEL ERECTION
27 Labor	SKILLED, SEMI-SKILLED, UNSKILLED
28 Labor Training Programs	THIOKOL CHEMICAL COMPANY PROGRAMS FOR UNSKILLED & SEMISKILLED WORKERS
29 Community Involvement	PLANTS TO EMPLOY LOCAL PERSONNEL; SELF-HELP

ECONOMICS

30 Construction Costs	$2,400 TO $4,000 PER UNIT INCLUDING LAND COSTS
31 Financing Methods	CONVENTIONAL
32 Useful Life	30 YEARS MINIMUM

MANAGEMENT

33 Proposer Organization	JOINT VENTURE
34 Internal Functions	MANAGEMENT; DESIGN & DEVELOPMENT; PRODUCTION; MARKETING; COMMUNITY RELATIONS
35 External Functions	
36 Market Area	
37 Delivery Rate	4 HOUSES PER DAY, 1,000 HOUSES PER YEAR—TOTAL STRUCTURE
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	USE OF PLASTIC PANELS
40 Codes	MECHANICAL, ELECTRICAL AND PLUMBING SYSTEMS ADAPTABLE TO NATIONAL MODEL CODES

Herbert H. Stevens

PROPOSER

Herbert H. Stevens, Jr., Research and Development Engineers, New York, New York

This proposal is totally innovative. The basic structural feature is a two-story concrete raft covering up to 20 acres and roofed by an airtight metal, plastic, or composite membrane anchored securely at exterior contact and internally as well if desired. This membrane is inflated to a shallow-dome shape and thenceforth supported by air pressure equal to 1 oz. per sq. in. introduced through a ventilating system. This structure would accommodate a mixture of low-rise multi-family and single-family dwellings.

The raft's top surface, under the membrane, is covered with soil for growing plants in the under-roof air space. Apartments are located on two levels of the circular enclosure leaving a central area for public use. A utility ring is provided on the lower level, using a system of radial corridors to distribute filtered air, water, power, and communication. It also serves to collect sewage and other wastes. Filter intakes allow optimum internal climate control.

The basic structural element is a reinforced concrete column tied into three horizontal slab sections with a 20-ft. span between column lines. The lower slab contains waste piping and utilities. The most innovative general feature is the watertight exterior slab surface, permitting the raft to be floated on wet soils or open water. It is suggested that the system could be erected in flotation basins, using modified shipbuilding techniques and moving the completed complexes by water to sites comprising marsh, filled land, or open water surface. Poor soil accommodates the structure, but any harder site inclusions would have to be removed if even settlement of ground was not assured. It is suggested that the system could be adapted to rolling topography by employing a stepping technique for the slabs and a tipping technique for the roof anchorage.

One submitted layout defined a 900-ft. diameter exterior for the raft, with the public central core 300 ft. in diameter. Wide-shallow and narrow-deep apartments would fill the intervening spaces. Architectural compromises are recognized; the degree of natural light permitted through the membrane and the openness of radial branching corridors raise questions. The plan presents the corridors as suitable for vehicles no larger than electric trash trucks and baby carriages. Windows in living-dining areas will open to these corridors, sacrificing acoustical privacy, and bedrooms will have no exterior windows. Natural light will be obtained from other habitable rooms.

Filtered conditioned air is introduced into bedrooms, flows through living-dining areas, and is exhausted through kitchen and bathroom; thus apartment units are joined at back and sides under a homogeneous garden slab, providing some horizontal flexibility to apartment size and arrangement. Alternatives: (1) each floor may be a minimum one-bedroom apartment with its own access to a duplex shared garden area, or (2) the upper apartment may have sole access to the roof garden, or (3) both floors may be planned as a single duplex apartment by rearranging stair landing doors. This allows flexibility over the family growth cycle.

A proprietorship is proposed for production with a prime contractor exercising total responsibility.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	27 TO 55 DWELLINGS UNITS PER ACRE
3 Topography	SUITABLE TO MARSH, FILLED LAND, OPEN WATER, AND POOR SOIL CONDITIONS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON ENCLOSED SPACES; COVERS 20 ACRES
6 Nonresidential Functions	RECREATION, SOCIAL, COMMERCIAL FACILITIES
7 Circulation	SEPARATE VEHICULAR & PEDESTRIAN CIRCULATION; RADIAL BRANCHING CORRIDORS
8 Site Planning Services	
9 Community Involvement	USER CONTROL OF PUBLIC SPACE
10 Utilities	ALL UTILITIES DISTRIBUTED THRU RADIAL CORRIDORS
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	UNTRIED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	2-STORY CIRCULAR CONCRETE RAFT; PRESSURE SUPPORTED MEMBRANE DOME
17 Exterior Elements	WINDOWS AROUND PERIPHERY; PLASTIC OR METAL DOME
18 Interior Elements	
19 Foundations	UNCONVENTIONAL — RAFT
20 Comfort Systems	
21 Plumbing	
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	STRUCTURE FLOATED INTO PLACE OR SITE ERECTED
25 Onsite Production	STRUCTURE FLOATED INTO PLACE OR SITE ERECTED
26 Onsite Construction	
27 Labor	
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP FOR INTERIOR FINISHES
ECONOMICS	
30 Construction Costs	$20,000,000 FOR SYSTEM 900 FT. DIA. WITH 1,000 UNITS
31 Financing Methods	UNINVESTIGATED
32 Useful Life	STRUCTURE-60 YEARS; REPLACEABLE DOME ROOF; PLASTIC-10 YEARS; ALUMINUM-30 YEARS
MANAGEMENT	
33 Proposer Organization	PROPRIETORSHIP
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	250,000 DWELLING UNITS PER YEAR AFTER 5 YEARS
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	ENTIRE SYSTEM
40 Codes	

Stiles-Hatton

PROPOSER

Stiles-Hatton, Inc., Grand Rapids, Michigan.

AFFILIATES

Steenwyk & Thrall, Architects & Engineers; Howard Sims & Associates, Architects & Engineers; Moore & Bruggink, Civil Engineers; Newhof, Winer & Associates, Consulting Structural Engineers.

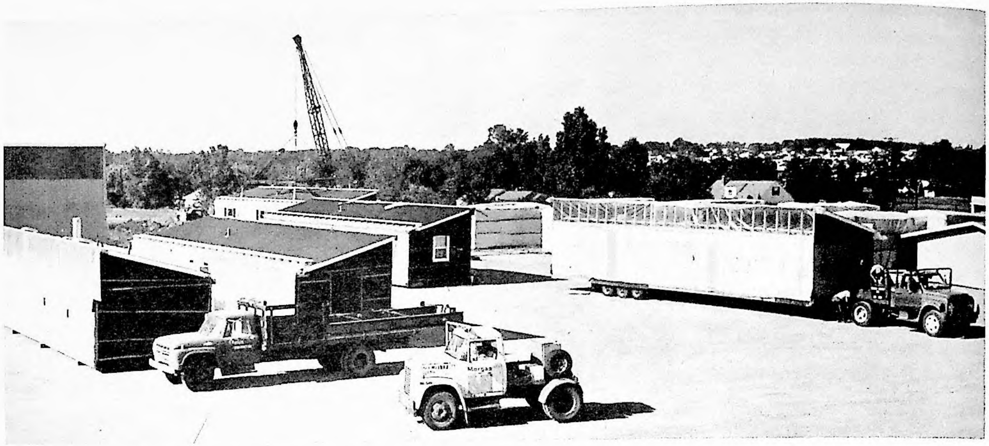
A wood-framed module, 12 ft. wide, up to 14 ft. high, and 40 ft. to 56 ft. long, makes up one-half of a dwelling unit in the housing system proposed. Although the two halves result in a single-family, one-story home that is conventional in appearance, it is in the manufacture of the module that a basic departure from the conventional is made.

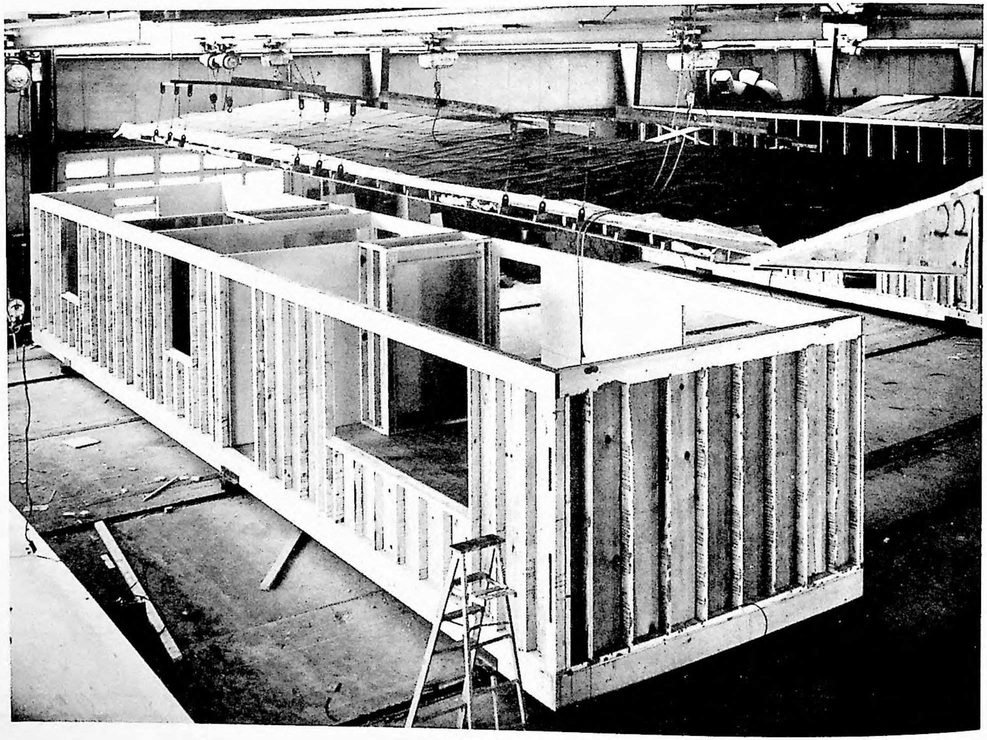
Virtually every step in construction of the module is in the factory, subject to the strictly controlled conditions. With the exception of conventional foundation work, placement and joining together of the two halves and utility hook-up, the entire house is to be factory-produced. Wiring and mechanical facilities also are factory installed.

Exterior walls may be clad in a variety of materials, with the interior, including the ceiling being finished in gypsum board. Roof decking for the gabled roof is plywood, covered with asphalt shingles. Subflooring is 5/8-in. fir plywood.

A gas-fired furnace will heat the house, with air conditioning being added as an option.

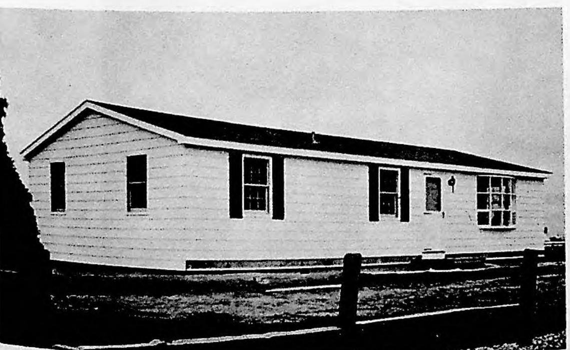
The system is in production, is currently being marketed, and is suitable for single-family attached and detached structures, as well as multifamily low-rise.





Summary Information

SITE SYSTEM		
1	Site Situation	URBAN, SUBURBAN
2	Density Range	15 TO 25 DWELLING UNITS PER ACRE (FLEXIBLE)
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	
6	Nonresidential Functions	
7	Circulation	
8	Site Planning Services	
9	Community Involvement	WORK WITH LOCAL GOVERNMENT, PLANNING & MINORITY GROUPS TO DETERMINE NEEDS
10	Utilities	
BUILDING SYSTEMS		
11	Housing Types	SINGLE-FAMILY DETACHED & SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	FLEXIBLE
13	Design Selection	STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION FACILITIES OPERATIONAL; BUILDING SYSTEM DEVELOPED & MARKETED
15	Community Involvement	
BUILDING SUBSYSTEMS		
16	Structure	WOOD-FRAMED, SELF-SUPPORTING MODULE
17	Exterior Elements	CONVENTIONAL FINISHES; PLYWOOD ROOF DECKING WITH ASPHALT SHINGLES
18	Interior Elements	GYPSUM BOARD FINISHES
19	Foundations	
20	Comfort Systems	GAS FIRED FURNACE; AIR CONDITIONING OPTIONAL
21	Plumbing	INTEGRATED WITH BUILDING SYSTEM IN FACTORY
22	Electrical	INTEGRATED WITH BUILDING SYSTEM IN FACTORY
23	Furnishings	
PRODUCTION		
24	Offsite Production	MODULES, INCLUDING MECHANICAL SERVICE LINES & EQUIPMENT
25	Onsite Production	
26	Onsite Construction	FOUNDATION; JOINING OF MODULES; UTILITY HOOK-UPS
27	Labor	
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS
ECONOMICS		
30	Construction Costs	
31	Financing Methods	
32	Useful Life	STRUCTURE—100 YEARS; HEATING—40 TO 45 YEARS; ELECTRICAL & PLUMBING—50 TO 70 YEARS
MANAGEMENT		
33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT, PRODUCTION, ERECTION AND CONSTRUCTION
35	External Functions	
36	Market Area	
37	Delivery Rate	
38	Consumer Protection	
GENERAL		
39	Major Innovative Concepts	
40	Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES



Stirling Homex

PROPOSER

Stirling Homex Corporation, Avon, New York.

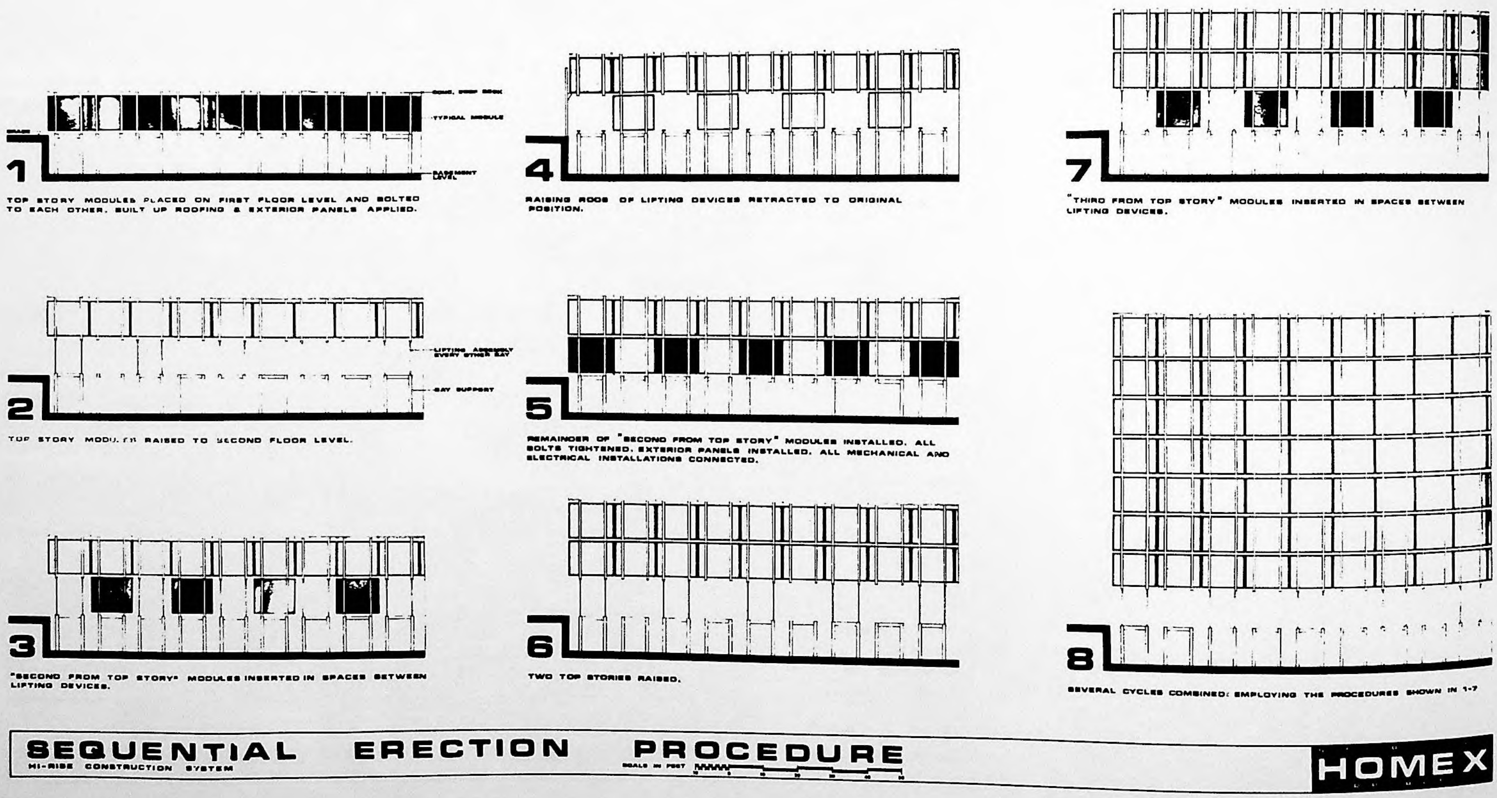
The basis for this system is the factory production of wood-framed modules, three or four of which would form a dwelling unit when combined onsite. The modules are virtually complete in every respect when they leave the plant, packaged for trucking to a site within a 400-mile radius. The only site requirements are placement on conventional foundations and quick hookups by readily trained crews. This system is currently in production for single-family housing units and multifamily low-rise structures, but is also proposed for high-rise buildings employing conventional construction materials. A volume production rate of 20 units per day is projected.

Townhouse modules are interchangeable in forming two-, three-, and four-bedroom units; and the proposed high-rise system can be adapted for school, dormitory, hospital, hotel, or motel use. Each 12-ft. x 24-ft. x 9-ft. module leaves the factory with fully installed vinyl-surfaced gypsum board interior, wood trim, drapery fixtures, cabinetry, plumbing, electrical components, and glazed windows. Using a main-flow assembly-line manufacturing process, constituent parts are cut, shaped, and assembled on both sides of the assembly line as well as overhead. Representatives from the Board of Fire Underwriters inspect and certify on the line. The modules are weatherproofed in heavy polyethylene film for shipping.

The upper halves of completed unit exteriors are comprised of maintenance-free, coated plywood; the lower portions generally are site-applied brick veneer over plywood. Painting of interior surfaces and tile applications are done at the plant. Copper tube is specified for plumbing lines, with plastic or cast iron optional for vents and drains. Central-system gas furnaces for heating, with capacity for air conditioning, are factory-installed in the module.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN, URBAN RENEWAL
2 Density Range	11.45 DWELLING UNITS PER ACRE (TOWN-HOUSE DEVELOPMENT)
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY AND SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	MIXED, FLEXIBLE USE OF DENSITIES
6 Nonresidential Functions	RECREATION AREAS; HOBBY ROOMS; COMMUNITY BUILDING; COMMERCIAL FACILITIES
7 Circulation	GRID-LIKE STREET PATTERN; CIRCUMFERENTIAL ROAD CONNECTING TO MAIN HIGHWAY
8 Site Planning Services	COMMUNITY PLANNER IN LOCAL AREA
9 Community Involvement	LOCAL PROFESSIONALS
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	EFFICIENCY TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	SYSTEM BEING MARKETED; HIGH-RISE UNDER RESEARCH
15 Community Involvement	USE OF LOCAL PROFESSIONALS
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAME MODULES
17 Exterior Elements	BRICK PANELS & COATED HARDBOARD SIDING; BALCONIES, PORCHES, CARPORTS (OPTIONAL)
18 Interior Elements	VINYL OR GYPSUM BOARD WALLS; CARPETING OR VINYL TILE FLOOR COVERING
19 Foundations	CONVENTIONAL BASEMENT OR CRAWL SPACE DESIGNED FOR CONDITIONS
20 Comfort Systems	GAS WARM-AIR HEATING & COOLING INTEGRAL WITH MODULE; OPTIONAL STANDARD SYSTEMS
21 Plumbing	CONVENTIONAL, COPPER, PLASTIC & CAST IRON PIPING, INTEGRAL WITH MODULES
22 Electrical	INTEGRAL WITH MODULES
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULES; INSTALLED MECHANICAL & ELECTRICAL EQUIPMENT
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ASSEMBLY OF MODULAR UNITS; MECHANICAL HOOK-UPS
27 Labor	SEMISKILLED & UNSKILLED FOR FACTORY & SITE CONSTRUCTION
28 Labor Training Programs	JOB-RELATED TRAINING & INDUSTRIAL COUNSELING WITH LOCAL ORGANIZATION
29 Community Involvement	USE OF LOCAL LABOR
ECONOMICS	
30 Construction Costs	$11.83 TO $17.82 PER SQ. FT.
31 Financing Methods	POSSIBLE PROMISSORY NOTE TO PURCHASERS OF AFFILIATED LEASING CORPORATION
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	PRODUCTION; DESIGN; MANAGEMENT
35 External Functions	FINANCING; SITE PLANNING; HOUSING MANAGEMENT
36 Market Area	400-MILE RADIUS OF FACTORY
37 Delivery Rate	20 DWELLING UNITS PER DAY
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	HIGH-RISE MODULAR BUILDING SYSTEM OF FIRE-RESISTANT CONSTRUCTION
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES


TYPICAL MODULE
BASEMENT LEVEL
1
TOP STORY MODULES PLACED ON FIRST FLOOR LEVEL AND BOLTED TO EACH OTHER. BUILT UP ROOFING & EXTERIOR PANELS APPLIED.
4
RAISING RODS OF LIFTING DEVICES RETRACTED TO ORIGINAL POSITION.
7
"THIRD FROM TOP STORY" MODULES INSERTED IN SPACES BETWEEN LIFTING DEVICES.
LIFTING ASSEMBLY EVERY OTHER BAY
BAY SUPPORT
2
TOP STORY MODULES RAISED TO SECOND FLOOR LEVEL.
5
REMAINDER OF "SECOND FROM TOP STORY" MODULES INSTALLED. ALL BOLTS TIGHTENED. EXTERIOR PANELS INSTALLED. ALL MECHANICAL AND ELECTRICAL INSTALLATIONS CONNECTED.
3
"SECOND FROM TOP STORY" MODULES INSERTED IN SPACES BETWEEN LIFTING DEVICES.
6
TWO TOP STORIES RAISED.
8
SEVERAL CYCLES COMBINED: EMPLOYING THE PROCEDURES SHOWN IN 1-7
SEQUENTIAL ERECTION PROCEDURE
HI-RISE CONSTRUCTION SYSTEM
SCALE IN FEET
HOMEX

The high-rise system, up to 21 stories, will feature a concrete-steel module, stacked on a conventional foundation with 16 apartments per floor. The curtain wall exterior is precast concrete or other covering. Interior wall construction is vinyl-surfaced gypsum board on steel studs. Factory-built brick panels comprise an alternative for exterior finish. The techniques for the high-rise structures are new in concept but use conventional materials throughout.

The proposer is planning a comprehensive employee-training program of job-related basic education, supervisory awareness, and personal counseling and orientation covering both prejob and onjob components. Heavy community involvement is assured through detailed plans for participation, including retention of local architect-planners.

Completed buildings will be offered for sale to nonprofit groups who will arrange public housing leases, the leases to secure long-term financing notes; the proposer has adequate financing sources.

High-rise System

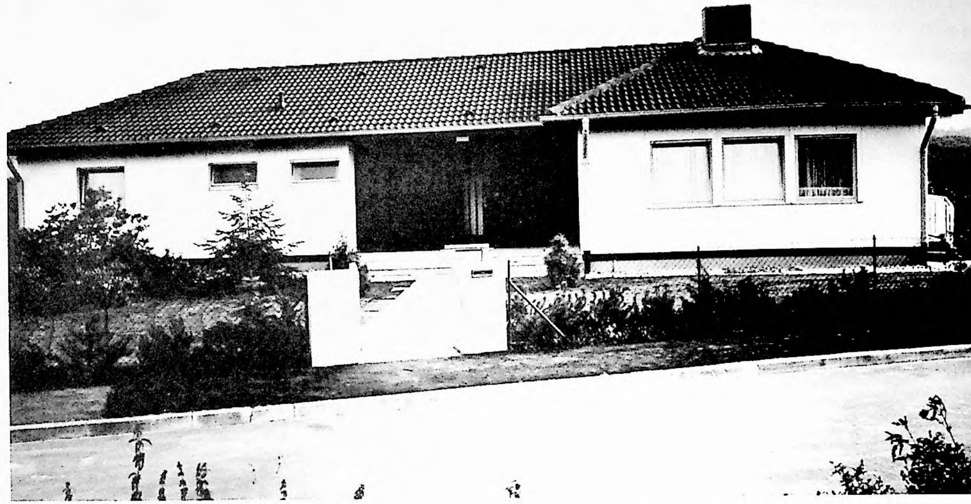
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	RESEARCH & DEVELOPMENT REQUIRED
15 Community Involvement	USE OF LOCAL PROFESSIONALS

BUILDING SUBSYSTEMS	
16 Structure	CONCRETE & STEEL MODEL; STEEL COLUMN & BEAM FRAME
17 Exterior Elements	CONCRETE, BRICK-PANEL OR OTHER SUITABLE CURTAIN WALLS; BALCONIES
18 Interior Elements	STEEL-STUD GYPSUM BOARD PARTITIONS; STAIRS; ELEVATORS
19 Foundations	CONVENTIONAL DESIGNED FOR SITE CONDITIONS
20 Comfort Systems	HEATING & COOLING
21 Plumbing	CONVENTIONAL, COPPER, PLASTIC & CAST IRON PIPING, INTEGRAL WITH MODULES
22 Electrical	INTEGRAL WITH MODULES
23 Furnishings	

Streif-Beckmann

PROPOSER

Streif Company, Linz, Germany
Beckman Company, Elwood, Nebraska



A panelized housing system, originally developed in Germany, based on predominantly wood panels 4-ft. x 8-ft. x 6-in. is proposed. The panels, all manufactured in a factory under highly rationalized processes at low cost, compared to conventional onsite construction, are used for exterior and interior walls and for floor and roof sections.

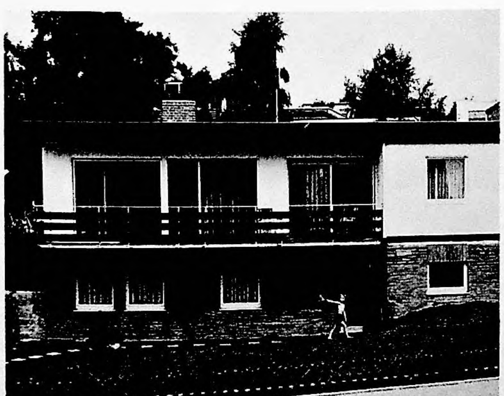
The proposed system offers two approaches for assembly. Using one approach, the workmen build up the structure from the basic 4-ft. x 8-ft. panels, handling and joining the elements with manpower only. Under the alternate approach, the modular panels are joined at the factory into complete wall lengths, approximately 33 ft. long and 8 ft. high (for both inner and outer walls), and these components are shipped to the site, and set by a 25-ton auto-crane. The second approach is faster and less costly due to the substantially larger area of walls placed in a single operation per man hour, compared to panel-by-panel placement.

Using either approach, houses are sited on conventional foundations—either slab-on-ground with perimeter footings or walls, or concrete slab topping an excavated basement.

Exterior finish for the housing components (deemed suitable for single-family detached and attached dwellings) is a plastic dispersion, white mortar coating, with trim at the line of gabled or flat roof, glazed wood. Interiors are papered, with ceilings finished in gypsum board. Ground floor finish at grade is polyvinyl chloride or parquet; indoor/outdoor carpeting or plastic is used on the second floor. The built-up flat roof is gravel-embedded in bitumen strip, while the gabled, hipped roof is covered with concrete tile.

The house will be equipped with a gas-fired warm air heating system located in a recess or in a closet. This unit handles all heating and ventilating chores, including freshening of room air content with outside air and humidification to the degree desired by the occupant.

The proposed modularized panel concept is in production and is being marketed presently in Germany, and, under license agreements, could be set up for utilization in this country. Responsibility for erection rests in the hands of manufacturer of the prefabricated components, to the advantage of the owner-builder who thus has only one contracting party with which to negotiate.



Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	NURSERY SCHOOL; COMMERCIAL SHOPS; OFFICE BUILDINGS
7 Circulation	SEPARATE PROVISION FOR VEHICULAR AND PEDESTRIAN TRAFFIC
8 Site Planning Services	
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	EFFICIENCY TO 6 BEDROOM
13 Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DEVELOPED & CURRENTLY MARKETED IN GERMANY
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	PREFABRICATED WOOD WALL, FLOOR & ROOF PANELS; OPTIONAL FACTORY-ASSEMBLED MODULES
17 Exterior Elements	MASONRY FACING; BUILT-UP FLAT ROOF OR CONCRETE TILE HIPPED ROOF
18 Interior Elements	SUBFLOOR; FLOOR; GYPSUM BOARD CEILING & PARTITIONS
19 Foundations	CONVENTIONAL; ADAPTED TO SITE
20 Comfort Systems	GAS OR OIL FIRED FORCED AIR OR HYDRONIC HEATING; OPTIONAL INTEGRATED COOLING
21 Plumbing	COPPER WATER PIPING; PLASTIC DRAINAGE PIPING; CONVENTIONAL FIXTURES
22 Electrical	CONVENTIONAL
23 Furnishings	

PRODUCTION

24 Offsite Production	PANELS; COMPONENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ERECTION OF PANELS & COMPONENTS; UTILITY INSTALLATION; FINISHES
27 Labor	
28 Labor Training Programs	
29 Community Involvement	

ECONOMICS

30 Construction Costs	$13.50 TO $20.50 PER SQ.FT. DEPENDING ON DESIGN
31 Financing Methods	SHORT TERM AVAILABLE
32 Useful Life	TOTAL STRUCTURE: 90 YEARS

MANAGEMENT

33 Proposer Organization	JOINT VENTURE
34 Internal Functions	OVERALL DESIGN, PRODUCTION, & CONSTRUCTION
35 External Functions	
36 Market Area	
37 Delivery Rate	1,000 UNITS PER YEAR OPTIMUM
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	CONFORM TO ALL APPLICABLE GERMAN CODES

Stylemaster Homes

PROPOSER

Stylemaster Homes, Inc., Fort Wayne, Indiana

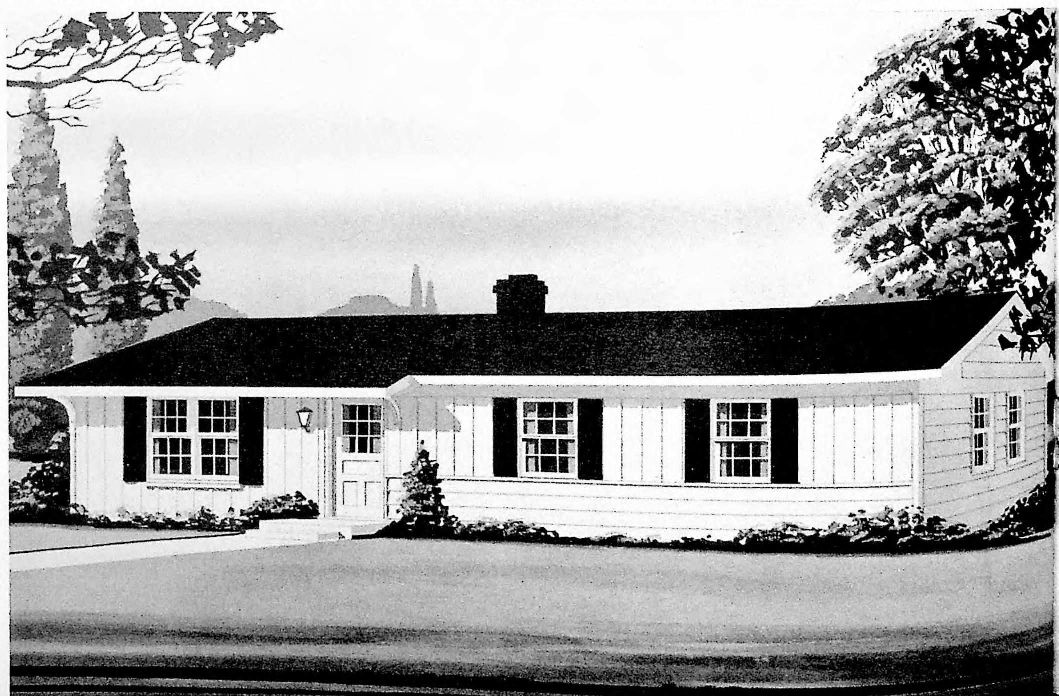
AFFILIATES

The Harvard Corporation; Realtor Sales Company; Subdivision Holding Company; Land Procurement Company; American Dwellings Inc.

Designs offered in this proposal are in either one- or two-story profiles for single-family detached or 1- to 5-bedroom apartment complexes. The proposed units are now being commercially produced. The proposer recommends that the construction program be made known to communities through presentations at social groups, churches, trade unions, and welfare agencies.

The dwelling unit here proposed is almost completely factory-built, leaving only utility connections and closure by joining modules as field work. All framing is of wood. The completed modules are shipped in widths of 12 ft. and can be produced in lengths of up to 50 ft. Adjoining parts are closed in the field with split-doorjamb or ceiling-beam and pilaster techniques. Prepared foundations are either block or post and beam.

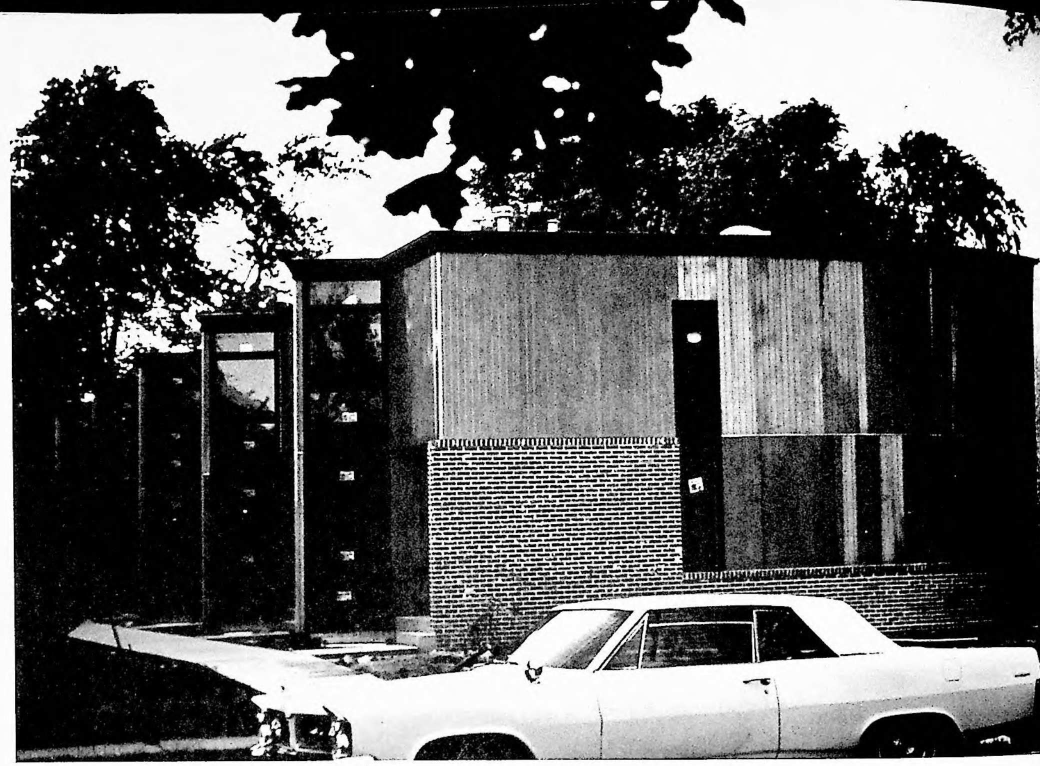
Exterior finish prescribed is either brick slab or aluminum facing; interior wall facing is gypsum board with 2-in. batt insulation. Steel exterior doors and aluminum sliding windows are plant installed. Plastic shower-tub subunits are specified.



Summary Information

SITE SYSTEM		
1	**Site Situation**	URBAN, SUBURBAN
2	**Density Range**	
3	**Topography**	
4	**Climate**	
5	**Planning Concepts**	
6	**Nonresidential Functions**	
7	**Circulation**	
8	**Site Planning Services**	
9	**Community Involvement**	DETERMINATION OF USER NEEDS; MARKET STUDIES
10	**Utilities**	
BUILDING SYSTEMS		
11	**Housing Types**	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12	**Unit Variations**	1 TO 5 BEDROOMS
13	**Design Selection**	FROM STANDARD PLANS
14	**State of Development**	PRODUCTION FACILITIES—DESIGN STAGE; BUILDING SYSTEM—TESTING REQUIRED
15	**Community Involvement**	DETERMINATION OF USER NEEDS; MARKET STUDIES
BUILDING SUBSYSTEMS		
16	**Structure**	SELF-SUPPORTING WOOD FRAME VOLUMETRIC MODULE
17	**Exterior Elements**	BRICK SLAB OR ALUMINUM FACING FINISHES
18	**Interior Elements**	GYPSUM BOARD FINISHES
19	**Foundations**	CONVENTIONAL CONCRETE BLOCK OR POST & BEAM
20	**Comfort Systems**	FACTORY FABRICATED
21	**Plumbing**	COPPER TUBING; PLASTIC DRAINAGE PIPE; FACTORY FABRICATED
22	**Electrical**	FACTORY FABRICATED
23	**Furnishings**	
PRODUCTION		
24	**Offsite Production**	MODULES
25	**Onsite Production**	
26	**Onsite Construction**	FOUNDATIONS; JOINING OF MODULES; UTILITY CONNECTIONS
27	**Labor**	SKILLED
28	**Labor Training Programs**	
29	**Community Involvement**	LOCAL CONTRACTORS AND SUBCONTRACTORS; SELF-HELP
ECONOMICS		
30	**Construction Costs**	\$10.26 PER SQUARE FOOT—MULTIFAMILY LOW-RISE
31	**Financing Methods**	
32	**Useful Life**	
MANAGEMENT		
33	**Proposer Organization**	CORPORATION
34	**Internal Functions**	
35	**External Functions**	
36	**Market Area**	
37	**Delivery Rate**	700 TO 1,000 DWELLING UNITS PER YEAR
38	**Consumer Protection**	
GENERAL		
39	**Major Innovative Concepts**	
40	**Codes**	

Systems Constructors Ltd.



PROPOSER

Systems Constructors Ltd., Chicago, Illinois

AFFILIATES

Baltic Construction Company; Royal Plumbing, Inc.; M.M.M. Heating Company; Spar Electric Company; Atrium Development Corporation

Components of this system are sized individually according to the load assigned to each. The modules (or boxes) are plant-fabricated of wood and are joined together onsite by steel connector plates nailed to each.

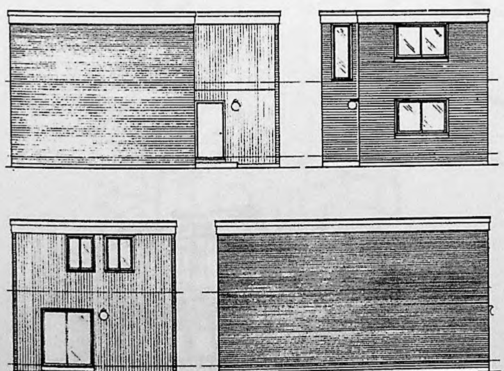
An innovation in the proposal is the vertical joining of components. Second-floor joists are separated by a spacer plate from the first-floor ceiling joists for independent deflection and improved sound isolation. Each module is self-supporting.

Each component is equipped with mechanical installations in the case of bathroom and kitchen modules; others are given interior finish treatment. All heating ducts and electrical conduits are factory-installed. Exterior siding is applied at the site.

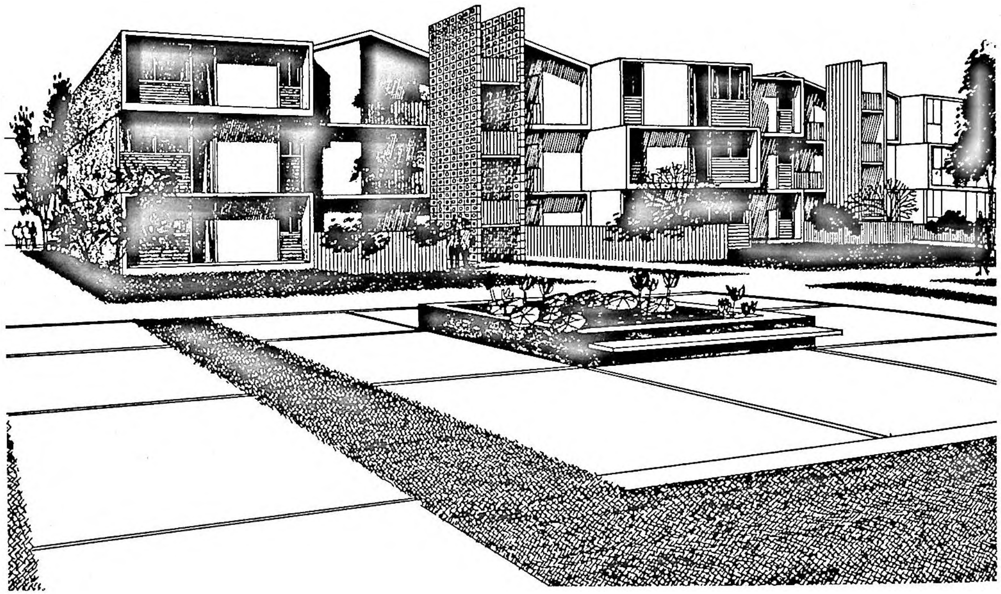
The site plan calls for placing of streets at different levels, with recreation areas in between. A self-help feature is the application of exterior siding and landscaping and other site improvement work done by occupants. The system has been developed but is not yet marketed.

Summary Information

SITE SYSTEM		
1	**Site Situation**	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	**Density Range**	
3	**Topography**	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	**Climate**	ADAPTABLE TO ALL CLIMATIC CONDITIONS
5	**Planning Concepts**	MULTILEVEL STRATIFICATION OF REFERENCE PLANS; COMMON OPEN SPACES
6	**Nonresidential Functions**	RECREATION AREAS BETWEEN MULTI-LEVEL STREETS
7	**Circulation**	SEPARATE OVERHEAD PROVISION MADE FOR VEHICULAR TRAFFIC; STREETS AT SEVERAL LEVELS
8	**Site Planning Services**	LOCAL SELECTED DESIGN TEAM
9	**Community Involvement**	
10	**Utilities**	
BUILDING SYSTEMS		
11	**Housing Types**	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	**Unit Variations**	
13	**Design Selection**	FLEXIBLE PLANNING VARIATIONS
14	**State of Development**	BUILDING SYSTEM DEVELOPED BUT NOT MARKETED; DESIGN AND TESTING REQUIRED
15	**Community Involvement**	
BUILDING SUBSYSTEMS		
16	**Structure**	WOOD-FRAME COMPONENT MODULES JOINED ON SITE BY STEEL CONNECTOR PLATES
17	**Exterior Elements**	EXTERIOR SIDING MATERIALS OPTIONAL
18	**Interior Elements**	BATHROOM & KITCHEN CORES; WOOD PARTITIONS; CONVENTIONAL FINISHES
19	**Foundations**	CONVENTIONAL
20	**Comfort Systems**	ELECTRIC HEATING SYSTEM; DUCT ENCASED IN WALL & FLOOR CONSTRUCTION
21	**Plumbing**	PIPING WITHIN UTILITY SERVICE COMPONENTS; CONNECTIONS IN HORIZONTAL RUNS
22	**Electrical**	WIRING INTEGRATED IN WALL & CEILING STRUCTURE
23	**Furnishings**	
PRODUCTION		
24	**Offsite Production**	VOLUMETRIC COMPONENT MODULES COMPLETE WITH KITCHEN OR BATHROOM EQUIPMENT
25	**Onsite Production**	
26	**Onsite Construction**	FOUNDATIONS; JOINING OF MODULES; UTILITY HOOKUPS
27	**Labor**	SEMISKILLED FOR PRODUCTION PLANT & SITE ERECTION; SKILLED FOR UTILITY HOOK-UPS
28	**Labor Training Programs**	
29	**Community Involvement**	LOCAL CONTRACTORS & SUBCONTRACTORS FOR FIELD ERECTION; SELF-HELP POSSIBLE
ECONOMICS		
30	**Construction Costs**	ON A 100 UNIT SCALE: $13,500 TO $14,500 PER UNIT
31	**Financing Methods**	
32	**Useful Life**	COMPLETE DWELLING UNIT: 35 YEARS
MANAGEMENT		
33	**Proposer Organization**	CORPORATION (LTD)
34	**Internal Functions**	OVERALL COORDINATION
35	**External Functions**	CARPENTRY; PLUMBING; ELECTRICAL; PROJECT DEVELOPMENT ADVICE
36	**Market Area**	NATIONWIDE, BEGINNING IN THE CHICAGO AREA
37	**Delivery Rate**	MINIMUM 100 DWELLING UNITS PER YEAR; OPTIMUM 1,000 UNITS PER YEAR
38	**Consumer Protection**	
GENERAL		
39	**Major Innovative Concepts**	
40	**Codes**	



TRW Systems



PROPOSER

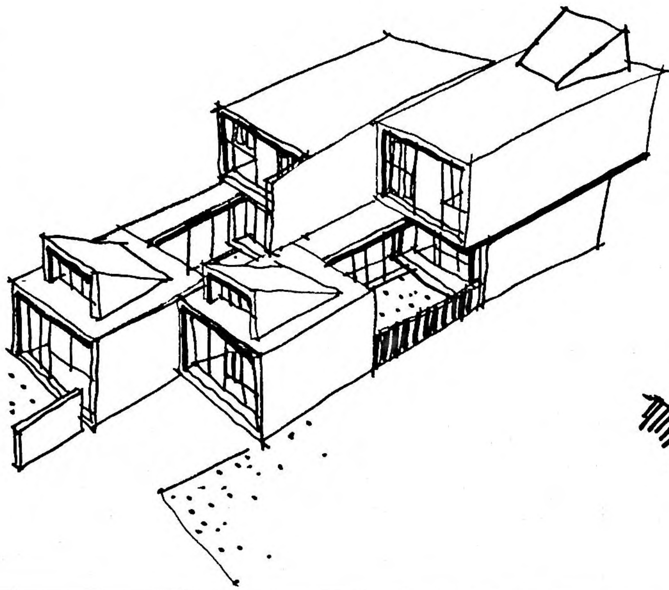
TRW Systems Group, Redondo Beach, California.

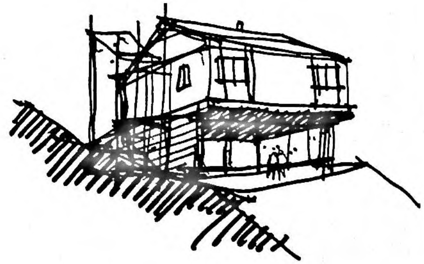
SUBCONTRACTORS

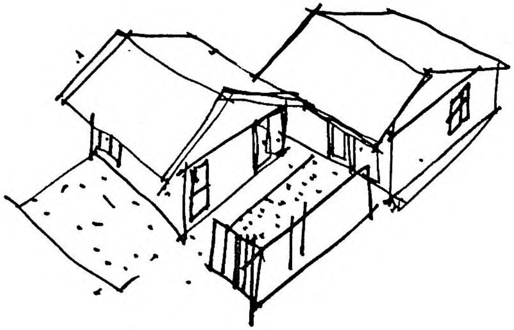
Building Systems Development, Architects; Mid-City Developers, Developers; Kaufman and Broad, Inc., Developers.

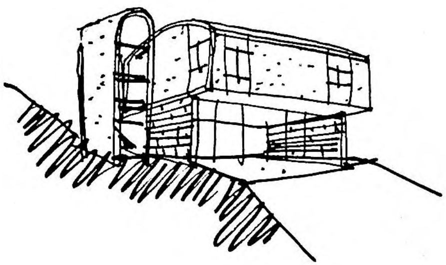
This proposer group will manufacture in portable factory operations, portable fibershell modules wrapped on mandrels. Partitions, end panels, and small shapes will be produced in permanent plants and shipped to the sites. The relocatable facilities will manufacture room-sized modules too large for highway transportation, bringing the factory to the site for these larger elements. Innovations in the system include the panel materials—kraftpaper-honeycomb core, faced on both sides with woven roving-resin and gypsum board for fire protection—and the forming of the modules in the temporary onsite plants by a mandrel-wrapping process. The finished product is appreciably lighter than wood frame and six to eight times lighter than concrete or masonry structures of comparable size.

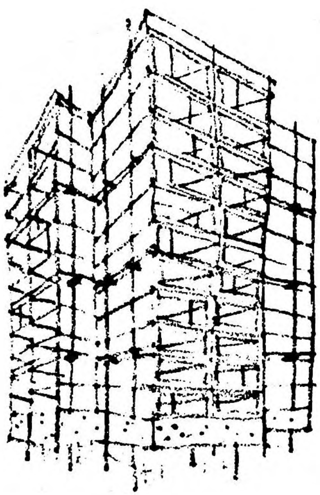
A key ingredient in the fabrication process is use of relatively low labor skill levels for new skills not currently in the building industry. Automation permits large volume output with a relatively small labor force. One permanent factory and one mobile factory can produce 1,000 dwelling units per year; one permanent plant and five mobile facilities can turn out 4,500 units per year. The proposer will produce the shells, integrate components, and service and sell them to licensed developer-builders who will assemble and finish the components. This proposal involves, initially, a wide range of housing types—attached and detached single-family and low-rise multifamily arranged as patio houses, townhouses, clustered, and in garden apartment complexes. The modules can be stacked within a cage, or suspension members, for multistory construction with a density per acre of 15 dwelling units recommended for the high-rise structures.











Summary Information

SITE SYSTEM

1	Site Situation	URBAN, URBAN RENEWAL, SUBURBAN, NEW TOWN
2	Density Range	13 TO 25 DWELLING UNITS PER ACRE; ADAPTABLE TO LOW, MEDIUM, AND HIGH DENSITY
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	PLANNED UNIT DEVELOPMENT; CLUSTERS; COURTYARD-ATRIUM; PATIO CLUSTERS
6	Nonresidential Functions	SOCIAL, COMMERCIAL & SERVICE FACILITIES
7	Circulation	PEDESTRIAN & VEHICULAR SEPARATION; UNDERPASSES/OVERPASSES
8	Site Planning Services	
9	Community Involvement	
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	UP TO 4 BEDROOMS
13	Design Selection	FROM STANDARD PLANS WITH OPTIONS
14	State of Development	PRODUCTION-DESIGN STAGE; BUILDING SYSTEM PROTOTYPE COMPONENTS CONSTRUCTED
15	Community Involvement	RESIDENTS WORK WITH ARCHITECT IN DESIGN; MODEL TO DETERMINE USER NEEDS

BUILDING SUBSYSTEMS

16	Structure	SELF-SUPPORTED MODULE (FIBERGLASS PLASTIC HONEYCOMB CORE); FLOOR, WALL, & ROOF PANELS
17	Exterior Elements	ENDWALLS; SIMULATED CONVENTIONAL FINISHES
18	Interior Elements	PARTITION PANELS; L-PANELS, CORNER REINFORCEMENT; PANEL EDGES
19	Foundations	POSSIBLE: PREFABRICATED BOX RAIL; POST & BEAM; DIRECT PLACEMENT; WOOD PILE
20	Comfort Systems	RADIANT PANEL, HYDRONIC, OR FORCED AIR HEATING-COOLING INTEGRATED WITH MODULE
21	Plumbing	CONVENTIONAL; FACTORY INSTALLED OR SUBASSEMBLY PREFABRICATED FOR SITE ASSEMBLY
22	Electrical	CONDUITS IN STRUCTURAL SHELL OR DROPPED CEILINGS; SURFACE MOUNTED RACEWAYS
23	Furnishings	

PRODUCTION

24	Offsite Production	MODULE, COMPONENT, PLUMBING & ELECTRICAL PANELS; WALLS; POSSIBLE FOUNDATIONS
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS, JOINING OF MODULES; HIGH-RISE FRAMING, MECHANICAL CONNECTIONS
27	Labor	UNSKILLED FACTORY WORK
28	Labor Training Programs	TRAINING LABOR FOR PRODUCTION & CONSTRUCTION
29	Community Involvement	LOCAL CONTRACTORS; TENANT INVOLVEMENT IN MANAGEMENT

ECONOMICS

30	Construction Costs	$11.55 TO $11.97 PER SQ. FT.
31	Financing Methods	CONVENTIONAL
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT, PRODUCTION
35	External Functions	DESIGN, LAND DEVELOPMENT, CONSTRUCTION, ERECTION
36	Market Area	
37	Delivery Rate	1,008 UNITS PER YEAR FOR ONE ONSITE FACTORY
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	PLASTIC MODULE MANUFACTURE BY MANDREL WINDING; POSSIBLE FOUNDATION DESIGN
40	Codes	MECHANICAL SYSTEMS ADAPTABLE TO NATIONAL MODEL CODES

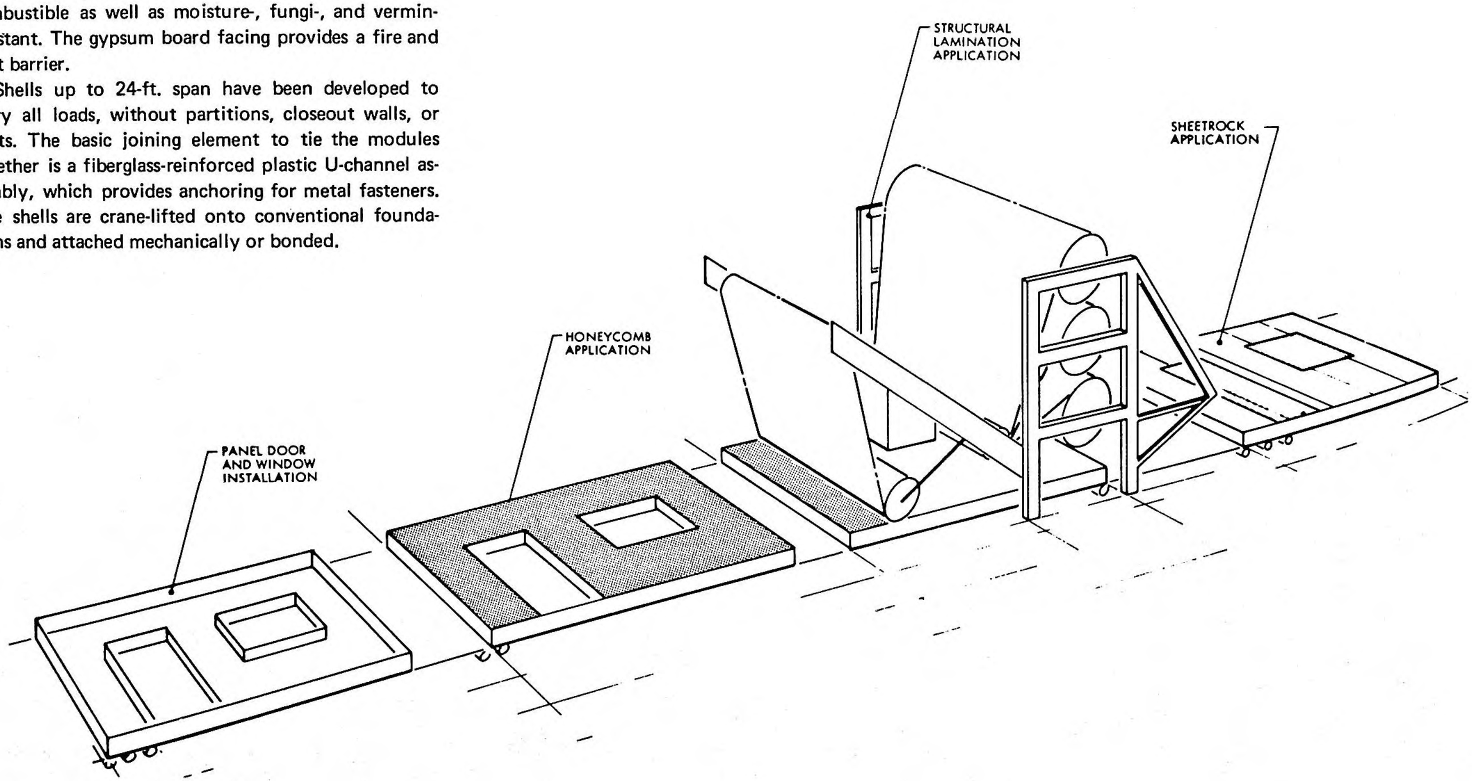
TRW Systems (continued)

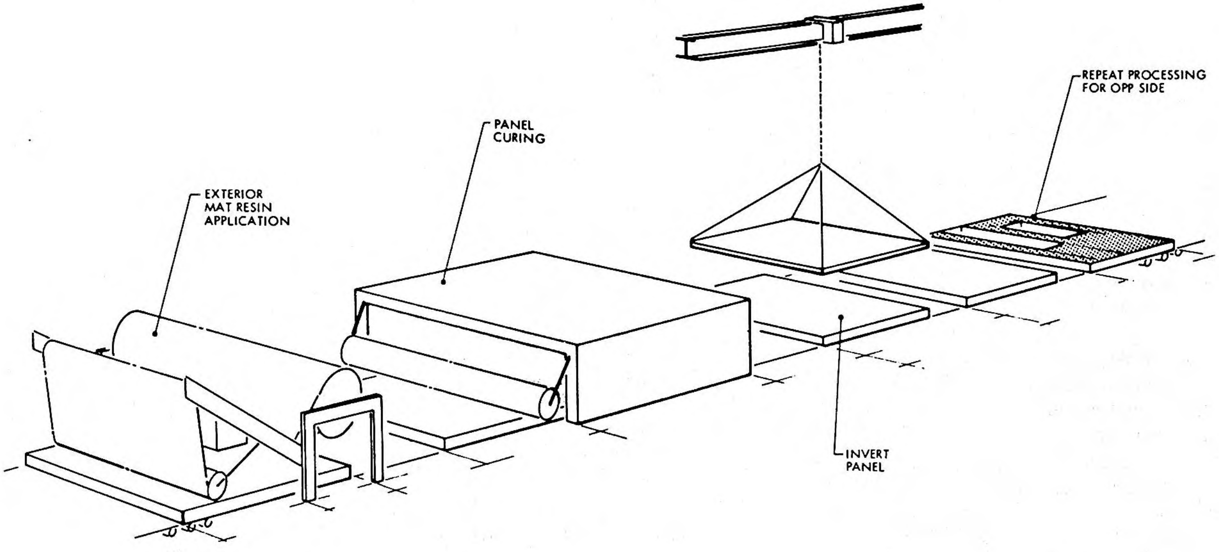
The basic structural sandwich is fabricated from glass fiber, reinforced polyester resin plastic, and the kraftpaper honeycomb, its layers wrapped on large-scale rotary mandrels. The mandrel collapses for stripping the shell. The module's reinforced plastic surface permits mechanical or bonded connections. Cost of the plastic is relatively high, but this is offset by easy fabrication methods. Semiskilled labor is employed in the plant. The kraftpaper is a low-cost item, even after treatment with special flame-retardant chemicals and polymers. In final form the paper in noncombustible as well as moisture-, fungi-, and vermin-resistant. The gypsum board facing provides a fire and heat barrier.

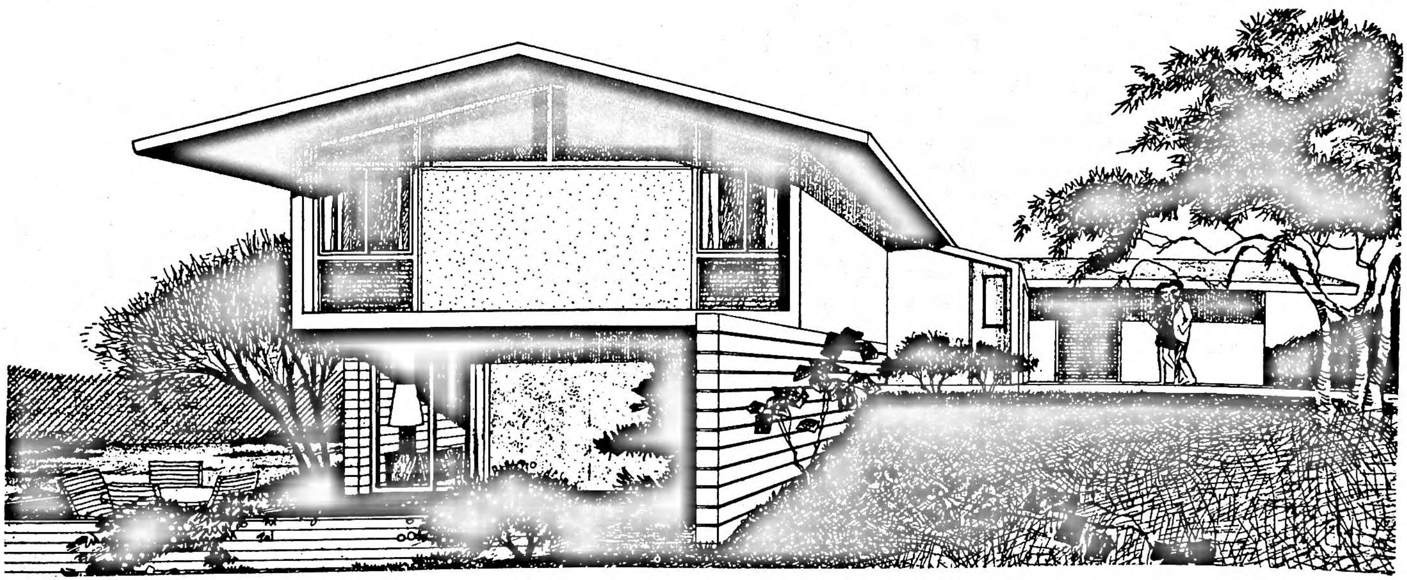
Shells up to 24-ft. span have been developed to carry all loads, without partitions, closeout walls, or posts. The basic joining element to tie the modules together is a fiberglass-reinforced plastic U-channel assembly, which provides anchoring for metal fasteners. The shells are crane-lifted onto conventional foundations and attached mechanically or bonded.

The basic system includes gas-fired forced-air furnaces, adaptable for cooling with the addition of cooling coils to the furnace and condenser units on the roof. Duct runs can penetrate the paper core, terminating at floor-level register-diffusers. Electrical distribution remains outside the structural shell and is surface-applied to minimize problems of design and coordination. Main service to panel boards runs in vertical chases, while wiring for lighting runs at partition-head level in channels that also serve as joint covers and picture-hanger ledges. Several alternatives are offered for the plumbing subsystem, but a standardized layout with vertical lines in continuous chases is proposed for prototype construction.

Innovative land-use concepts in this proposal cover aspects of multiple use, new town development, infill construction and rehabilitation of existing neighborhoods, strategic placement of development, use of floats on water for temporary and permanent (relocation) housing, and preservation of important ecological areas. Open space is a feature of the planning.




REPEAT PROCESSING FOR OPP SIDE
PANEL CURING
EXTERIOR MAT RESIN APPLICATION
INVERT PANEL



Techcrete Consortium

PROPOSER CONSORTIUM

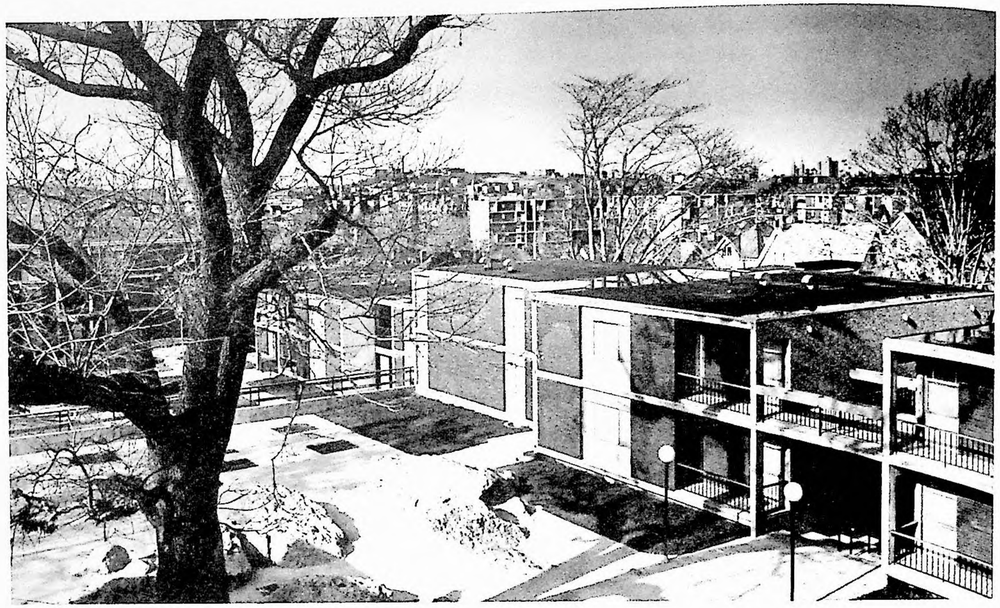
Techcrete Consortium, Cambridge, Mass.
Arthur D. Little, Inc.
Carl Koch and Associates, Inc., Architects
Aetna Life & Casualty

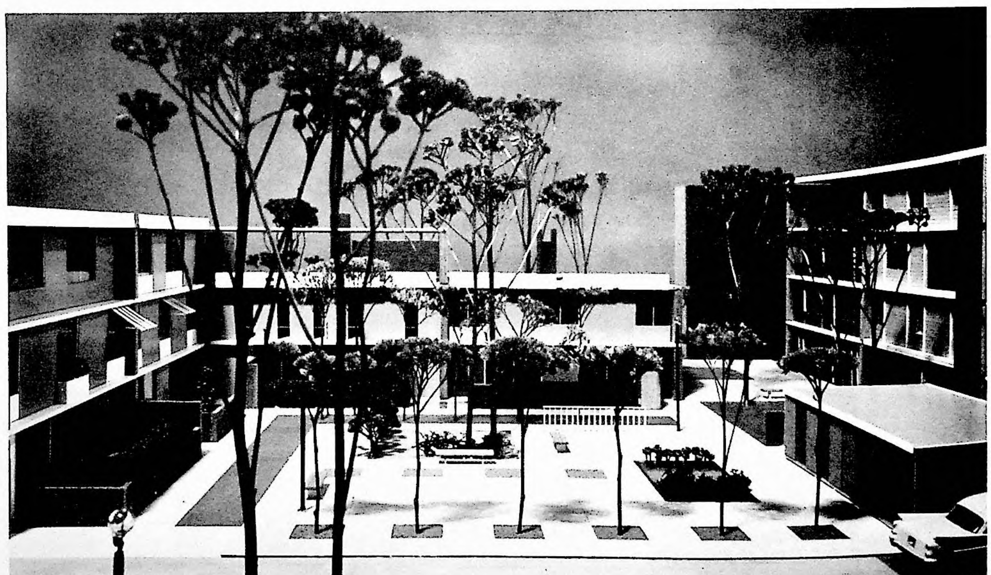
Aimed at medium- to high-density apartment construction, rather than single-family housing, the housing system proposed has already been employed for actual large-scale use.

The proposer consortium includes a management and contract research firm, an architect-engineer, and a major insurance company, all with long experience in all phases of housing. With its own financial and management resources, it feels it can take the entire development process, from start to completion and management, in stride. It is proposed that a major manufacturer, similar to an automobile manufacturer with experience in mass production and management, would join the consortium, as would a major construction firm, to complete the capabilities of the organization.

The system makes use of precast, prestressed concrete bearing walls and hollow-core prestressed concrete planks, which (in conjunction with similarly built shear walls where required) form the structural frame for buildings that can be erected from two to 32 stories in height. The technique was developed more than 7 years ago in studies for urban housing authorities.

Major concrete components that make up the structural shell are: (1) Extruded, prestressed hollow-core floor and roof planks, machine-produced in lengths up to 700 ft., and then cut to 32 ft.-lengths. Plank depth for a floor live load of 40 lb. per sq. ft. is 8 in. (2) Precast, story-high, 8-in. bearing walls (in varying lengths from 20 ft. to 50 ft.) with door openings. These leave front and back walls free to accommodate (in modular curtain wall construction) windows, doors, glass walls for access to balconies, and permit architectural treatment of surfaces. (3) Precast shear walls to provide structural stability in buildings of more than five stories.





In addition to these principal components, three other types may be incorporated as required: precast concrete stairways and stairwell panels; precast elevator cores and corridor structures; and precast balcony spandrel and sunshade components.

The floor planks, spanning 32 ft. between bearing walls, define a 32-ft., one-way planning grid perpendicular to the facade, thus defining a flexible structural shell ready for installation of subsystems.

The system's elements are joined by stressing rods that run continuously through the walls from foundation to roof, thus clamping floor panels and bearing walls together in a rigid frame when stressed. In buildings of more than five stories, the precast shear walls and the layout of bearing walls permit further self-bracing.

Designers contemplate a main utility core (containing bath, kitchen, heating and cooling units, and trash-disposal chute), which is positioned in a standardized location. Unit plans are designed to grow outward from a defined gap in the plank layout at this point. The utility core units themselves are factory-made, complete with all necessary equipment, then sealed and stored until lifted into place as the structure rises. Only minor field connections are required.

Exterior nonbearing walls can be modular panels of almost any material, factory-assembled for erection by crane; interior panels are preassembled gypsum walls with integral gypsum studs (or light-gauge steel studs with gypsum-board facing), with prehung door units and packaged closets. Interior finishes also can be of almost any suitable material; insulation and sound-deadening properties of the dense concrete walls, floors and roofs are superior.

The plumbing system includes a prefabricated piping cage for back-to-back placement of baths or kitchens; electrical wiring, in general, runs behind baseboards on the interior partitions (wiring is precut, rolled, and stored in the utility core unit, along with the distribution panel). Heating may be conventional hydronic from a central plant with baseboard radiation; or with air conditioning, the more sophisticated fan-coil units are more economical. Supply and return piping and control devices are built into the core unit to eliminate much site labor and installation.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	10 TO 100 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	COMMON OPEN SPACES; STREET GRID; CUL-DE-SACS; SUPER BLOCK
6 Nonresidential Functions	ROOF AREAS FOR TENNIS, HANDBALL, SUNBATHING; LAUNDRY; SCHOOL; LIBRARY
7 Circulation	SEPARATE VEHICULAR & PEDESTRIAN CIRCULATION
8 Site Planning Services	LOCAL SELECTED DESIGN TEAM
9 Community Involvement	GENERAL COMMUNITY INVOLVEMENT IN PLANNING
10 Utilities	CONVENTIONAL; PACKAGED TREATMENT ONSITE SANITARY SEWER SYSTEM

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS; FLEXIBLE
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM DEVELOPED & MARKETED
15 Community Involvement	COMMUNITY LEADERS INVOLVED IN PLANNING UNITS & COMMON FACILITIES

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE BEARING & SHEAR WALL PANELS, PRESTRESSED FLOOR & ROOF PLANKS
17 Exterior Elements	PREFABRICATED EXTERIOR WALLS; PRECAST BALCONY SPANDRELS, SUNSHADE COMPONENTS
18 Interior Elements	SELF-SUPPORTING BATHROOM/KITCHEN MODULES; PREFABRICATED GYPSUM PANELS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	GAS OR OIL CENTRAL HYDRONIC HEATING; BASEBOARD RADIATION OR FAN COIL WITH COOLING
21 Plumbing	CONVENTIONAL; INTEGRATED MECHANICAL RACEWAY; COPPER, NO-HUB CAST-IRON PIPING
22 Electrical	INTEGRATED MECHANICAL RACEWAY; WIRING HARNESS; ROOF SNOW MELTER
23 Furnishings	

PRODUCTION

24 Offsite Production	CONCRETE WALL, ROOF, FLOOR PANELS; STAIRWAY; BALCONY, SUNSHADE COMPONENTS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF COMPONENTS; MECHANICAL ASSEMBLIES & HOOKUPS
27 Labor	SEMISKILLED FOR PLANT; SKILLED, SEMISKILLED, UNSKILLED FOR SITE ERECTION
28 Labor Training Programs	TRAINING PROGRAM FOR MINORITY GROUPS
29 Community Involvement	LOCAL CONTRACTORS & LABOR

ECONOMICS

30 Construction Costs	$13.80 PER SQ. FT., 1000 UNITS PER YEAR
31 Financing Methods	PROPOSER SUPPLIED THROUGH RETAINED EARNINGS; CO-OP OWNERSHIP VENTURE
32 Useful Life	STRUCTURAL SYSTEM—40 YEARS

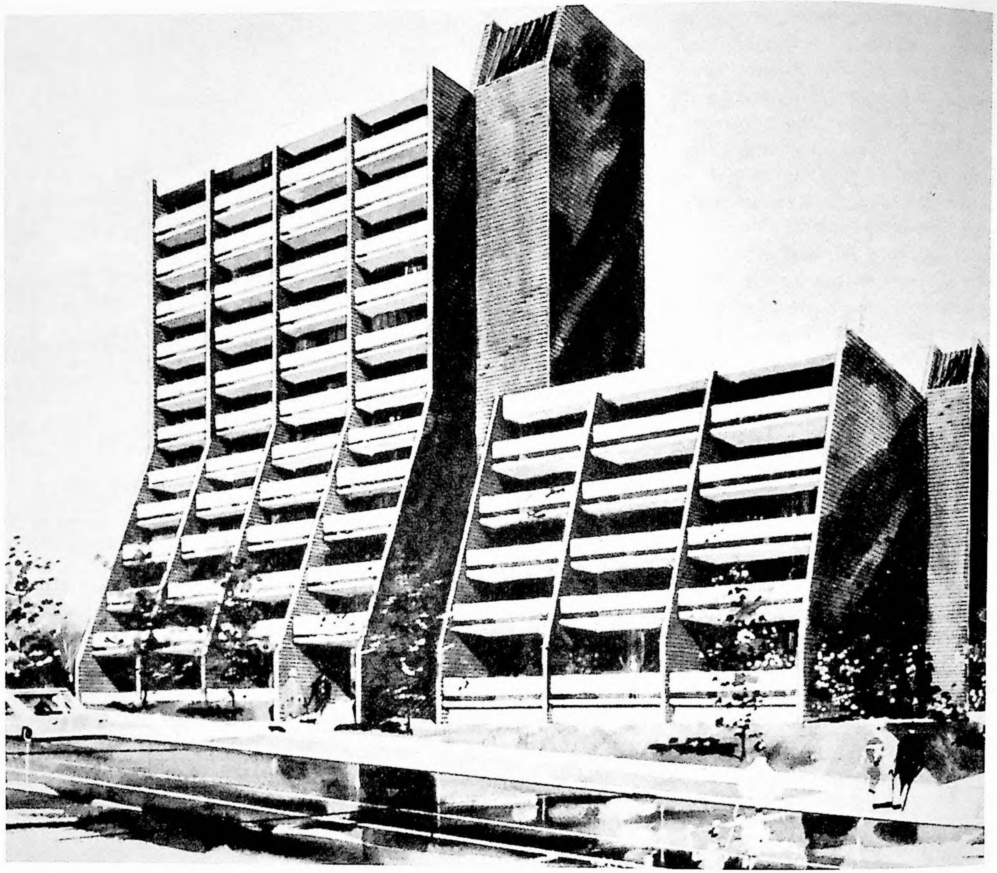
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	COORDINATION; ARCHITECTURAL DESIGN; FINANCING
35 External Functions	PRODUCTION; CONSTRUCTION; MANAGEMENT
36 Market Area	200 MILE RADIUS FROM FACTORY
37 Delivery Rate	1,000 UNITS PER YEAR FOR FIVE YEARS
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM; SEWAGE DISPOSAL PACKAGE-TREATMENT SYSTEM
40 Codes	ADAPTABLE TO BOCA CODE

Teeples & Thatcher



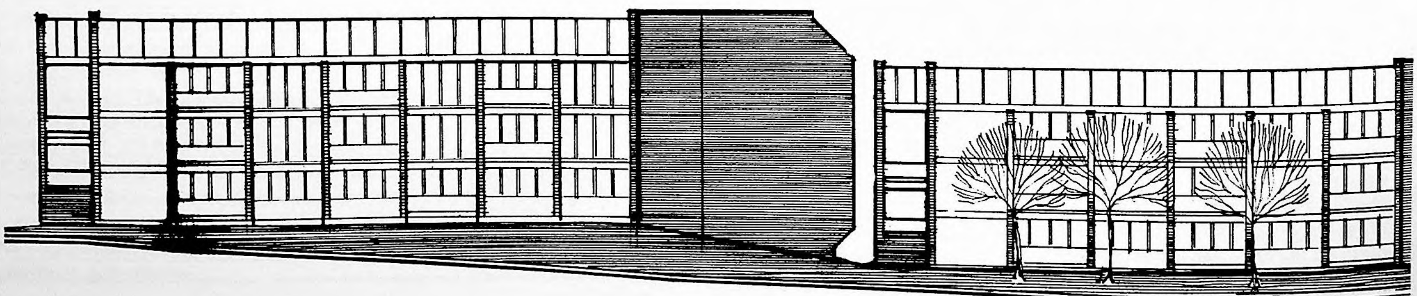
PROPOSER CONSORTIUM

Teeples & Thatcher, Inc., Contractors, Portland, Oregon
Travers/Johnson, Architects and Planners, Portland, Oregon
Thomas R. Mackenzie, Structural Engineer, Portland, Oregon

A combination of load-bearing reinforced concrete block walls and precast reinforced concrete floor panels is the concept offered. The system is erected with readily available materials, by a minimal supervisory crew of three, unskilled labor, and mechanical craftsmen.

Certain features of the proposed system are noted as being innovative or advantageous. For example, doors for the apartments are full height, 7 ft. 11 in., from floor to ceiling, and not only afford an unusual architectural appearance and feeling to the units, but also represent a savings in cost. The use of precast floor panels of standard dimensions delivers surfaces of controlled smoothness, making ceiling finishing a matter of light-texture spray only, and permitting carpeting to be laid directly on the slab without preparation. Back-outlet plumbing fixtures reduce costs of both rough-in plumbing and of installation.

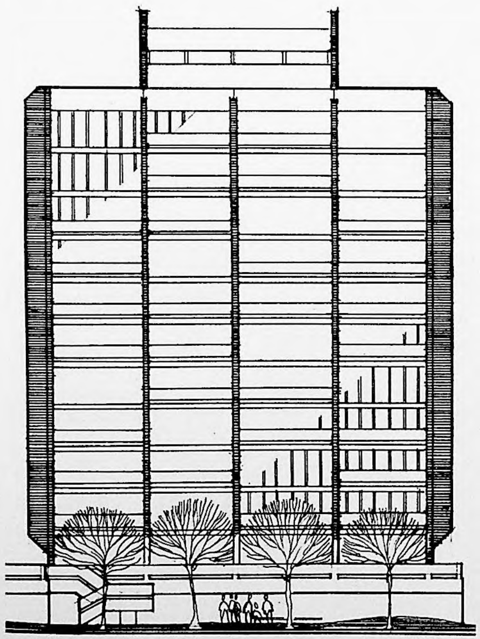
Depending upon topography or soil conditions, the building, set upon its continuous, conventionally designed spread footings, may have a cast-in-place first-floor ground slab, or, if the soil is poor, may use precast panels here too. In this case, the loadings are transferred from the panels to the footings, rather than to the unstable soil.



Roof for apartment structures may be precast panels, similar to the floor units, or steel roof decking may be used, with either covered by built-up roofing. Exterior finish may be a variety of materials, but the use of structural clay brick units is recommended for esthetic considerations and value in savings on maintenance. Balconies, with sand-blasted concrete railings are planned for all living units.

Inside partitions (of metal or wood-stud construction) will be finished with gypsum board or thin-coat plaster covering the inside surfaces of the masonry block. Alternatively, inside finishes may be vinyl coverings, wallpaper, fabrics, or textured surfaces.

The housing system currently is being marketed, primarily in the Northwest, where a motel is being constructed using the panel and block concept. The proposer states that a skeleton crew of four (three supervisory and one office engineer) readily could expand its production (using local labor and subcontractors) to a rate of 500 units a year.



Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	27 TO 117 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	PARKS; GOLF COURSE; SCHOOLS
7 Circulation	PROVISIONS FOR VEHICULAR TRAFFIC
8 Site Planning Services	CONSORTIUM MEMBERS & LOCAL PROFESSIONALS
9 Community Involvement	EVALUATION OF SYSTEM—QUESTIONNAIRES ANSWERED AFTER TOUR OF HOUSE
10 Utilities	UNDERGROUND ELECTRIC SERVICE
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	PRODUCTION PLANT READILY AVAILABLE; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE BLOCK OR CLAY BRICK BEARING WALLS; PRECAST CONCRETE FLOOR & ROOF PANELS
17 Exterior Elements	BALCONIES; PRECAST CONCRETE OR STEEL ROOF DECKING WITH BUILT UP ROOFING
18 Interior Elements	
19 Foundations	CONVENTIONAL; SPREAD FOOTINGS OR SLAB-ON-GROUND
20 Comfort Systems	BASEBOARD HEATING EITHER INDIVIDUAL UNITS OR CENTRAL SYSTEM; AIR CONDITIONING
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL
23 Furnishings	CONVENTIONAL
PRODUCTION	
24 Offsite Production	CONCRETE PANELS MANUFACTURED AT STANDARD PLANTS
25 Onsite Production	
26 Onsite Construction	CONVENTIONAL CONSTRUCTION; FOUNDATIONS
27 Labor	SKILLED; SEMISKILLED; UNSKILLED
28 Labor Training Programs	TRAINING FOR APPRENTICES & UNSKILLED LABOR
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$13.00 PER SQ. FT.
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURE—100 YEARS; PLUMBING & ELECTRICAL WIRING—50 YEARS; ELEVATORS—40 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	COMMUNITY PLANNING; INTERIOR DESIGN; ERECTION; CONSTRUCTION; DESIGN; ENGINEERING
35 External Functions	ELECTRICAL; PLUMBING
36 Market Area	
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Total Development

PROPOSER

Total Development Corporation, Pikeville, Kentucky
Comprehensive Design Colaborative, Pikeville, Kentucky

Onsite assembly of modular panels and other prefabricated components is the concept embodied in the housing system proposed. Although the system could be employed anywhere in the country, it offers its greatest potential in Appalachia. The system was developed in response to the specific needs of low-income dwellers in these mountainous regions where the basic need was for developing economical housing on hillsides previously deemed unusable, leaving the larger, more costly flat areas for industry and commercial facilities. The proposer solves the problems of hillside design by a combination of foundations closely adapted to the topography, without the need for unnecessary movement of earth or for massive retaining walls, and with a structural system that can be transported, erected, and assembled without the need for flat working space and large machinery.

Stepped footings, concrete masonry piers, flat slabs or grade beam designs—any one or a combination of these foundation types—are used for the panelized home structures, leaving the natural topography largely undistrubed. Onto these foundations goes the shell of the system—consisting of self-supporting 4-ft. x 8-ft. exterior panels, plywood box beams (spanning up to 24 ft.) for floor and ceiling support, modular floor and ceiling panels, and roof trusses for fabled roof. (In the case of the rare flab slab on grade, the floor box beams and panels are eliminated.)

For multifamily units, a white cement masonry block bearing wall forms part of the structural system of the housing units, the plywood box beams spanning from wall to wall or wall to exterior panels. This party wall is both a fire wall and a privacy barrier, with reduced sound transmission from unit to unit.

All the components of the modularized system are prefabricated by an assembly-line procedure. The exterior panels typically consist of three studs on 2-ft. centers, 4-ft. top and bottom plates, and 4-ft. x 8-ft. sheathing, the assembly being power-nailed.

Each prefabricated element has been designed for easy handling, lifting, and joining by two men, unassisted by heavy machinery, thus making feasible house erection on steep slopes and uneven topography. The shells of the houses are usually closed-in in one working day, eliminating dependence upon favorable weather.

Contributing to savings are the use of closets which serve also as storage walls and room dividers, and the use of prefabricated staircases. The use of skilled labor onsite has been reduced to a minimum by prefabrication and prefinishing as many components as possible. At present, use of a factory-fabricated plumbing wall is planned, with shipment to the site of a complete bathroom for installation as a unit being contemplated for the future.

Prospective occupants may be employed in erection of the houses, with their salaries being applied as a down payment.

Summary Information

SITE SYSTEM	
1 Site Situation	MOUNTAIN SITES IN APPALACHIA; RURAL; SUBURBAN
2 Density Range	4 TO 15 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO FLAT & STEEP TOPOGRAPHY & TO ALL NORMAL SOIL CONDITIONS
4 Climate	ADAPTABLE TO ALL CLIMATES
5 Planning Concepts	CLUSTER DESIGN; GREENBELTS WEAVING THROUGH CLUSTERS; COMMON OPEN SPACES
6 Nonresidential Functions	PLAY; COMMUNITY MANAGEMENT, & MAINTENANCE AREA
7 Circulation	AS FEW THROUGH ROADS AS PRACTICABLE; RECREATION AREAS CONNECT TO GREENBELTS
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	USER PREFERENCES & TOTAL ENVIRONMENT CONSIDERED
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH, DEVELOPMENT, PROTOTYPE & TESTING
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAME WALL & FLOOR PANELS; PLYWOOD BOX-BEAM FLOOR-FRAMING; ROOF TRUSSES
17 Exterior Elements	
18 Interior Elements	INTERIOR WALL PANELS; PREFABRICATED STAIRS & CLOSET UNITS
19 Foundations	STEPPED FOOTINGS; MASONRY PIERS; SLAB OR GRADE BEAMS; CONCRETE BEARING WALLS
20 Comfort Systems	GAS FORCED AIR HEATING; OPTIONAL UNIT COOLING
21 Plumbing	PREFABRICATED PLUMBING WALLS WHERE POSSIBLE
22 Electrical	CONVENTIONAL; BASEBOARD STRIP FOR PLUG MOLDS
23 Furnishings	
PRODUCTION	
24 Offsite Production	BEARING WALLS; FLOOR BEAMS & PANELS; PLUMBING WALL; ROOF COMPONENTS; STAIRWAY
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ASSEMBLY OF PANELS & COMPONENTS; UTILITY INSTALLATIONS
27 Labor	LOCAL SEMISKILLED & UNSKILLED LABOR
28 Labor Training Programs	TRAINING PROGRAM IN BUILDING TRADES PROPOSED
29 Community Involvement	OCCUPANT CAN APPLY HIS OWN LABOR TOWARD DOWNPAYMENT ON HOUSE
ECONOMICS	
30 Construction Costs	$10,773 PER UNIT ($13.27 PER SQ. FT.); 1,500 UNITS PER YEAR
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	SYSTEM DESIGN; PRODUCTION; CONSTRUCTION
35 External Functions	CONSTRUCTION CONTRACTORS
36 Market Area	PRIMARILY APPALACHIA AREA; ADAPTABLE TO OTHER AREAS
37 Delivery Rate	OPTIMUM 1,500 DWELLING UNITS PER YEAR
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	COMPLIES WITH ALL CODES

Townland

PROPOSER

Townland Marketing and Development Corporation, Cherry Hill, New Jersey (Formerly, Keene Corporation, New York, New York).

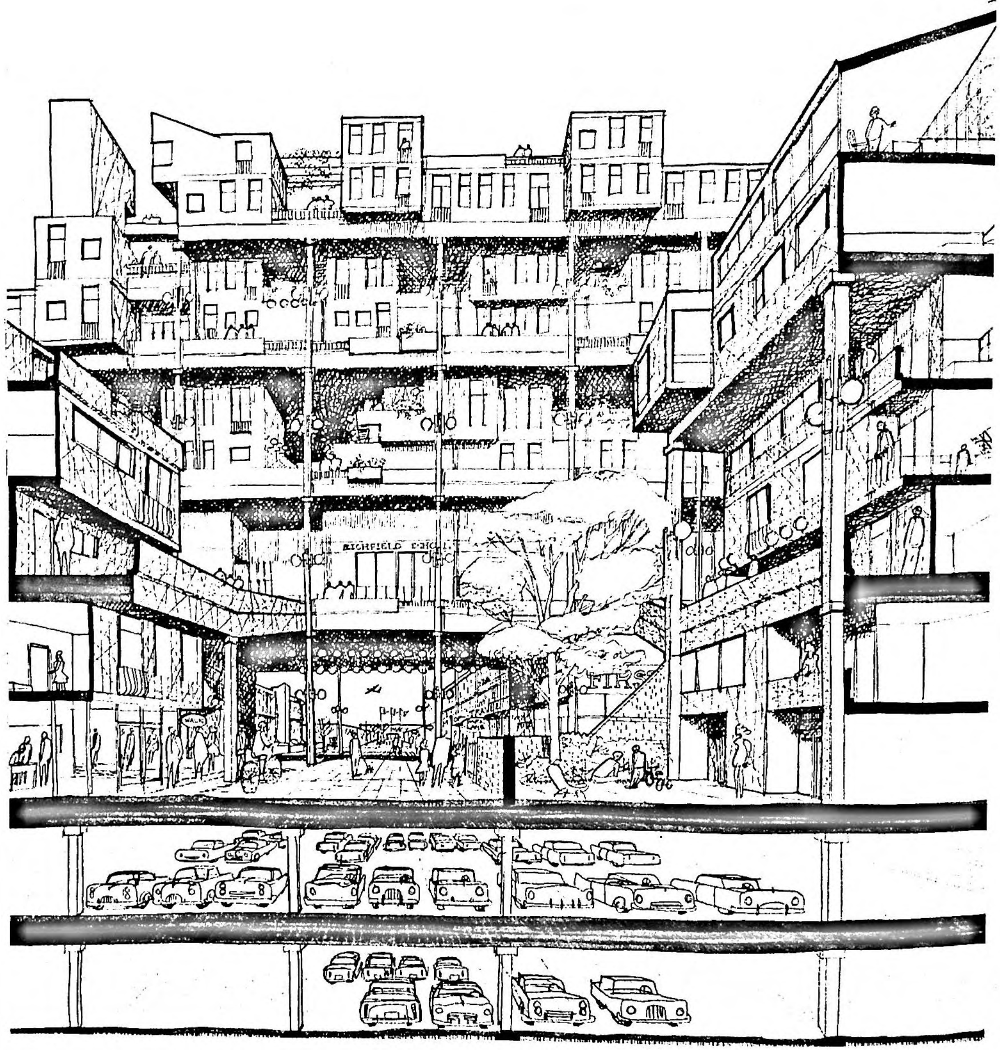
AFFILIATES:

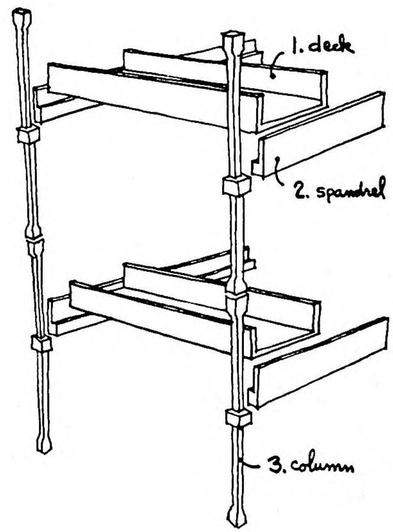
Keene Corporation, Manufacturing; Alvin E. Gershen Associates, Planning and Zoning; Robert Hughes Associates Corporation, Project Managers and Cost Engineers; Lennox Industries, Inc., Manufacturers; Node 4 Associates; Ryan, Inc. of Wisconsin, Earth Movers and Road Builders; Warner, Burns, Toan & Lunde, Architects; Wickes Corporation, Manufacturers; 3H Building Corporation, Builders and Developers; Portland Cement Association, Research and Development; Grumman Corporation, Designers and Manufacturers; Formigli Corporation, Manufacturers.

Actual creation of urban land—as a series of tiers to heights of up to 150 ft. above the basic lot—on which three-story individual homes, townhouses, or apartments, public streets, and other amenities can be placed, is the concept of this proposal.

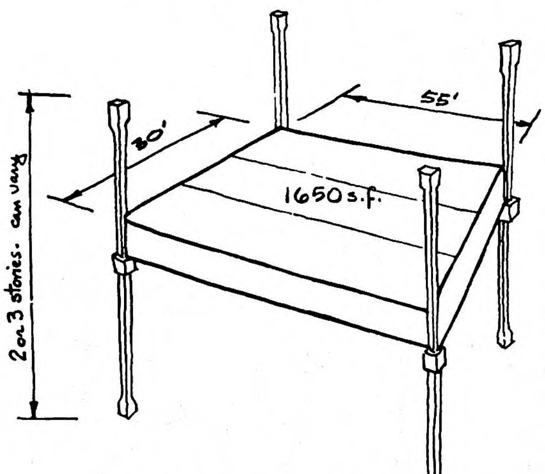
The system is particularly adaptable to narrow city lots and to full utilization of air rights; but it is also adaptable to new town developments of relatively low-rise housing complexes achieving considerable density without occupying large land areas. An added advantage in urban renewal situations is that the structure can be built on lots adjoining areas to be razed or replaced, or even straddling rundown structures to be demolished. Hence, residents need not be displaced, or need only to move a relatively short distance while the renewal program continues. A volume production of from 810 to 5,400 dwelling units per year is considered feasible for this completely developed system.

The concept includes two distinct subsystems: (1) The supported land system, which is the actual structural framework that supports the streets and homes as they rise above ground level, carries all normal utilities, and may include amenities such as park areas, swimming pools, or other public spaces; and





Precast Structural Members



Land Module Grid

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; URBAN RENEWAL; NEW TOWNS
2 Density Range	50 TO 100 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NORMAL CLIMATES
5 Planning Concepts	"SYNTHETIC LAND"; SUPPORTED LAND SYSTEM (SLS); UTILIZATION OF AIR RIGHTS
6 Nonresidential Functions	RECREATIONAL, SOCIAL, & COMMERCIAL FACILITIES
7 Circulation	SEPARATE VEHICULAR TRAFFIC; HIGHWAY ACCESS ROAD; ELEVATED PEDESTRIAN WALKS
8 Site Planning Services	AFFILIATE OF PROPOSER ORGANIZATION
9 Community Involvement	INVOLVES COMMUNITY IN SHAPING ENVIRONMENT
10 Utilities	INCORPORATED IN STREET PANEL SYSTEM; STREET UTILITY CORES

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
15 Community Involvement	INVOLVES COMMUNITY IN SHAPING ENVIRONMENT

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE FRAME & STREET PANELS; DWELLING UNIT: WALL & FLOOR PANELS
17 Exterior Elements	WALL PANELS, CONVENTIONAL FINISHES; PRECAST CONCRETE DECK ELEMENTS; BALCONIES
18 Interior Elements	METAL-FRAME WALL PANELS; CONVENTIONAL FINISHES; MECHANICAL/ELECTRICAL CORE UNITS
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS WARM AIR SYSTEM INCLUDED IN CORE UNIT; INTEGRATED COOLING OPTIONAL
21 Plumbing	FACTORY-FABRICATED PLUMBING TREE IN MECHANICAL WALL OF CORE UNIT
22 Electrical	CONVENTIONAL, INTEGRATED WITH BUILDING SYSTEM; MASTER TELEVISION ANTENNA
23 Furnishings	MOVABLE CLOSETS; BEDWALL; OTHER PREFINISHED COMPONENTS

PRODUCTION

24 Offsite Production	CONCRETE FRAME COMPONENTS; WALL & FLOOR PANELS; MECHANICAL/ELECTRICAL CORE UNITS
25 Onsite Production	CONCRETE FRAME COMPONENTS (OPTIONAL)
26 Onsite Construction	ASSEMBLY & ERECTION OF FRAME & DWELLING UNITS; FOUNDATIONS; CONNECTIONS
27 Labor	
28 Labor Training Programs	5-YEAR TRAINING PLAN TO ESTABLISH NEW SKILLS
29 Community Involvement	SELF-HELP

ECONOMICS

30 Construction Costs	$6,116 PER ($4.25 PER SQ. FT.), STRUCTURAL UNIT
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURE—100 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	SYSTEM DESIGN; MANAGEMENT; PRODUCTION
35 External Functions	ARCHITECTURAL DESIGN; LAND PLANNING; CONSTRUCTION & ERECTION
36 Market Area	
37 Delivery Rate	810 TO 5,400 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CORES

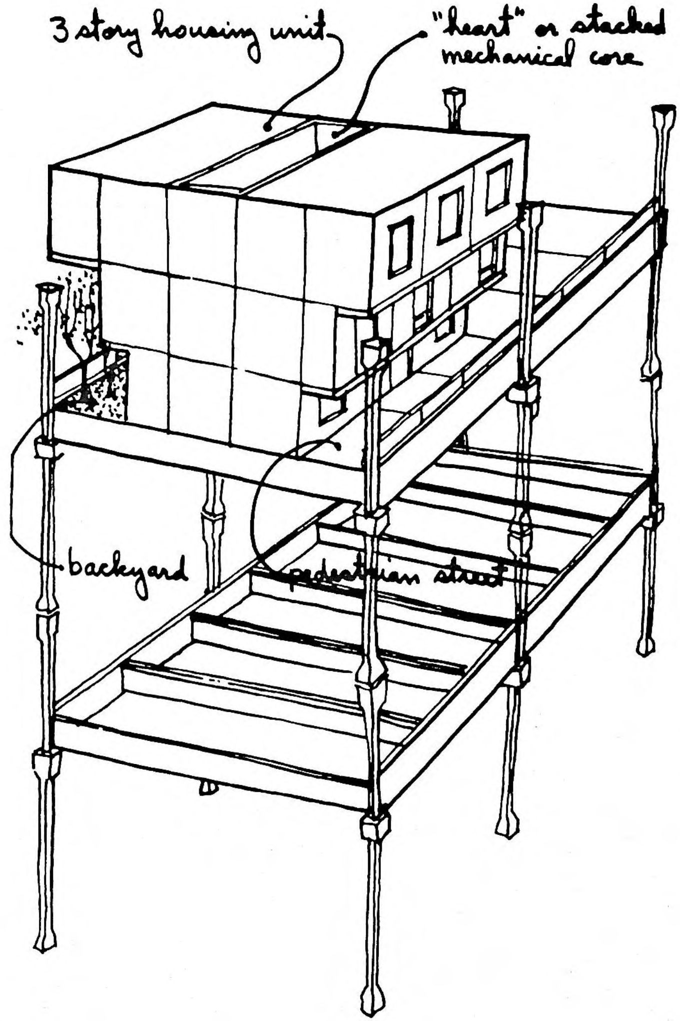
Townland (continued)

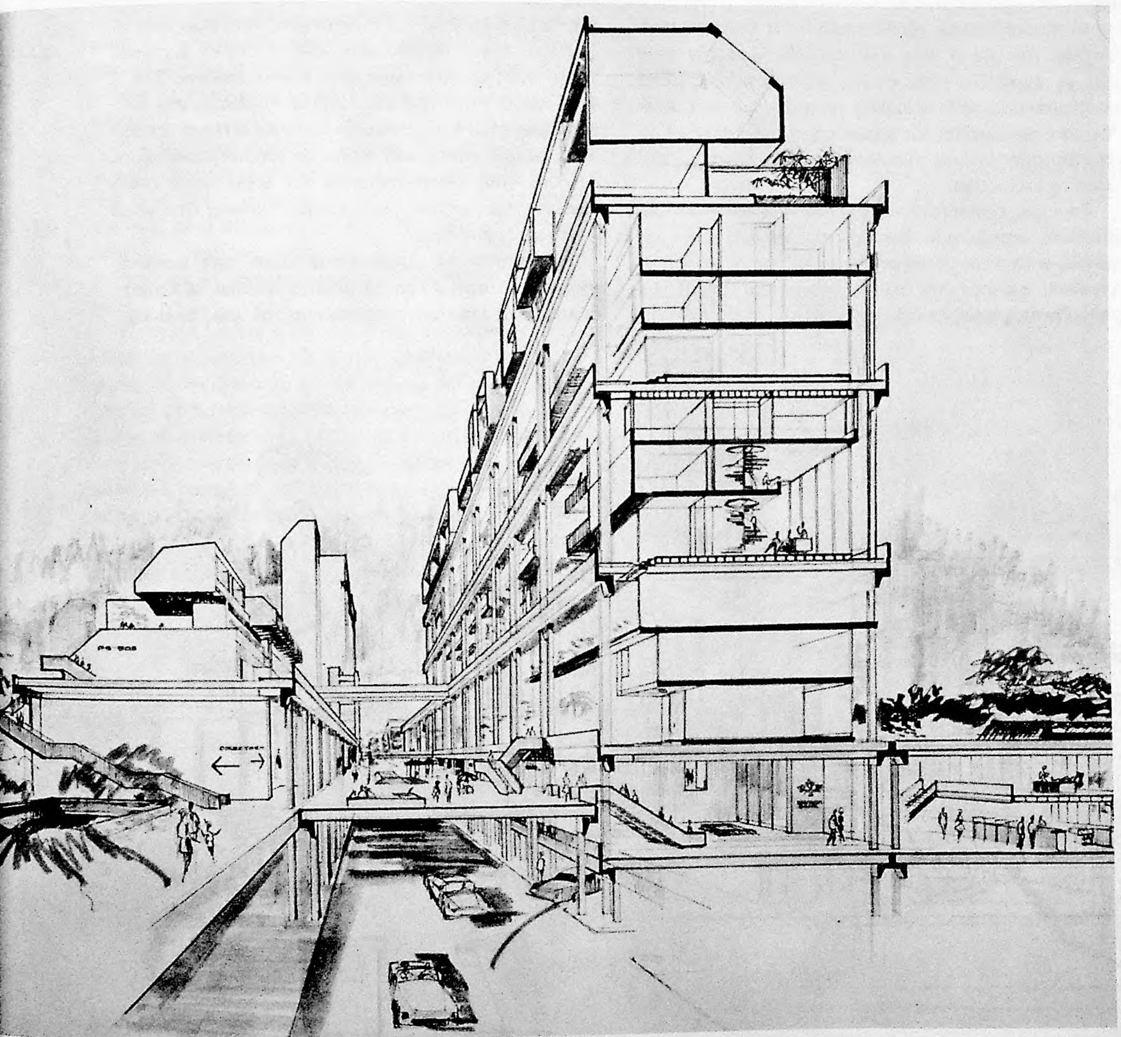
(2) The three-story homes that are placed on the tiers supported by the structural system. These are panel constructed and designed to allow each owner or occupant a front and back yard, which can include tree and shrub planting. By offsetting the various floors of the three-story dwellings, space can be gained at the street level for a private back or front yard, and balconies and other elements can be added to upper floors to enhance the outdoors effect.

The supported land system consists of columns of standard cross section connecting with spandrel beams at two- or three-story intervals, with deck units that make up both the streets and the foundations for the housing. The effect is to create concrete grids enclosing open multistory spaces. All concrete used is precast, prestressed, and mass-produced either in an offsite or onsite plant.

Deck elements, each 10 ft. wide x 3 ft. deep x 55 ft. long, are made up of standard U-shaped sections with a 4-in. slab at bottom and 9-in. thick webs at each side. Lightweight concrete is used to hold down maximum erection weight. Spandrel elements are L-shaped concrete members, spanning 30 ft. and shaped to receive deck elements with adequate seating and to allow space for a mechanical supply package that contains utilities. The columns themselves are square sections, centered on the grid lines of the modular system, with bearing elements designed to receive spandrel or deck units located 1 in. off the grid line to permit any desired extension of the system. Column splices are placed near the point of minimum bending stress; all compression connections are made by steel plates bearing on steel plates; all tension connections are made with high-strength bolts or prestressed rods. After erection, all joints are filled with an expansive cement grout, so that the system becomes monolithic upon completion.

Elevators, stairs, and mechanical shafts utilize the floor deck components as wall elements—with special





stair and slab elements added as required. House units placed on these decks or tiers are built around a core unit, 12 ft. x 15 ft. or 12 ft. x 20 ft. (depending on the size of the dwelling), which includes a steel stairway with a choice of various finishes; the heating unit, air-conditioning ductwork, vertical utilities run, ano the kitchen (with factory-assembled cabinetry, connections for choice of appliances, finish flooring and base, and raceways for electrical wiring and appliances).

Exterior panels for the units are based on a channel system, spaced as required to achieve floor-bearing capacity and rigidity, with welded headers, runners, and openings for windows and doors. The panels are backed with an noncombustible, sound-deadening material (rigid board or loose, waterproof mineral insulation), with a layer of gypsum board which may be finished to suit the owner's taste. The exterior of the panels can also be finished with a variety of factory-applied materials. The panels contain all electrical raceways and boxes for field wiring.

Interior partition panels are of lighter gauge framing, with gypsum board on both sides and sound-deadening insulation—and also contain all required electrical raceways. Floor panels are also of steel framing, with fireproof and sound-deadening backing, anchored to wall panels by factory-applied metal bearing plates. Finish can be a variety of materials, ranging from hardwood to carpeting to vinyl tile above a metal, wood, or plastic subfloor.

The street itself will contain precast concrete panels for total access to utilities within the structural frame, will carry distinctive surfacing (brick, paving block, concrete, stone), will incorporate snow-melting equipment where required, and will carry needed rails and parapets.

The supported land system itself will carry all utilities, much as city streets do in conventional patterns, but some special additions are necessary for such considerations and venting of appliances, heating and cooling devices (each house will have its own unit). Subsystems such as plumbing will be totally factory-fabricated, requiring a minimal amount of field labor for interconnections.

Transamerica

PROPOSER CONSORTIUM

Transamerica Corporation, San Francisco, California
Transamerica Development Corporation, San Francisco, California
Bankers Mortgage Company, San Francisco, California
Transamerica Research Corporation, San Francisco, California

AFFILIATES

City Planning Associates, Inc., Site Planning; First Community Development Corporation, Project Management; John T. Law Associates, Architectural Services; T. R. Arnold Associates, Production Management

Factory-built, plywood modules that can be assembled into single-family and multifamily low-rise (with addition of a structural frame) dwellings form the concept for this proposed system.

Basic module length is 36 ft., and modules can be stacked to three stories in height without added structural support. Over three stories, a site-constructed precast concrete frame is contemplated, and in this case, the modules are to be built with a lightweight concrete floor system, so that the entire module can be lifted (or rolled) into the frame.

A special feature of the modules is the fact that, through the use of accessory and filler elements, they can be assembled into atrium, courtyard, and other configurations, with a variety of roof lines and other features. Accessories for expansion or individualization of the units include fireplaces, privacy fencing, and opening protection.

Principal components of the modules are plywood, grid-core stressed-skin floor panels, stressed-skin roof panels, with walls of either standard framing or also of plywood stressed-skin panels. When assembled, the modules are placed on light steel beams, which then act as principal support over conventional foundations.

In detail, the floor is a series of grid-core panels, made up of a top skin of 5/8-in. plywood, a 2-in. x 6-in. stringer as a frame, 3/8-in. plywood ribs running diagonally, fiberglass batt insulation with vapor barrier on the inside surface, and a bottom skin of 3/8-in. plywood. Roof panels have a top surface of 3/8-in. plywood over 2-in. x 3-in. stringers, fiberglass batt insulation, and a bottom skin also of 3/8-in. plywood. Walls, built on jigs, have 4-in. x 4-in. headers, 2-in. x 4-in. wood studs and sills, similar insulation and interior faces of 1/4-in. plywood. Exterior surfaces are also of plywood, which can either be specially treated, or overlaid with other materials for appearance. Resin coatings are applied to exterior surfaces for good weathering qualities.

Particularly in single-family units and condominiums, the owner can be given a number of options relative to interior appointments of the dwelling–

selection of interior cabinet styles, wall finishes, colors, and fiberglass bathroom wall panels and fixtures.

Basic heating and ventilating system is planned as a warm air system, using a variety of possible fuels, with a furred-down space in the sloping roof of the single-family, one-story module serving as a heating duct and location for registers. Air conditioning and ventilating could also be handled in the same manner, using conventional units now available. A major advantage is that all ducting is of manufactured wood components, so that no sheetmetal work is involved in the building process.

The plumbing system is preassembled, utilizing PVC or ABS pipe wherever acceptable, with plumbing waste and vent piping installed in an accessible chase, or in the rear of a closet to provide for easy connection between modules, and for inspection. Tubs and showers are of one-piece molded fiberglass, as are lavatories.

Electrical wiring is carried in surface-mounted raceways, an innovation being the delivery of electrical power at the juncture of the ceiling and wall on the interior of the module—the raceway, additionally, providing an architectural accent as well as a convenient way to handle the system. This raceway is continuous with the header at the top of the wall—and a lighting soffit is also attached to provide the indirect lighting.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	6.2 TO 37 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ESPECIALLY SUITABLE FOR SOUTH-WESTERN CLIMATE
5	Planning Concepts	OPEN COURT; CLUSTER
6	Nonresidential Functions	COMMON OPEN SPACES; PLAY AREAS; PARK AREAS; EDUCATIONAL FACILITIES
7	Circulation	SEPARATE VEHICULAR TRAFFIC; CUL-DE-SACS; WALKWAYS; UNDERPASSES/OVERPASSES
8	Site Planning Services	CONCEPT REVIEW BY SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	
10	Utilities	UNDERGROUND WIRING

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	EFFICIENCY; 1, 3 TO 5 BEDROOMS
13	Design Selection	SELECTION FROM STANDARD PLANS
14	State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	STRESSED-SKIN PLYWOOD PANEL VOLUMETRIC MODULES; PRECAST CONCRETE FRAME FOR HIGH-RISE
17	Exterior Elements	PORCHES; SUN SCREENS; ATRIA; SHED ROOF
18	Interior Elements	
19	Foundations	CONVENTIONAL FOUNDATIONS; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20	Comfort Systems	GAS OR ELECTRIC HEATING SYSTEM FOR INDIVIDUAL DWELLING UNITS
21	Plumbing	CONVENTIONAL; PVC OR ABS PIPING INTEGRATED IN WALL PANELS; FIBERGLASS FIXTURES
22	Electrical	CONVENTIONAL; INTEGRATED WITH MODULES AT THE FACTORY
23	Furnishings	

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES
25	Onsite Production	
26	Onsite Construction	FOUNDATIONS; PLACING OF MODULES; ERECTION OF PRECAST CONCRETE FRAMES
27	Labor	UNSKILLED IN FACTORY
28	Labor Training Programs	ON-THE-JOB TRAINING
29	Community Involvement	LOCAL CONTRACTORS; LOCAL LABOR

ECONOMICS

30	Construction Costs	$14,390 PER UNIT FOR MULTIFAMILY LOW-RISE ($8.50 PER SQ. FT.)
31	Financing Methods	
32	Useful Life	STRUCTURAL SYSTEM—50 TO 60 YEARS; ELECTRICAL SYSTEM—40 YEARS

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	MANAGEMENT; LAND DEVELOPMENT; FINANCING; MARKET RESEARCH
35	External Functions	ARCHITECTURAL DESIGN; PRODUCTION
36	Market Area	200- TO 500-MILE RADIUS OF FACTORY
37	Delivery Rate	
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	

Unit Homes, Inc.

PROPOSER CONSORTIUM

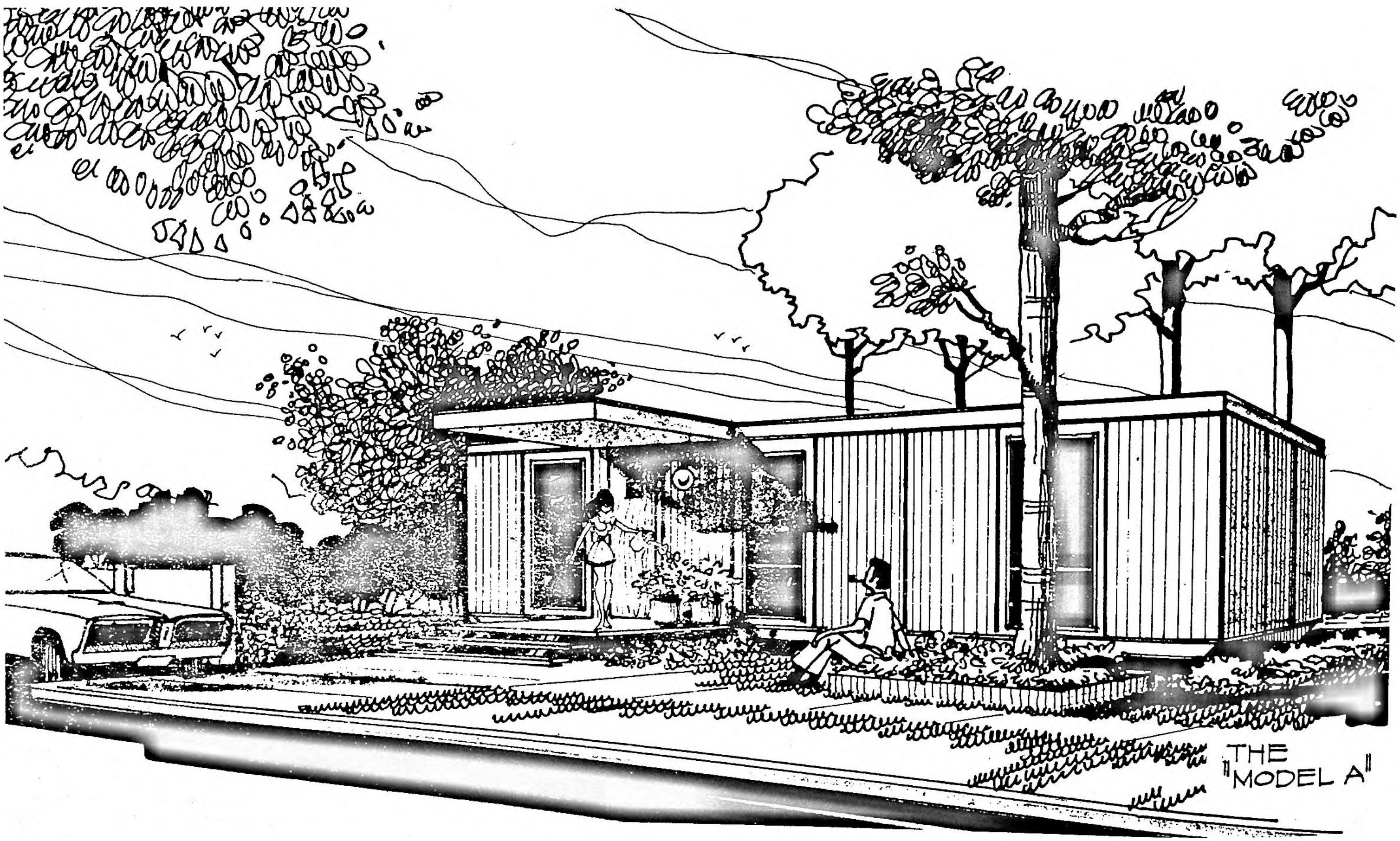
Unit Homes, Inc., Management, Houston, Texas
T. Leo Dawsey, Architects, Houston, Texas
Robert E. Wilson, Construction, Houston, Texas
Cecil Lott, Real Estate Broker, Houston, Texas
L. A. Hill, Jr., Finance, Houston, Texas

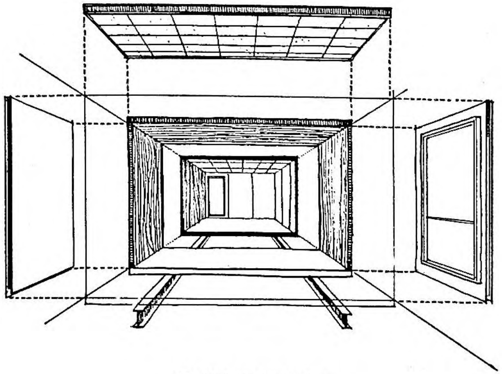
This system employs a 4-ft.-wide, 2-in.-thick foam-filled wood panel as the basic structural unit. These are stressed-skin plywood components with polyurethane filler, factory-produced in lengths of 8 ft., 12 ft., or 16 ft. The proposer describes them as studless, thin walls. Similar panels are used for roof and floor construction; all are manufactured on a 2-in. X 4-in. wood-stud subframe.

Units constructed from these basic panels can be erected on six foundation piers on rough, ungraded terrain or can be stacked in a skeletal frame for high-rise adaptation. The single-family units are easily relocatable.

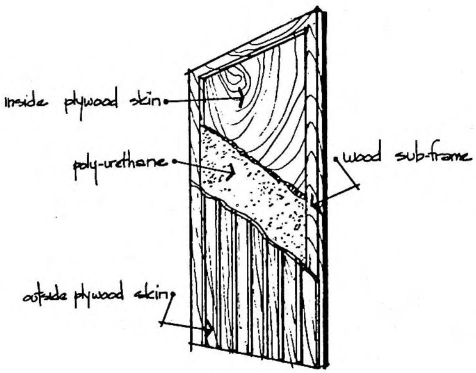
Interior finish is plywood paneling with ceilings covered with coated acoustical tile. Exterior application is redwood or cedar siding over the wall panels; silicone rubber is applied to the roof panels.

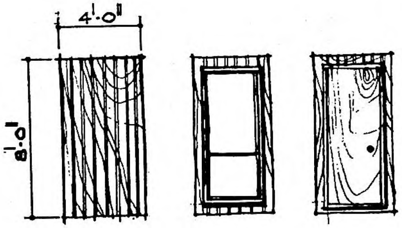
All mechanical and electrical systems are built into the panels at the plant for easy field connections.





PANELIZATION DIAGRAM





THE BASIC PANELS

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	48 TO 56 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION; SIDEWALKS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 2 BEDROOM
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STRESSED-SKIN, PLYWOOD & WOOD-FRAME, FLOOR, WALL & ROOF PANELS; HIGH-RISE FRAME
17 Exterior Elements	SILICONE RUBBER ROOFING; REDWOOD OR CEDAR SIDING
18 Interior Elements	MECHANICAL MODULES; PREFABRICATED PLYWOOD PARTITIONS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	DWELLING UNIT HEATING/COOLING SYSTEM; INTEGRATED WITH BUILDING SYSTEM
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL, ROOF & FLOOR PANELS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF PANELS; UTILITY HOOK-UPS
27 Labor	UNSKILLED AND SEMISKILLED AT FACTORY & ONSITE
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS

ECONOMICS

30 Construction Costs	$10.00 PER.SQ. FT.
31 Financing Methods	PARTIAL PROPOSER SUPPLIED
32 Useful Life	STRUCTURAL SYSTEM—30 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT
35 External Functions	ARCHITECTURAL DESIGN; CONSTRUCTION; FINANCING
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

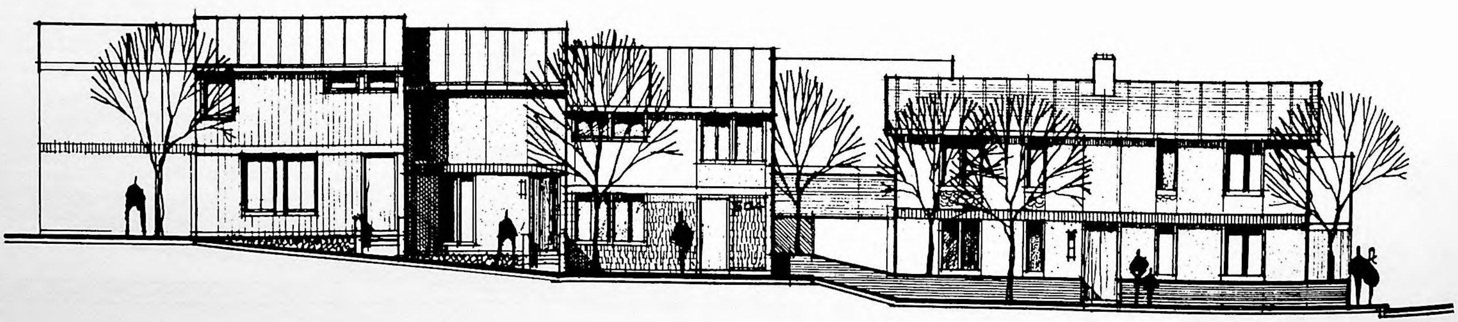
United States Steel

PROPOSER

United States Steel Corporation, Pittsburgh, Pennsylvania

Completely panelized—using a steel-stud reinforced wood frame—and erected by nearly conventional nailing wherever possible, this system is particularly directed toward single-family residences of almost any size and appearance, and multifamily low-rise dwelling units. It is anticipated that a volume production rate of 2,000 units per can be maintained for this system.

Key to the system is the exterior panel construction: either 4 ft. x 8 ft. or 4 ft. x 10 ft. in standard sizes (though longer wall units can be fabricated), they are compatible with conventional 2-in. x 4-in. construction, with the exception that they contain 18-gauge galvanized steel studs interspersed with the wood studs, to give greater strength as bearing walls, and to reduce the possibility of flexing, creeping or other disturbance of dimensional stability. An epoxy adhesive firmly attaches interior gypsum board skins to the metal studs, physically strengthening the board itself and eliminating the danger of nailpopping. These exterior panels thus have an actual steel frame which consists of two edge and one intermediate steel stud, and top and bottom steel rails. This frame is attached to a high-density, nail-base fiberboard by means of steel barbs on the frames. Either 2 in. or 4 in. of fiberglass insulation is inserted between the studs. Interior panels are of similar, but lighter construction.



Panels that are to contain doors and windows are fabricated in the same manner, with wood-framed rough openings to receive the door or window unit. Fiberboard is installed on both interior and exterior faces (in load-bearing walls, a header is placed over the window or door). Exterior finish may be lapped steel or aluminum siding, laminated plywood, or site-added veneer, if desired.

Roof trusses are jig-assembled from precut lumber and secured with gang-nail galvanized steel plates. Gable wall units and gable-end roof overhang construction extending from eave to peak are shop-fabricated, also of wood components. Bathroom and kitchen service walls are factory-fabricated wherever codes permit, with all plumbing and other services included for quick and simple onsite hookups.

Foundations are normally slab-on-ground to which nailing strips are fixed for attachment of the wall panels.

The panels are shipped, complete to the last nail and finishing detail, to builders for quick erection. Exterior doors are steel, factory-assembled (with foam cores) and magnetic weather seals; factory-glazed, single-hung aluminum windows are also installed; prepainted, steel-clad wood sills are included to eliminate warping and maintenance costs.

Conventional flooring is installed onsite; normally a 1/2-in. plywood subfloor can be finished with any desired flooring material, ranging from oak to carpeting. Ceiling material is gypsum board, secured so that the long dimension is at right angles to the bottom chord of the trussed rafters; ceiling insulation (also installed onsite) is 2-in. or 4-in. mineral wool, with an impregnated paper vapor barrier.

Heating systems may be gas-fired, forced-air, field-installed, or electric baseboard units, which can be factory-wired and mounted on panels. Provision for air conditioning units and ductwork can be included with the heating system. Since the proposer does not consider it practical to install electrical systems in the panels at the factory, electrical distribution systems are installed overhead, and "fish" wires are placed in panels containing more than 2 in. of insulation during factory fabrication, to permit easy wiring of outlets after the home has been assembled. Wood plates at the top of panels are prepunched at fish-wire locations; outlets are installed after walls are assembled.

Summary Information

SITE SYSTEM		
1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	8 TO 24 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTERS; COMMON OPEN SPACES
6	Nonresidential Functions	TOT LOTS; PLAY AREAS; ACTIVITY & RECREATION COURTS; COMMUNITY FACILITIES
7	Circulation	SEPARATE VEHICULAR CIRCULATION; CUL-DE-SACS; SUPER BLOCK; STREET GRID
8	Site Planning Services	PROPOSER'S LAND PLANNING CONSULTANT
9	Community Involvement	SURVEY OF USER NEEDS; COMMUNITY GROUPS TO BE INVOLVED IN PLANNING
10	Utilities	CONVENTIONAL
BUILDING SYSTEMS		
11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	1 TO 4 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15	Community Involvement	SURVEY OF USER NEEDS & APPLICATION OF NEEDS TO BUILDING SYSTEM
BUILDING SUBSYSTEMS		
16	Structure	STEEL & WOOD FRAME PANELS (FIBERBOARD & GYPSUM BOARD FACED); WOOD ROOF TRUSSES
17	Exterior Elements	OPTIONAL STEEL, ALUMINUM, WOOD SIDING OR BRICK VENEER; STEEL SOFFIT & FASCIA
18	Interior Elements	STEEL OR WOOD STUD GYPSUM BOARD PARTITIONS; STAIR ASSEMBLIES
19	Foundations	CONVENTIONAL SLAB-ON-GROUND
20	Comfort Systems	GAS FORCED AIR OR ELECTRIC BASEBOARD HEATING, INTEGRATED COOLING
21	Plumbing	INTEGRATED WITH BUILDING SUBSYSTEMS; OPTIONAL CONVENTIONAL INSTALLATIONS
22	Electrical	CONVENTIONAL
23	Furnishings	
PRODUCTION		
24	Offsite Production	WALL & PARTITION PANELS; ROOF TRUSSES; STAIR ASSEMBLIES; PLUMBING WALLS
25	Onsite Production	OPTIONAL ONSITE PANEL PRODUCTION PLANTS
26	Onsite Construction	FOUNDATIONS; PANEL & ROOF ERECTION; MECHANICAL HOOK-UPS OR INSTALLATIONS
27	Labor	5% SKILLED; UNSKILLED & SEMISKILLED LABOR FOR PLANT PRODUCTION
28	Labor Training Programs	PLANT PRODUCTION TRAINING PROGRAM
29	Community Involvement	LOCAL CONTRACTORS; OCCUPANT EMPLOYMENT IN PRODUCTION PLANTS
ECONOMICS		
30	Construction Costs	$7,590 TO $12,935 PER DWELLING UNIT FOR 2,000 PER YEAR
31	Financing Methods	
32	Useful Life	RANGE & REFRIGERATOR—20 YEARS; WATER HEATER—10 YEARS; EXTERIOR PAINT—15 YEARS;
MANAGEMENT		
33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT; RESEARCH; DESIGN & ENGINEERING; PRODUCTION; CONSTRUCTION; MARKETING
35	External Functions	ARCHITECTURAL, LAND PLANNING; USER NEEDS SURVEYS
36	Market Area	NATIONAL
37	Delivery Rate	2,000 DWELLING UNITS PER YEAR
38	Consumer Protection	
GENERAL		
39	Major Innovative Concepts	PANEL BUILDING SYSTEM; POSSIBLE ONSITE CONVERSION TO COMMUNITY FACILITIES
40	Codes	GENERALLY ADAPTABLE TO ALL NATIONAL MODEL CODES

United States Steel

PROPOSER

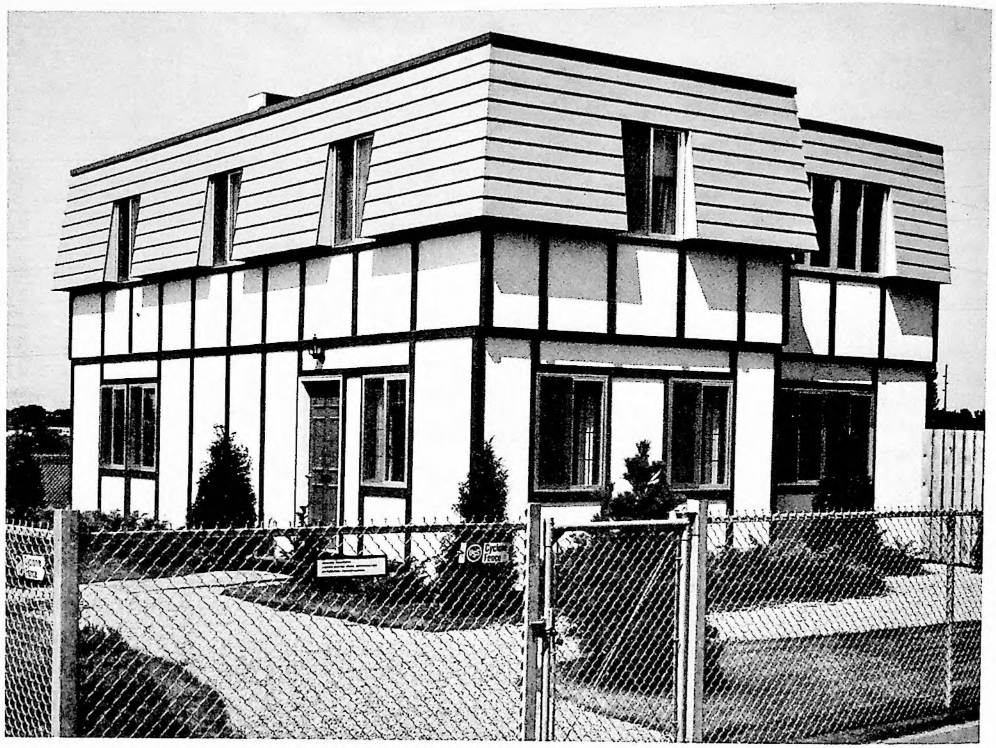
United States Steel Corporation, Pittsburgh, Pennsylvania

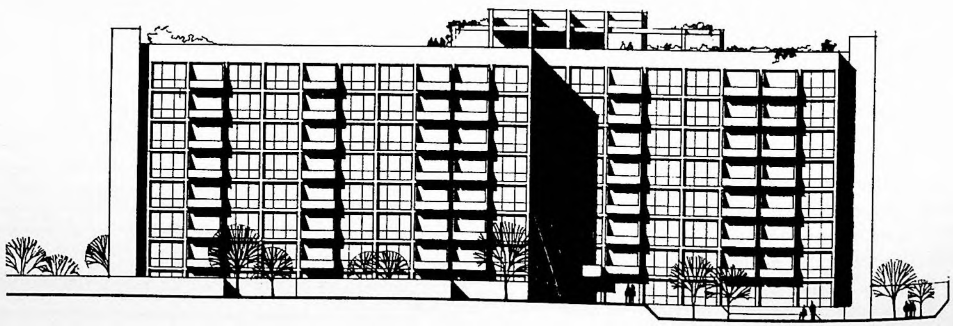
A steel-framed module that can be combined into numerous configurations to provide variety in appearance and accommodations is the concept of the housing scheme proposed. The system is adaptable to single-family, multi-family low-rise, and high-rise buildings of up to 10 stories, with almost innumerable possible variations. The system also can be used for construction of ancillary structures such as communal laundries and recreation areas. The proposer indicates an optimum production rate of 2,000 units per year, with distrubiton on a national basis.

Basic to the system is a 12-ft.-wide box module varying in lengths up to 38 ft. 2 in., as completely factory-finished as possible, including plumbing, wiring, wall and floor finishes.

The module of monocoque-like, noncombustible construction is completely framed in cold-formed galvanized steel structural members, with gypsum products used for the shell and weather enclosure. Wall studs and ceiling joists are 3 1/8-in. x 1 3/4-in. x 1/2-in. steelmembers; floor and roof joists are 6 in. x 2 in.; floor perimeter beams, ceiling perimeter beams, door and window studs, partition studs, and all other members are also of steel of varying sizes. Roof decking is 1/2-in. plywood; subflooring is 5/8-in. shiplap plywood underlayed with 1/2-in. gypsum board providing sound isolation and fire resistance; interior walls, roof gable ends, and outer sheathing are of gypsum board. Final exterior finish can be of many materials, to satisfy architectural requirements.

An advantage of the module's all-steel framing is the fact that wall penetration and fenestration layouts are actually limitless, since locations are not restricted by structural considerations. The long walls of the modules are load-bearing—unless beams and columns are added to allow larger openings between modules. High-rise structures can be assembled using the basic module, with the addition of a separate steel structural frame which can be partially assembled before erec-





tion. Modules can be placed on almost any type of conventional foundation.

Interior partitions are of steel studs and gypsum board and can be reinforced at more damage-prone areas with prefinished plywood laminated to the gypsum board for additional resistance while still providing an easily maintained surface. Living areas and bedrooms are carpeted, and all other areas are surfaced with seamless, cushioned vinyl flooring. Interior walls can be painted or covered with seamless vinyl; and for two- and three-story units interior stairs are steel risers with precast concrete treads.

Modules are prepiped and can be adapted to any appropriate equipment for heating, cooling, ventilating, electrical and other services. Though the modules are adaptable to other systems, the proposer favors an electric radiant heating system; and installation of all mechanical equipment at the factory can save considerable work at the site.

There is little provision for self-help operations, on the grounds that areas in which homeowner skills are sufficiently present—such as painting and decorating—can make little real difference in cost.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2	Density Range	8 TO 100 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	CLUSTERS; URBAN BLOCK IN-FILL & EXPANSION; CYCLED BLOCK RESTRUCTURING
6	Nonresidential Functions	TOT LOTS; PLAY AREAS; SCHOOLS; SOCIAL SERVICE & SHOPPING FACILITIES; CHURCHES
7	Circulation	SEPARATE VEHICULAR CIRCULATION; STREET GRID; SUPER BLOCK: WALKING PATHS
8	Site Planning Services	LAND PLANNING CONSULTANT THROUGH PROPOSER
9	Community Involvement	SURVEY OF USER NEEDS & LOCAL DEMOGRAPHIC DATA
10	Utilities	CONVENTIONAL

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12	Unit Variations	EFFICIENCY; 1 TO 4 BEDROOMS
13	Design Selection	FLEXIBLE
14	State of Development	BUILDING SYSTEM & PRODUCTION FACILITIES—DESIGN STAGE
15	Community Involvement	USER EVALUATION OF PROTOTYPE

BUILDING SUBSYSTEMS

16	Structure	STEEL FRAME & GYPSUM BOARD SELF-SUPPORTED VOLUMETRIC MODULE; FRAME FOR HIGH-RISE
17	Exterior Elements	CONVENTIONAL FINISHES
18	Interior Elements	STEEL STUD GYPSUM BOARD PARTITIONS; STEEL RISER & CONCRETE TREAD STAIRS
19	Foundations	CONVENTIONAL
20	Comfort Systems	CONVENTIONAL SYSTEMS INTEGRATED IN MODULES; OPTIONAL ELECTRICAL RADIANT HEATING
21	Plumbing	KITCHEN, BATHROOM, LAUNDRY EQUIPMENT INTEGRATED IN MODULE
22	Electrical	INTEGRATED IN MODULE
23	Furnishings	

PRODUCTION

24	Offsite Production	VOLUMETRIC MODULES; HIGH-RISE FRAME MEMBERS
25	Onsite Production	VOLUMETRIC MODULES; HIGH-RISE FRAME MEMBERS
26	Onsite Construction	FOUNDATIONS; PLACING & JOINING MODULES; HIGH-RISE FRAME ERECTION
27	Labor	UNSKILLED, SEMISKILLED & SKILLED FOR PRODUCTION & CONSTRUCTION
28	Labor Training Programs	PROPOSER'S ON-THE-JOB TRAINING FOR UNSKILLED & SEMISKILLED
29	Community Involvement	LOCAL CONTRACTORS & COMMUNITY WORKERS; SURVEY OF EFFECTIVENESS

ECONOMICS

30	Construction Costs	$8,257 TO $11,900 PER UNIT, 2,000 UNITS PER YEAR (BEST RATE)
31	Financing Methods	
32	Useful Life	RANGE, REFRIGERATOR—20 YEARS; HOTWATER HEATER—10 YEARS; EXTERIOR PAINT—15 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT; RESEARCH; DESIGN & ENGINEERING; PRODUCTION; CONSTRUCTION; MARKETING
35	External Functions	ARCHITECTURAL; LAND PLANNING; USER NEEDS SURVEYS
36	Market Area	NATIONAL
37	Delivery Rate	2,000 DWELLING UNITS PER YEAR PER PLANT, OPTIMUM
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	GENERALLY ADAPTABLE TO ALL NATIONAL MODEL CODES

Urban Systems Development

PROPOSER

Urban Systems Development Corporation, Planning and Coordinating, Arlington, Virginia

AFFILIATES

Hellmuth, Obata, Kassabaum Inc., Architectural Design; William Tao and Associates, Engineering; Westinghouse Electric Corporation; National Urban League

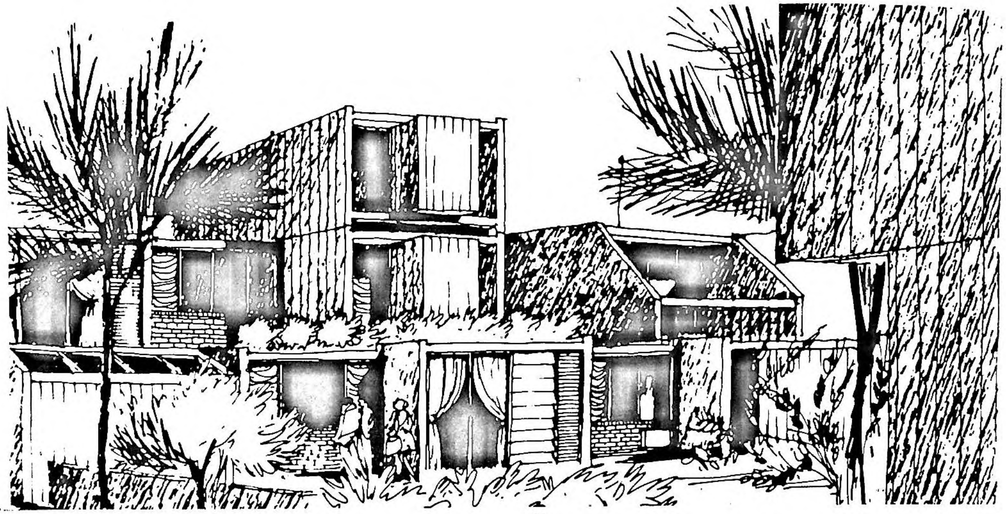
Precast concrete modular units that utilize a sprayed-on concreting technique to produce relatively thin, thus lightweight wall sections are the basis for this system.

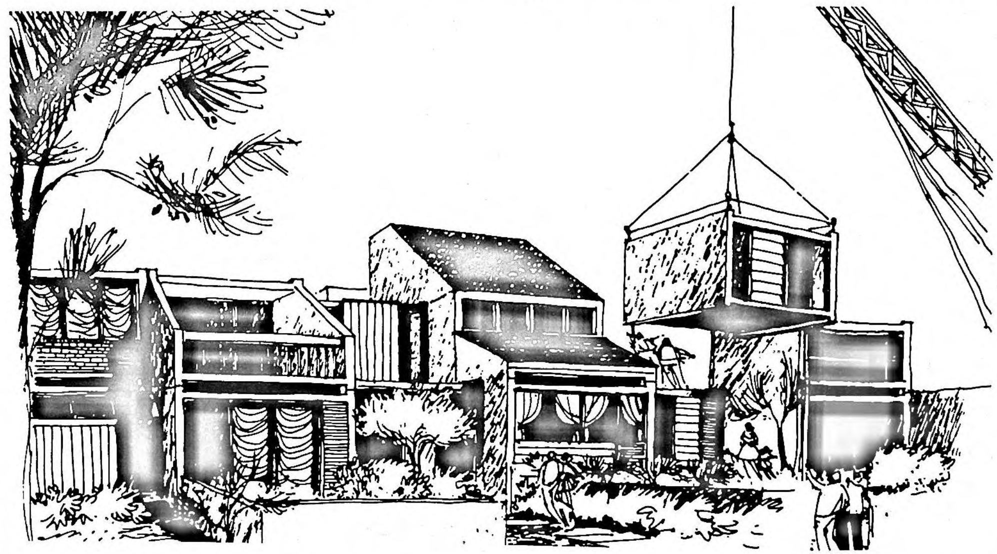
The system is designed primarily for apartment construction, the modules being stacked, arranged side-by-side in various configurations, provided with individual or public access means and using other schemes to give a varied arrangement. Interiors of the modules and placement of doors, interior access and windows can provide a wide variety of apartments, townhouses or single-family dwellings. The proposer indicates a volume production of from 1,000 to 5,000 dwelling units per year.

The key innovation in the system is the use of shotcrete (sprayed concrete) in construction of the walls of the 10-ft. to 14-ft. wide modular units—a technique that has been well-established for such uses as site-casting of thin-shell concrete roofs, elevated tanks, and resurfacing existing buildings. Result is an exceptionally dense, strong concrete which offers the traditional advantages of sound insulation, durability, structural rigidity, fire resistance—and at the same time can be kept to thicknesses of 3 in. for lighter weight.

Use of the shotcreting technique also makes possible easy assembly of electrical and other distribution systems, and reinforcing in the walls, without the usual difficulties inherent in assembling such items for insertion in a mold in normal precasting methods.

Construction of the module begins with casting of a 5-in. thick, hollow-cored floor slab, which is moved





from the casting area to the wall construction area within a factory either onsite or in close proximity. Here, a collapsible steel interior form is erected, mesh reinforcing placed and lapped with reinforcing dowels that project from the floor slab; boxes to form openings, alignment plates and other inserts are attached. The shotcrete is then applied and screeded to proper thickness (3 in. for walls and ceiling), and the module steam-cured for approximately a day.

Once the module has attained sufficient compressive strength it is moved to another station where mechanical, electrical and appliance installation work is completed, and final interior finish (painting, vinyl wall coverings and floor coverings) is completed. Stair units, where required, are packed within the modules for shipping.

The modules are open-ended as cast, then completed (for exterior walls) with factory-installed curtain-wall infill panels that can be of almost any material desired by the architect. This affords the added advantage that such end-wall panels can be manufactured in sizes to cover the open ends of a number of units for desired effects.

Monolithic concrete joints between the modules provides lateral rigidity and restraint against buckling. Conventional foundation systems are used.

The modules incorporate heating, ventilating, cooling and power distribution, thus making each module mechanically and electrically self-sufficient as it leaves the factory. A 12-in. deep chase formed by the top and bottom curb projections on each module accommodates all service utilities,, plus kitchen and bathroom exhausts. Variations of these chases can be built to accommodate high-rise structures where staggered arrangement of the modules may require them. In general, electric heating is planned through baseboard or through-the-wall units; cooling will be accomplished by individual through-the-wall units as well.

System designers have paid special attention to security considerations of tenants through establishment of definite boundaries between public, semipublic and private space—providing safe transitions between such spaces, avoiding long interior corridors and dark interior stairs, and using such devices as keyless locks on outer doors.

A special feature of the planning is the use of packaged sewage treatment plants, based on an electrolytic processing for separating solids, for housing developments of 50 to 500 units and specially suited to suburban or outlying city locations where municipal services may not be available, but where the development itself is too small to justify its own municipal treatment plant.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL; CLEARED OPEN LOT
2 Density Range	5 TO 50 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER; COURTYARD; COMMON OPEN SPACES
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN TRAFFIC; WALKING PATHS; UNDERPASSES & OVERPASSES
8 Site Planning Services	
9 Community Involvement	COMMUNITY LIAISON TO BRING RESIDENTS INTO PLANNING
10 Utilities	UNDERGROUND WIRING; CENTRAL ELECTRICAL SYSTEM; PACKAGED SEWAGE TREATMENT PLANT

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 to 5 BEDROOMS
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	BUILDING SYSTEM DESIGNED & BEING DEVELOPED
15 Community Involvement	LIAISON WITH RESIDENTS IN PLAN & DESIGN; LOCAL GROUP TO WORK WITH MODULES

BUILDING SUBSYSTEMS

16 Structure	SELF-SUPPORTING CONCRETE MODULES; PARTIALLY CANTILEVERED
17 Exterior Elements	SANDWICH INFILL PANEL END WALLS, BALCONIES
18 Interior Elements	SELF-SUPPORTING BATHROOM, KITCHEN & HVAC MODULES; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; DESIGNED TO LOCAL CONDITIONS
20 Comfort Systems	ELECTRIC HEATING, BASEBOARD OR THROUGH-WALL UNITS; THROUGH-WALL COOLING UNITS
21 Plumbing	CONVENTIONAL; COPPER OR PLASTIC PIPING, KITCHEN & BATHROOM INTEGRATED IN MODULE
22 Electrical	INTEGRATED WITH BUILDING SYSTEM IN FACTORY
23 Furnishings	

PRODUCTION

24 Offsite Production	(OPTIONAL) MODULES; INFILL PANELS (NEAR SITE)
25 Onsite Production	(OPTIONAL) MODULES; INFILL PANELS
26 Onsite Construction	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOK-UPS
27 Labor	SKILLED, SEMISKILLED & UNSKILLED FOR PRODUCTION; SKILLED FOR SITE ERECTION
28 Labor Training Programs	TRAINING PROGRAM
29 Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS

ECONOMICS

30 Construction Costs	$9.60 PER SQ. FT., 1,000 UNITS PER YEAR; $9.35 PER SQ.FT., 5,000 UNITS PER YEAR
31 Financing Methods	WESTINGHOUSE ELECTRIC CORPORATION LINE OF CREDIT WILL BE USED
32 Useful Life	CONCRETE SHELL SHOULD LAST LONGER THAN MORTGAGE

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	PLANNING, ORGANIZATION, & PRODUCTION
35 External Functions	ARCHITECTURAL DESIGN, ENGINEERING
36 Market Area	150 MILE RADIUS FROM PLANT
37 Delivery Rate	1,000 TO 5,000 DWELLING UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	MODULE CONSTRUCTION; INTERIOR SECURITY DESIGN
40 Codes	ADAPTABLE TO NATIONAL PLUMBING CODE & USASI

Vencedor Development

PROPOSER

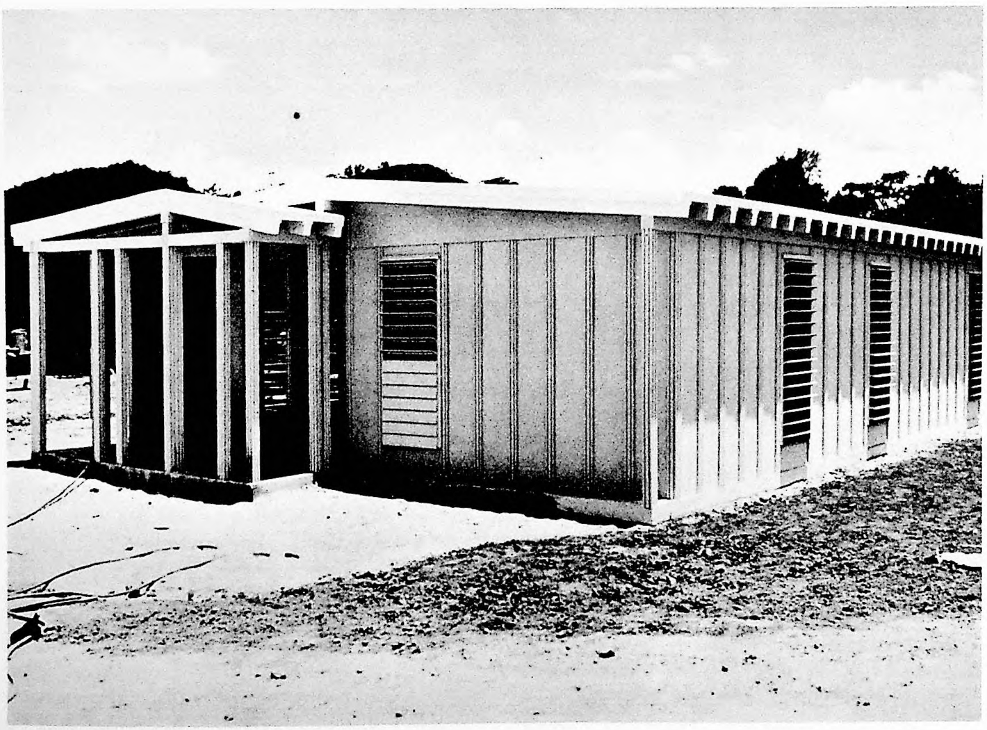
Vencedor Development Corporation, Bayamon, Puerto Rico

A building system that combines the advantages of cast-in-place concrete with easily assembled, modular components is proposed. A typical 750-sq.-ft. single-family home may be built with the system in one-third the time that conventionally cast concrete would require.

Secret of the system is the use of extruded asbestos cement posts and panels to form inner and outer skins of the exterior walls, and with the cavity between these skins being filled with a concrete mixture, thus creating a solid wall, approximately 2 1/2 in. thick. The extruded asbestos cement panels, while remaining as permanent elements of the walls, serve as forms for the infill concrete.

Erection sequence of the components is simple: (1) wall panel posts are erected and tied to the foundation slab with steel tie rods through a hollow core; (2) exterior and interior panels are fitted into grooves precast into posts; (3) the infill concrete is placed; and (4) extruded plates and roof beams are placed and completed with a rod- and mesh-reinforced foamed concrete deck.

The uncomplicated construction procedure, the elimination of form stripping, and the light weight of the extruded components (each piece is easily carried by one or two men) all contribute to savings in construction time.



The panel-and-post system produces a board-and-batten effect for both exterior and interior wall surfaces, which may be easily painted and are virtually maintenance free. The extruded shapes for the roof system results in an attractive beam ceiling effect. No wood or plastic trim is used throughout the house; the entire structure is decay and termite proof, has good sound isolating characteristics, and is resistant to hurricane-force winds.

A special post-and-panel interior wall subsystem is provided for the plumbing wall, against which are backed kitchen and bathroom facilities.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	20 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	STREET GRID; SIDEWALKS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12 Unit Variations	3 OR MORE BEDROOMS
13 Design Selection	STANDARD PLANS
14 State of Development	BUILDING SYSTEM DEVELOPED AND BEING MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS	
16 Structure	ASBESTOS-CEMENT POSTS & PANELS, CONCRETE INFILL, ROOF BEAMS, CONCRETE TOPPING
17 Exterior Elements	PANELS & ROOF COVERING
18 Interior Elements	POST & PANEL PLUMBING WALL
19 Foundations	
20 Comfort Systems	
21 Plumbing	PVC PIPING; INTEGRATED IN POST & PANEL PLUMBING WALL
22 Electrical	
23 Furnishings	

PRODUCTION	
24 Offsite Production	EXTRUDED POSTS, PANELS, ROOF PLATES & BEAMS
25 Onsite Production	POSSIBLE PORTABLE MANUFACTURING SYSTEM
26 Onsite Construction	FOUNDATIONS; COMPONENT ERECTION; CONCRETE INFILL & TOPPING; UTILITIES
27 Labor	UNSKILLED
28 Labor Training Programs	
29 Community Involvement	

ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	

GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM: ASBESTOS-CEMENT POSTS & PANELS, BEAMS & ROOF COVERING
40 Codes	

The Vertical Battery Consortium

PROPOSER CONSORTIUM

Ganteaume & McMullen, Inc., Boston, Massachusetts
J. C. Bianco & Associates, Croyden, England
United Fruit Company, Boston, Massachusetts

Based on a specially devised system for casting relatively heavy concrete elements in a vertical position, the system proposed is aimed primarily at medium- to high-rise structures, although it can be used for single-family dwellings, if in large enough numbers.

The basic element of the system is a 14-ft. x 8-ft. slab, varying in thickness and in predetermined openings, which forms bearing walls, floors, and roofs. Similar precast, reinforced slabs can be prepared to serve as balconies or other projections that may be desired for architectural or other purposes.

The slabs are cast in a battery mold actually constructed and erected onsite—a system of finely finished concrete leaves within which the required slabs can be prepared, with reinforcing and any required openings. (Certain site conditions will necessitate an offsite battery mold—an entirely satisfactory alternative in many situations.) When cured, the slabs are lifted from the battery mold by two projecting steel bolts protruding from the top edge. Reinforcing bars also project on the edges.

In erection, the wall slabs are held in position by crops while being leveled on the lifting bolts of the panel below, and the reinforcing loops are tied together by two longitudinal reinforcing bars; then the joint is grouted or dry-packed to form a firm structural connection.

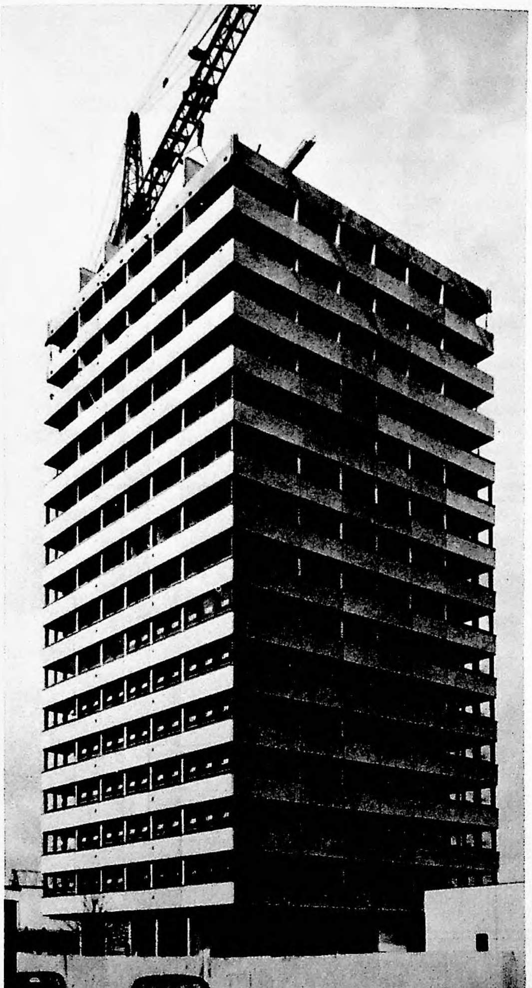
Electrical conduit—arriving at each floor through a central riser—can be threaded through these connection points before grouting. Interior partitions are also of concrete, except where space must be provided for electrical and other services. In these cases, partitions will be wood-studed, gypsum-board-faced units.

Vertical chases adjacent to bathroom and kitchen units will accommodate all mechanical services, with plumbing connections made through a plywood insert in the wall separating the bathroom or kitchen from the chase. Since plumbing fixtures are located directly beneath each other on succeeding floors, identical plumbing trees can be fabricated in a jig on the site, loaded in a container and spotted in the structure by crane.

All heating is electrical (although provision can be made for other energy sources). Heating units are baseboard convectors, mounted under windows and facade panels; each apartment is equipped with a variable heating control from a central meter.

Interior finish is held to a minimum; plastering is not required, and variety of floor and wall coverings is available. Furniture, cabinetry, and appliances are designed for shop manufacture wherever possible—and some of these items, such as closets, are planned to serve double duty as fillers and partitions.

The casting system has been in use in Great Britain for some 17 years. The consortium plans to undertake training of local labor, since electrical, plumbing, and other work can be handled in onsite shops by a very few skilled men, little further skilled labor is required for connections and installation.



Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL
2 Density Range	40 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	RECREATION CENTERS; SCHOOLS; LIBRARY; CHURCH; MARKETING CENTERS
7 Circulation	
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	STUDY TO DETERMINE COMMUNITY NEEDS
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	2 TO 3 BEDROOMS
13 Design Selection	
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED IN ENGLAND
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	PRECAST CONCRETE PANELS FOR BEARING WALLS, FLOORS, & ROOFS
17 Exterior Elements	BALCONIES; EXTERIOR FINISH, CONCRETE OR OTHER WEATHERING MATERIAL
18 Interior Elements	CONCRETE OR WOODSTUD GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	ELECTRIC BASEBOARD HEATING
21 Plumbing	PREFABRICATED PLUMBING TREES
22 Electrical	CENTRAL RISER
23 Furnishings	

PRODUCTION

24 Offsite Production	
25 Onsite Production	FLOOR, WALL & ROOF PANELS CAST IN A BATTERY MOLD; PLUMBING TREES
26 Onsite Construction	FOUNDATION; JOINING OF PANELS; MECHANICAL INSTALLATION
27 Labor	UNSKILLED; MINIMUM OF SKILLED
28 Labor Training Programs	TRAINING FOR UNSKILLED
29 Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	$12.45 PER SQ. FT. (MULTIFAMILY HIGH-RISE)
31 Financing Methods	
32 Useful Life	STRUCTURE—50 YEARS; ELECTRIC HEAT—30 YEARS; PLUMBING—30 YEARS

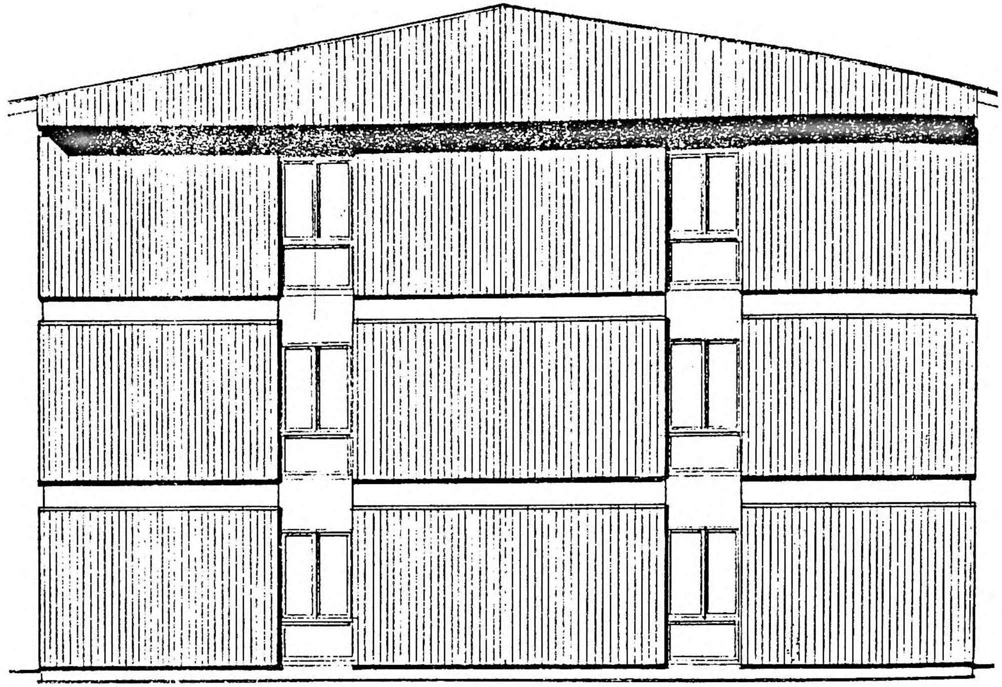
MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	44 PANELS PER DAY (2,400 SQ. FT. OR 2 APARTMENTS PER DAY)
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM: CONCRETE SLABS SITE-CASTING IN VERTICAL BATTERY MOLD
40 Codes	

Virginia Polytechnic Institute



PROPOSER CONSORTIUM

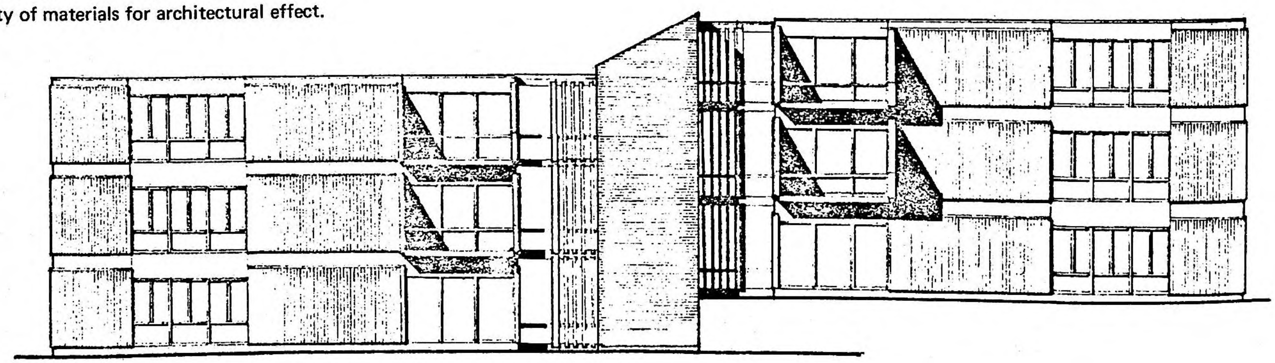
Virginia Polytechnic Institute, Blacksburg, Virginia
Redman Industries, Inc., Dallas, Texas
Schultz Construction Company, Reston, Virginia

Factory-fabricated, wood-framed dry and wet modules, with a rigid steel, structural frame, can be combined to produce single-family attached homes and low-rise apartments, under the proposal submitted.

The basic modules—the wet and dry sections—combine to form a three-bedroom unit, with windows along one wall and at the ends. Thus two units can be placed side by side to form a three-story building, 48 ft. x 48 ft., containing six living units. Numerous combinations can be achieved to vary appearance and accommodate a variety of floor plans.

Heart of the system is the structural frame, designed to resist vertical loads as well as wind loads of 15 lb. per sq. ft. for a three-story structure. The frame is made of light-gauge, cold-rolled welded steel members. Floors are cast of lightweight, 1 1/2-in. insulating concrete, poured over light-gauge corrugated steel decking welded to the structural frame. Roofs are of metal.

Interior and exterior walls are nonstructural, as are the ceilings. Exterior walls are framed on 2-in. x 3-in. fire-retardant-treated wood studs 16 in. on center, with sill and plate of the same material, which can be covered with a variety of materials for architectural effect.



Interior partitions are framed with 2-in. x 2-in. wood studs covered with prefinished gypsum board, prefinished plywood, or other materials.

Floors are carpeted—with the exception of kitchens, bathrooms, dining and utility rooms, which will have linoleum covering; gypsum board ceilings are covered with textured vinyl material and also contain insulation. Kitchen cabinetry is prefabricated, prefinished wood, with formica tops and splash; bathroom walls are covered with vinyl.

Conventional foundation systems (footings, short concrete piers on 12-ft. centers, perimeter walls, or precast concrete) are planned, depending on site conditions.

Although heating and ventilating requirements vary, the proposal is based on a gas-fired, forced-air heating and ventilating system, with ducts sized to accommodate cooling. Ducts are galvanized iron in furred areas over corridors and closets; furnace flues are carried through continuously to the roof.

Plumbing in the preassembled wet module will conform to all codes, except that the drain piping and fittings are plastic. Electrical distribution system is 115-130 volt, 60-cycle, with a main disconnect and circuit breaker in each living unit. Lighting fixtures are provided in kitchens, bathrooms, utility rooms and corridors.

The proposer is prepared to lead the consortium in management and planning, providing for user participation in planning stages, and in evaluations of the housing after it is in use.

Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN; RURAL
2	Density Range	20 TO 40 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	SUITABLE FOR TEMPERATE & HOT CLIMATES
5	Planning Concepts	CLUSTER & LINEAR CONCEPTS; OPEN SPACES
6	Nonresidential Functions	COMMUNITY CENTER; PLAY AREA; DAY CARE AREA; COMMERCIAL OFFICES
7	Circulation	CURVILINEAR STREETS; PEDESTRIAN WAYS CONNECT RESIDENCES & PLAY AREAS
8	Site Planning Services	DESIGN TEAM AT CENTRAL LOCATION
9	Community Involvement	
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	1 TO 5 BEDROOMS
13	Design Selection	STANDARD PLANS (FLEXIBLE VARIATIONS)
14	State of Development	CONTINUING DESIGN & DEVELOPMENT
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	WOOD FRAME MODULES; LIGHTWEIGHT CONCRETE FLOORS; WELDED STEEL STRUCTURAL FRAME
17	Exterior Elements	NONSTRUCTURAL WOOD FRAME WALLS WITH VARIOUS EXTERIOR FACINGS
18	Interior Elements	NONSTRUCTURAL WALLS & PARTITIONS; GYPSUM BOARD CEILING
19	Foundations	CONVENTIONAL CONCRETE FOOTINGS, PIERS, OR WALLS
20	Comfort Systems	GAS-FIRED FORCED AIR HEATING & VENTILATING; DUCT SYSTEM
21	Plumbing	INCLUDED IN PREASSEMBLED MODULE; PLASTIC DRAINAGE PIPES WHERE PERMISSIBLE
22	Electrical	CONVENTIONAL
23	Furnishings	

PRODUCTION

24	Offsite Production	BASIC "WET" MODULE & "DRY" MODULE
25	Onsite Production	
26	Onsite Construction	FOUNDATION; ERECTION OF STEEL FRAME & MODULES; UTILITY HOOKUPS
27	Labor	
28	Labor Training Programs	
29	Community Involvement	

ECONOMICS

30	Construction Costs	$8,435 PER UNIT, 1,440 UNITS PER YEAR (BEST RATE)
31	Financing Methods	CONVENTIONAL & PROPOSER SUPPLIED
32	Useful Life	

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	DESIGN; PRODUCTION; CONSTRUCTION; MANAGEMENT
35	External Functions	
36	Market Area	23 PLANT LOCATIONS EACH SERVING A 200-MILE RADIUS
37	Delivery Rate	1,440 DWELLING UNITS PER YEAR (BEST RATE)
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	ADAPTABLE TO ALL NATIONAL CODES

Whitley & Whitley

PROPOSER

Whitley & Whitley, Architects, Shaker Heights, Ohio.

AFFILIATES

American Wood System (affiliate of Plywood Fabricator Service, Inc.—American Plywood Association); American Standard, Inc., Component Plumbing System; Crane Co.; Davis Products Co., Kitchen Equipment.

Prefabricated, self-supporting, open-framed plywood wall, floor, and roof panels are assembled onsite around a componentized mechanical core to produce the proposed system for single-family dwellings. Dwellings already constructed under this concept (except for the core which is not yet fully developed) have had wide acceptance and approval with a low-income group minority community.

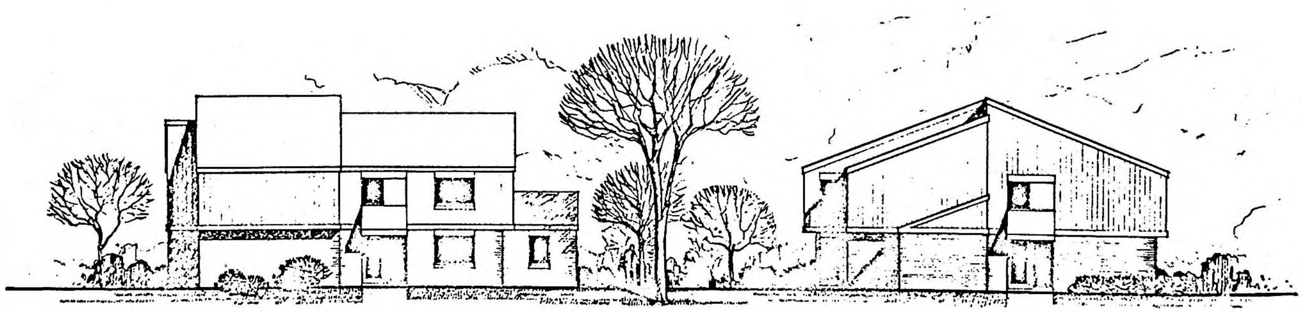
Wall sections consist of exterior plywood sheets applied to wood studs; a variety of textures and finishes offering owner-choice and architectural diversity are possible. From a maintenance standpoint, cedar-faced plywood has proved economical as well as attractive. Floor and roof panels are stressed-skin construction, the gluing of the plywood sheets to the wood framing members producing components with structural load-bearing capacity. Floor panels are sheathed on both sides, providing for basement ceilings; roof panels are sheathed on one side only and are applied over prefabricated wood trusses where sloped roofs are called for.

Typical exterior wall treatment of the two- and three-story dwellings is staining or painting of the slightly overhanging upper stories, while brick veneer is applied to the first floor wall panels. Other optional finishes include siding, shingles, and paneling.

Assembly of the panels around the packaged core typically takes only a day. The other site operations include interior finishing (gypsum board-paint), laying of asphalt floor tile, hook-up of the core to utilities, and pouring of conventionally designed and constructed basement or bearing-wall foundations. From ground breaking to turnkey is estimated to take not more than 3 weeks.

The core concept, when fully developed, will embody a packaged, prewired electrical panel, forced warm air furnace, gas-fired hot water heater, plus all kitchen and bathroom facilities, and is expected to be installable in a single, onsite operation.

The proposer will act as a central management organization for national franchising of their housing system, which they state to be fully developed, tested, and ready for production.



Summary Information

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	
3 Topography	
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12 Unit Variations	2 TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION PLANT DESIGN STAGE; BUILDING SYSTEM DEVELOPED, NOT MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STRUCTURAL WOOD-FRAME PLYWOOD WALL, FLOOR, & ROOF PANELS
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	GYPSUM BOARD FINISHES; RESILIENT FLOORING
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS-FIRED FORCED WARM AIR HEATING; INCLUDED IN CENTRAL MECHANICAL CORE
21 Plumbing	KITCHEN & BATHROOM FIXTURES & PIPING INCLUDED IN MECHANICAL CORE;
22 Electrical	ELECTRIC PANEL & WIRING INCLUDED IN MECHANICAL CORE
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL, FLOOR & ROOF PANELS; CENTRAL MECHANICAL CORE
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ASSEMBLY OF PANELS; PLACING OF MECHANICAL CORE & HOOK-UP
27 Labor	UNSKILLED
28 Labor Training Programs	
29 Community Involvement	USE OF LOCAL CONTRACTORS; SELF-HELP

ECONOMICS

30 Construction Costs	$13,800 PER UNIT, FIRST 36 UNITS
31 Financing Methods	
32 Useful Life	

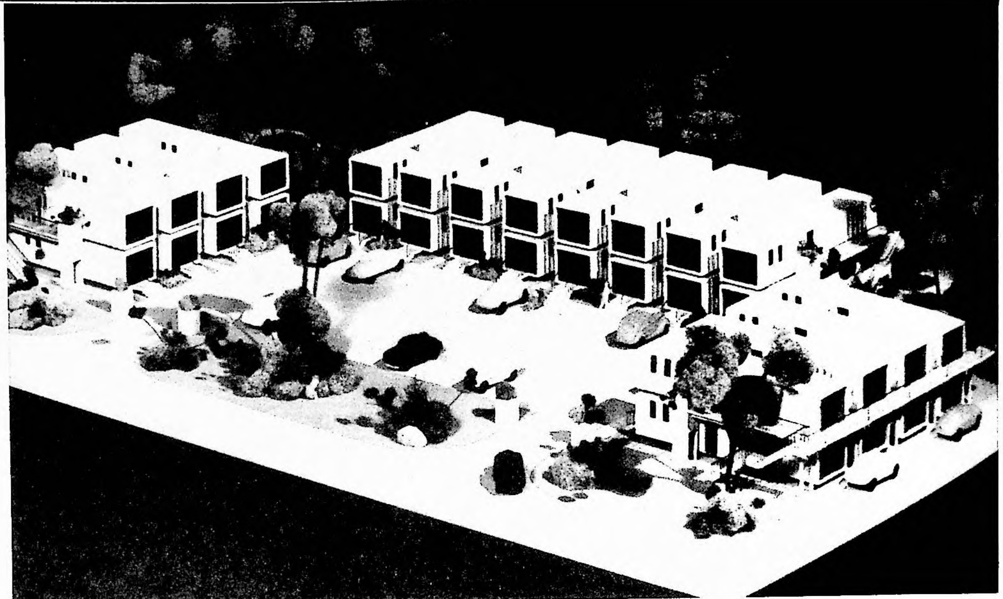
MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	MANAGEMENT
35 External Functions	MECHANICAL SYSTEMS AND COMPONENT PRODUCTION THROUGH FRANCHISE
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	

Whitmire & Allen



PROPOSER CONSORTIUM

Whitmire and Allen, Inc., Management, Lake Wales, Florida
R. James Robbins, AIA, Architect, Tampa, Florida

The basic elements of this low-cost housing system are dwelling-sized modules of protected wood-frame construction, having a trussed-wall subsystem, with stressed-skin floor and roof, supported on stilt framing. The modules, typically 12 ft. wide and 52 ft. long, are completely factory-manufactured and, when shipped, are ready for occupancy, except for lifting into the frames and utility hookup.

The modules are suitable for both single-family configuration and for multifamily low-rise structures. The stilt support system for single-family use is of structural steel members, while that for multifamily is a combination of precast and cast-in-place concrete. The modules are constructed with blanket insulation, thus affording both sound and weather insulation, and the units have a 1-hour fire rating.

Exterior finish of the modules is plywood paneling, while the interiors are completed conventionally with gypsum board. A prefabricated external plug-in stack, which in multifamily projects may be shared by several units, supplies water, electricity, venting and waste disposal to the dwellings, with unitized, self-contained heating and air conditioning units installed in each unit.

Two-bedroom models are currently in production and available, as are the steel stilt frames for their support, with shipments presently being made within a 300 to 500 mile radius from a Florida plant.

Summary Information

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2 Density Range	32 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; SIDEWALKS
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	WOOD-FRAME MODULES WITH TRUSSED WALL, STRESSED-SKIN FLOOR & ROOF; STEEL FRAME
17 Exterior Elements	
18 Interior Elements	GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL; TO BE DESIGNED TO SPECIFIC SITE CONDITIONS
20 Comfort Systems	CONVENTIONAL; CENTRAL ELECTRIC HEATING & COOLING SYSTEM FOR BUILDING
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL
23 Furnishings	

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES; STEEL SUPPORT FRAME
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ERECTION OF STEEL STILT FRAME; PLACING OF MODULES
27 Labor	UNSKILLED
28 Labor Training Programs	ON-THE-JOB TRAINING
29 Community Involvement	LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	$9.79 PER SQ. FT., 1500 UNITS PER YEAR (BEST RATE)
31 Financing Methods	PROPOSER SUPPLIED FOR PROTOTYPE; CONVENTIONAL FOR LONG-TERM FINANCING
32 Useful Life	STRUCTURE—40 YEARS; ROOF—20 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	ARCHITECTURAL DESIGN; ENGINEERING; MANAGEMENT
35 External Functions	
36 Market Area	300 TO 500 MILE RADIUS OF FACTORY
37 Delivery Rate	1,500 UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Wollander and Associates

PROPOSER CONSORTIUM

Wollander and Associates, Tacoma, Washington
West Coast Mills, Inc., Tacoma, Washington
Chris Berg, Inc., Tacoma, Washington.

A housing system which will solve two problems at once—the problem of providing shelter for the underprivileged and that of furnishing gainful, dignified employment to the same people, is proposed. Although structurally the units are considered suitable for every type of development except high-rise, their advantages in terms of social values seem greatest when the units are erected as single-family detached homes on small lots with adjacent green space and small parks.

The basic dwelling unit consists of two volumetric modules, 12 ft. wide, but varying in length from 38 ft. to 54 ft., placed side-by-side to form a house 24 ft. wide. The modules are of wood-frame, panelized construction, the 4-ft. x 8-ft. panels being sandwiches of plywood exterior, 2 in. of friction-fit insulation, and foil-backed gypsum board interior. The modules are unframed, but gain structural rigidity through assembly of the panels and the stressed-skin floor and roof systems.

Three types of production-erection are proposed for the units, dependent upon labor and site conditions. The modules may be built onsite, panel-by-panel, using largely unskilled labor; the panels may be assembled at the factory into larger units, perhaps room length, and crane-placed at the site; or, the entire volumetric module, 12 ft. wide, up to 54 ft. long, may be assembled at the factory and trucked for placement on foundations at the site. Regardless of the method used, the basis of the module remains the simple panel and, as such, is suitable for mass production in the factory by largely unskilled labor, many of these workmen conceivably being those for whom the homes are being built.

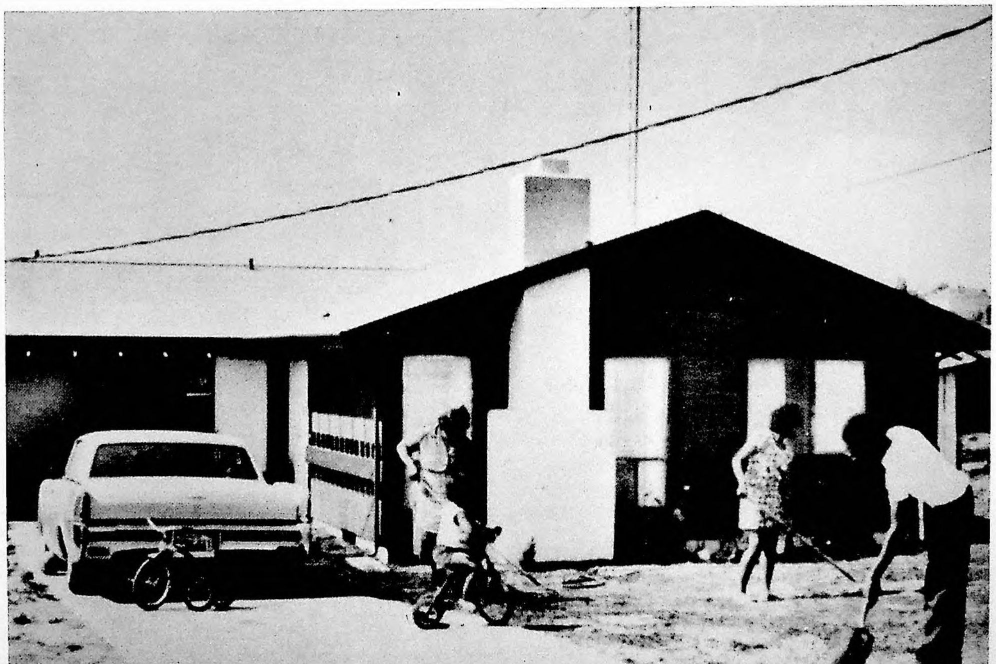
The proposal underscores heavily its concern for employment of the underprivileged, and puts forth a system of franchising both manufacture of panels and construction of the housing units to aid that goal. Maximum use of subcontractors is expected to further this concept. A volume production of as many as 3,000 units per year is considered feasible.

The proposer believes that housing for the underprivileged, to be successful, must contain the amenities of the privileged insofar as low cost will permit. One of these amenities is privacy of the individual and the subgroup in the family. To achieve this, the arrangement of rooms in the dwelling unit have subdivided into three zones: one for parents, one for children, and one for children and parents together. This is accomplished through a formal and an informal living area. The formal, for the adults, is adjoined by their bedroom and bathroom facilities. The informal living area, including TV, is adjacent to the children's bath and bedrooms; kitchen and dining areas are included in this informal area and become a shared zone of activity during the day.

The innovative juxtaposition of sleeping areas to living areas, eliminates costly, wasteful, and unused hall and corridor space. Essentially, the zoned family living arrangement is formed by the two living areas located in one of the 12-ft. modules, and the sleeping and bath facilities in the other, butted to the living module, side-by-side.

The siting of these homes on small, individual lots, affords social amenities similar to the provisions for privacy afforded by the zone system. Pride of ownership and its accompanying incentive to keep a possession presentable are enhanced, if ownership is visibly evident, as in a detached home. To be economically feasible, lots approximately 35 ft. x 90 ft. are proposed with common green space and small parks to heighten a feeling of spaciousness.

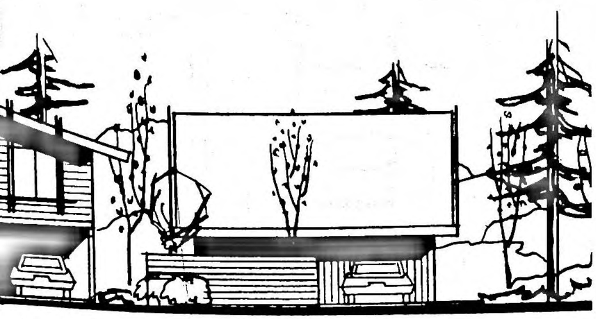
Factory production of the modular homes, using unskilled, local labor, is expected to extend to every aspect of the units except foundations, which may be



slab-on-ground or foundation bearing walls with crawl space. Bath, kitchen, and sewage disposal facilities will be prepackaged and installed as units at the site (or at the factory in the case of factory-assembled room modules). All wiring and plumbing (plastic or copper) will be accomplished in the plant. Heating will be optionally gas or oil-fired with convectors or electric radiant panels.

Community involvement of the people who will make and live in the houses is expected to start with the planning phase, at which time a local advisory committee will be asked to endorse the proposed plans, continue through the use of local labor to continuing management, and extend to self-help provisions both in maintenance and such finishing operations as painting, and modifications such as addition of carport or garage.

Production facilities are in existence and many prototype homes similar to those proposed have been built. The system is considered as fully developed and is presently being marketed.



Summary Information

SITE SYSTEM

1	Site Situation	URBAN, URBAN RENEWAL
2	Density Range	10 TO 30 DWELLING UNITS PER ACRE
3	Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5	Planning Concepts	COMMON OPEN SPACES; SMALL PARKS; COMMUNAL GREENWAYS
6	Non-residential Functions	RECREATION AREAS
7	Circulation	SEPARATE PEDESTRIAN AND VEHICULAR CIRCULATION; CURVILINEAR THROUGH STREETS
8	Site Planning Services	
9	Community Involvement	PROPOSER WILL SEEK COMMUNITY ENDORSEMENT
10	Utilities	CONVENTIONAL; OPTIONAL ENERGY SOURCES PER INDIVIDUAL BUILDINGS

BUILDING SYSTEMS

11	Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	2 TO 5 BEDROOMS
13	Selection Method	FROM STANDARD PLANS
14	State of Development	BUILDING SYSTEM CURRENTLY MARKETED; PRODUCTION FACILITIES OPERATIONAL
15	Community Involvement	COMMUNITY ADVISORY COMMITTEE

BUILDING SUBSYSTEMS

16	Structure	WOOD FRAME WALL, FLOOR & ROOF PANELS; OPTIONAL WOOD FRAME VOLUMETRIC MODULES
17	Exterior Elements	CONVENTIONAL FINISHES
18	Interior Elements	CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL
20	Heating, Ventilating, Air Conditioning	OPTIONAL FUEL, HEATING; INTEGRATED WITH BUILDING SUBSYSTEM
21	Plumbing	CONVENTIONAL; COPPER OR PLASTIC WATER PIPING; OPTIONAL MATERIAL FOR DRAINAGE PIPING
22	Electrical	CONVENTIONAL
23	Furnishing	CARPETING

PRODUCTION

24	Offsite Production	PANELS (VOLUMETRIC MODULES OPTIONAL)
25	Onsite Production	
26	Onsite Construction and Erection	FOUNDATIONS; ERECTION OF PANELS OR PLACEMENT OF MODULES
27	Labor	UNSKILLED LABOR FOR PRODUCTION PLANT
28	Labor Training Programs	CONSTRUCTION MANAGEMENT & EQUIPMENT UTILIZATION TRAINING PROGRAM
29	Community Involvement	LOCAL CONTRACTORS; LOCAL CONSULTING ARCHITECT; SELF-HELP LABOR

ECONOMICS

30	Construction Costs	$9.90 TO $10.71 PER SQ. FT., 1,000 UNITS PER YEAR
31	Financing Methods	CONVENTIONAL
32	Useful Life	STRUCTURE; 30 YEARS MINIMUM

MANAGEMENT

33	Proposer Organization	CONSORTIUM
34	Internal Functions	DESIGN; MANAGEMENT; PRODUCTION; SHIPPING, ERECTION
35	External Functions	
36	Market Area	
37	Production Rate	1,000 (MINIMUM) TO 3,000 UNITS PER YEAR
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	PLUMBING & HVAC GENERALLY ADAPTABLE TO ALL NATIONAL MODEL CODES

Zapata Engineers

PROPOSER

Zapata Engineers, Inc., Houston, Texas.

AFFILIATES

Diversified Builders, Inc.; Paramount Pacific Co.; Warrier Construction, Inc.; Willia McWillis Co.; Wyatt, Hedin Engineering Co.; Hallange & Associates; Lord Bishop.

A combination of lightweight, cast-in-place concrete with collapsible tunnel forms is proposed to produce a variable dwelling unit module for single-family and multifamily low-rise structures.

The tunnel forms which provide support for the full formwork for casting the entire envelope of the unit can be varied at the top to produce arched, vaulted, cathedral, or flat ceiling lines, either to conform with interior decoration designs or with desired roof-lines specified by the architect.

Forms are self-supporting and can be set up in 50 ft. x 12-ft. width, in such a way that projections will permit the addition of cantilevered balconies and projections if desired. Lengths can vary, in 1-ft. increments, from 20 ft. Using the collapsible forms, units can be cast in one- and two-story combinations (the lower story having a flat top to provide a floor for the upper), and can be grouped together in various configurations.

The basic structural element is very similar to systems used for many years in highway and other construction. Walls and roof (or ceiling) are a single monolithic structure and constitute the structural, thermal, accoustical, and weather envelope.

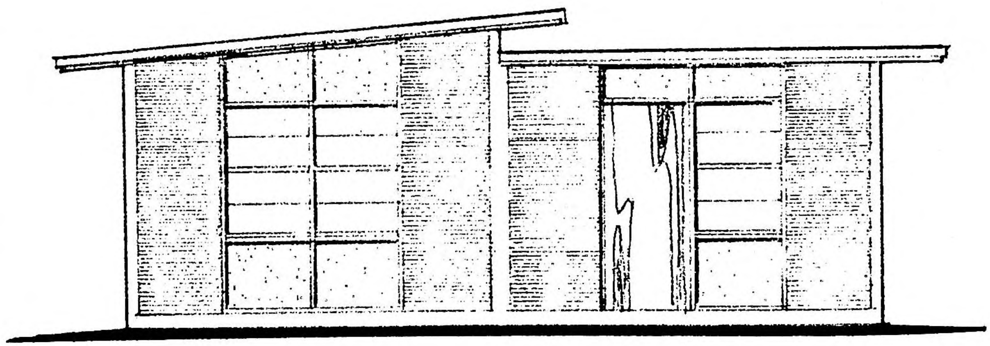
The inside form is tunnel-shaped, fully collapsible (breaking the surface at the three horizontal-soffit intersecting lines). The surface is coated with epoxy or fiberglass material to give a smooth finish. Outside panels, fabricated in full lengths, are also coated with a lining material. The procedure in using the system is as follows: (1) Inside forms are set up and braced, then prefabricated window and door subframes are aligned and placed to fit tightly between the inner and outer surfaces, remaining as nailers in the concrete; (2) Bulkheads determining the overall lengths are placed; (3) Reinforcing steel is set and tied; (4) Electrical conduits, outlet boxes, etc. are set; (5) Outside panels are set and concrete placed.

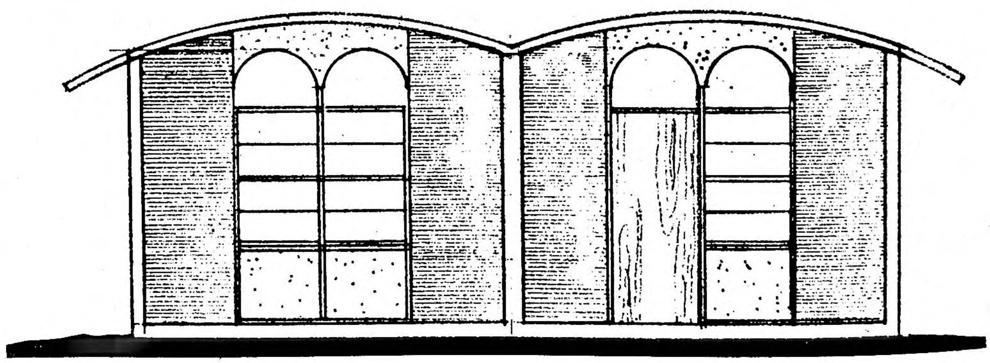
When the concrete has cured sufficiently, outer panels are stripped, the inner form is collapsed and removed through the open end of the structure (a lightweight rear closure wall can be cast with the rest of the structure, at one end).

Final work includes only sealing walls with a waterproofing agent, and addition of built-up roofing as desired. Infill walls at the front can be of any material for architectural effect. Interior partitions are then added—they are wood-framed sandwich panels that need only attachment to walls and floors. Interior finish can be paint or paper for walls, or vinyl tile, carpeting, wood-block or other materials for floors.

Bathrooms, kitchens and closet units are factory-produced and fully self-contained; and in wet-wall areas, plumbing is already installed (as is electrical wiring), so that onsite connections are the only requirement. Heating, ventilating and air conditioning are provided by a basic gas-fired hot-air heating unit centrally located in a closet with an architecturally designed duct; a variation can be with distribution ducts encased in the concrete floor slab.

Waste and sanitary plumbing lines are prefabricated in an onsite shop (or can be fabricated in an offsite location), for installation before concrete pouring operations begin. Stairs and stair wells are similarly prefabricated.





Summary Information

SITE SYSTEM

1	Site Situation	URBAN; SUBURBAN; RURAL
2	Density Range	10 TO 30 DWELLING UNITS PER ACRE
3	Topography	SUITABLE TO GRADIENTS LESS THAN 12%
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; ESPECIALLY SUITABLE FOR SOUTH
5	Planning Concepts	INTEGRATED LAND USE; MIXED DENSITIES
6	Nonresidential Functions	RECREATION FACILITIES FOR ELDERLY; PLAYGROUND; SCHOOLS; SHOPPING
7	Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; SIDEWALKS; CURVILINEAR STREETS
8	Site Planning Services	
9	Community Involvement	LOCAL PARTICIPATION IN DESIGN
10	Utilities	

BUILDING SYSTEMS

11	Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12	Unit Variations	
13	Design Selection	
14	State of Development	BUILDING SYSTEM—DESIGN STAGE; DEVELOPMENT REQUIRED FOR RESIDENTIAL USE
15	Community Involvement	

BUILDING SUBSYSTEMS

16	Structure	CAST-IN-PLACE LIGHTWEIGHT CONCRETE MODULES; VARYING ROOF LINES
17	Exterior Elements	CONVENTIONAL WALL FINISHES; BUILT-UP ROOFING; STAIRS
18	Interior Elements	WOOD-FRAMED SANDWICH PANEL INTERIOR PARTITIONS; CONVENTIONAL FINISHES
19	Foundations	CONVENTIONAL
20	Comfort Systems	GAS-FIRED; WARM AIR HEATING; OPTIONAL COOLING; POSSIBLE DUCTING CAST IN SLAB
21	Plumbing	INTEGRATED WITH BUILDING SYSTEM
22	Electrical	INTEGRATED WITH BUILDING SYSTEM
23	Furnishings	

PRODUCTION

24	Offsite Production	BATHROOM & KITCHEN UNITS; PANEL PARTITIONS
25	Onsite Production	CONCRETE MODULES; WIRING
26	Onsite Construction	FOUNDATIONS; PLACING & CONNECTION OF MODULES; UTILITY HOOK-UPS
27	Labor	SKILLED; SEMISKILLED
28	Labor Training Programs	
29	Community Involvement	LOCAL CONTRACTORS; SELF-HELP

ECONOMICS

30	Construction Costs	$12.00 PER UNIT, 1000 UNITS PER YEAR
31	Financing Methods	
32	Useful Life	STRUCTURE—30 YEARS

MANAGEMENT

33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGEMENT; PRODUCTION; DESIGN
35	External Functions	
36	Market Area	
37	Delivery Rate	
38	Consumer Protection	

GENERAL

39	Major Innovative Concepts	
40	Codes	

type A proposals

LIMITED INFORMATION

Edward H. Amos

PROPOSER

Edward H. Amos, Consulting Engineer, Cleveland, Ohio

AFFILIATE

Herbert Luxenberg, Builder and Developer

An important difference distinguishes the highway-transportable modular home proposed from the usual mobile home. This system affords the ready potential for future change and modification that is possessed by the conventional wood-framed home, while prefabrication of the unit partakes of the technology and production-line economies of mobile home manufacture.

The difference is in the construction of the 60-ft.-long exterior side walls of the 12-ft.-wide, 9-ft.-high module. These are assembled as trusses, with vertical studs, 4 ft. on center, being braced diagonally, alternating top to bottom, bottom to top. The effect is to produce an over-all structure in combination with the roof, floor and end-wall systems, that has the structural stiffness, rigidity, and strength to withstand the stresses of transportation and erection, without the need for the heavy steel framework that forms the understructure of the usual mobile home.

An obvious savings in materials and labor results from elimination of the steel under-carriage, but it is onsite that the potential of the wood truss system is realized, resulting in a home that is not restricted to a given volume of space. Since the diagonal bracing (creating the truss) no longer is required for the structural strength needed for transport, once the module is sited, this bracing may be cut into as required. Openings for added windows, doors, or for addition of extra rooms, or complete new modules can be made by the owner, the vertical framing members alone being capable of maintaining the structural integrity of the unit. To assist the owner in this self-help activity, the proposer will develop plans indicating how modifications can be made.

The modules, delivered from the factory on flatbed trailers, may be sited by driving over a prepared foundation jacking the unit off the trailer, then pulling the trailer away and easing the unit into place. Modules may be crane-placed and may be stacked to form two-story structures, the truss construction enabling the modules to be point-supported while awaiting erection of a permanent supporting structure.

Exteriors of the modules may be similar to usual mobile home finishes, although wood siding may be offered for greater market acceptability. Interior partitions may be conventional wood-stud, gypsum-board construction.

The wood-framed modules can be put into production almost immediately, since many existing mobile home plants could readily manufacture them.

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL; SPECIFIC SITE NEAR CLEVELAND, OHIO
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	2 TO 3 BEDROOMS
13 Design Selection	STANDARD PLANS
14 State of Development	BUILDING SYSTEM — IN DESIGN STAGE REQUIRING DEVELOPMENTAL, PROTOTYPE CONSTRUCTION & TESTING; PRODUCTION PLANT IN OPERATION

BUILDING SUBSYSTEMS

16 Structure	WOOD FRAME SELF-SUPPORTED VOLUMETRIC MODULE; FRAMEWORK FOR STACKED UNITS
17 Exterior Elements	OPTIONAL WOOD SIDING; CONVENTIONAL MOBILE HOME ELEMENTS & FINISHES
18 Interior Elements	OPTIONAL WOOD-STUD GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	OPTIONAL ROOF-MOUNTED HEAT PUMPS OR AIR CONDITIONERS

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES; FRAMEWORK; MECHANICAL SUBSYSTEMS
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOK-UPS
27 Labor	SEMISKILLED FOR PRODUCTION PLANTS; UNSKILLED, SKILLED FOR SITE CONSTRUCTION
29 Community Involvement	LOCAL LABOR

ECONOMICS

30 Construction Costs	$7,000 (F.O.B.) TO $10,000 (INSTALLED) PER UNIT (720 SQ. FT.)
31 Financing Methods	CONVENTIONAL & DEVELOPER-BUILDER SUPPLIED
32 Useful Life	SIMILAR TO CONVENTIONAL MOBILE HOMES

MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	COORDINATION; RESPONSIBILITY; DESIGN; ENGINEERING; SPECIFICATIONS
35 External Functions	CONSTRUCTION, PRODUCTION, FINANCE, MARKETING, DISTRIBUTION, SUBCONTRACTING
36 Market Area	NATIONAL; PROTOTYPE ERECTION IN CLEVELAND AREA

GENERAL

39 Major Innovative Concepts	MODULE WITH WOOD STUD EXTERIOR WALLS ASSEMBLED AS A TRUSS
40 Codes	ADAPTABLE TO NATIONAL CODES

Dugas Construction

PROPOSER

Dugas Construction, Inc., Manchester, New Hampshire

AFFILIATES

Dugas Homes, Inc.; D.C.I. Component Homes; Dee Associates; Fuimond Agency, Inc.

A system of prefabricated panelized, wood-framed, conventional single-family homes is proposed with onsite erection by trained crews in suburban subdivisions and developments, with low cost being achieved through volume production.

All decks, interior and exterior walls (in wall lengths), second floors, gable ends, and other components are manufactured on assembly lines, with the plant serving also as a storage and distribution center for other onsite building materials, purchased in quantity at reduced prices. The panelized sections and other components are assembled into a shell, with some homes being sold in an unfinished, shell state, thus permitting self-help completion by owners.

Foundations for the typical rambler or ranch style homes, ranging in size from 24 ft. x 30 ft. to 24 ft. x 36 ft., are conventional, cast-in-place concrete, with reusable, expandable formwork being set in foundations. The forms are handled and pulled by crane, thus contributing to higher volume and lower costs, with concommitant reduction in wear and damage to the forms.

All work, from concept through final development of the subdivision, is handled by the proposer or one of its several affiliated and wholly owned companies, a prime essential of the organization's business philosophy being that no subcontractors be employed, that all work be accomplished by its own crew of skills and crafts.

The organization feels especially experienced in coping with the increasing land scarcity through development of submarginal land. This is done through extensive earthmoving in order to reclaim certain areas, and, as an example, through installation of subdivision sewage pumping stations, where soil conditions will not accommodate individual septic systems.

Summary Information

SITE SYSTEM

1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY AND SOILS
4 Climate	
5 Planning Concepts	DEVELOPMENT OF SUBMARGINAL LAND AREAS
6 Nonresidential Functions	
7 Circulation	CUL-DE-SACS
8 Site Planning Services	PROPOSER ORGANIZATION
9 Community Involvement	
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	
13 Design Selection	
14 State of Development	PRODUCTION FACILITIES OPERATIONAL; SYSTEM DEVELOPED & CURRENTLY MARKETED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	WOOD FRAME WALL, FLOOR, DECK AND GABLE END PANELS
17 Exterior Elements	
18 Interior Elements	
19 Foundations	CONVENTIONAL
20 Comfort Systems	
21 Plumbing	CONVENTIONAL
22 Electrical	
23 Furnishings	

PRODUCTION

24 Offsite Production	WALL, FLOOR, GABLE END AND DECK PANELS
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF PANELS
27 Labor	SKILLED FOR PRODUCTION PLANT & FOR SITE CONSTRUCTION
28 Labor Training Programs	
29 Community Involvement	

ECONOMICS

30 Construction Costs	$16,200 TO $23,700 PER UNIT
31 Financing Methods	CONVENTIONAL
32 Useful Life	

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	SITE PURCHASING & DEVELOPMENT; PRODUCTION, CONSTRUCTION, & ERECTION
35 External Functions	NONE
36 Market Area	
37 Delivery Rate	ONE DWELLING UNIT — 3 TO 5 DAYS
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	PRODUCTION LOGISTICS REQUIRING NO SUBCONTRACTORS
40 Codes	

Eastern Modular Corporation

PROPOSER

Eastern Modular Corporation, Wilkes-Barre, Pennsylvania.

AFFILIATE

Delaware Steel Company, Inc.

A wood-framed module, complete and ready for assembly onsite for use as single-family detached or attached homes is the product of this proposer. The modules are self-supporting but are not designed for stacking for high-rise construction. The major innovation cited is that the basic home is completed in the factory—including all variations. Thus, six models are presently contemplated for choice by the builder or buyer.

The modules can be sited on any type of conventional foundation, either crawl space, slab, or full basement. They can be finished in a number of variations of trim and siding and with varying roof lines to provide architectural diversity. By the same token, the modules also can be assembled for use as carports, family rooms, and recreational areas.

Raw materials selected for durability, economy, and performance, are manufactured into components and combined into subsystems in the factory. Both interior and exterior panels, framed with 2 in. x 4 in. studs 16 in. on center, are of sandwich construction to provide for proper sound and thermal insulation. Interior partitions may be finished with either gypsum board or prefinished wood paneling. The subfloor is 1/2-in. plywood overlaid with carpeting or other suitable covering. In some instances, built-in furniture such as dressers are included in the modules.

Interiors contain molded-fiberglass bathroom units for lightness of weight and utility, all piping is copper tubing, modules are prewired as delivered to the site, and mechanical systems include air conditioning (at additional cost).

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	MODULES ADAPTABLE FOR RECREATION FACILITIES
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED
12 Unit Variations	
13 Design Selection	
14 State of Development	PRODUCTION FACILITIES—OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAMED VOLUMETRIC MODULE
17 Exterior Elements	CONVENTIONAL FINISHED INTEGRATED IN MODULE; CARPORTS
18 Interior Elements	CONVENTIONAL FINISHES INTEGRATED IN MODULE
19 Foundations	CONVENTIONAL SLAB, CRAWL SPACE, OR BASEMENT
20 Comfort Systems	INTEGRATED IN MODULE; OPTIONAL AIR CONDITIONING
21 Plumbing	FIBERGLASS BATHROOM UNITS; COPPER TUBING; INTEGRATED IN MODULE
22 Electrical	INTEGRATED IN MODULE
23 Furnishings	BUILT-IN & FREE STANDING, INTEGRATED IN MODULES
PRODUCTION	
24 Offsite Production	COMPLETE MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ASSEMBLY OF MODULES
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$14,226 PER DWELLING UNIT
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF MODULE SYSTEM
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

Factory Built Homes, Inc.

PROPOSER

Factory Built Homes, Inc., Pittsburgh, Pennsylvania

Wood-framed townhouses are offered that can be built anywhere within a 200-mile radius of the Pittsburgh-area plant. These homes, including all materials, mechanical systems and other prefabricated parts are delivered as a package to the site, and there erected conventionally, in a planned sequence. The total package concept results in a reduction of onsite time and labor, thus lowering overall construction costs.

The townhouses typically are erected in linear groupings of eight, with the living rooms of each opening onto green space in the rear. The exterior of the grouping is brick on the first floor and metal siding in the rear. The second floor is treated as a mansard roof, finished with asphalt shingles. The interior finish is hardcoat plaster over exterior walls, partitions, and the masonry block or brick party wall.

Included is electric baseboard heating, carpeting, and vinyl tile in bath, kitchen, and dining areas.

Summary Information

SITE SYSTEM		
1	**Site Situation**	URBAN; SUBURBAN
2	**Density Range**	
3	**Topography**	
4	**Climate**	
5	**Planning Concepts**	LINEAR GROUPINGS; GREEN SPACE
6	**Nonresidential Functions**	
7	**Circulation**	
8	**Site Planning Services**	
9	**Community Involvement**	
10	**Utilities**	
BUILDING SYSTEMS		
11	**Housing Types**	SINGLE-FAMILY ATTACHED
12	**Unit Variations**	2-BEDROOM UNITS
13	**Design Selection**	SELECTION FROM STANDARD PLANS
14	**State of Development**	PRODUCTION FACILITIES BUILT & OPERATIONAL
15	**Community Involvement**	
BUILDING SUBSYSTEMS		
16	**Structure**	WOOD FRAME; MASONRY BLOCK OR BRICK PARTY WALL; PREFABRICATED WOOD ROOF TRUSSES
17	**Exterior Elements**	MANSARD ROOF; CONVENTIONAL FINISHES; BRICK-VENEER FACING
18	**Interior Elements**	CONVENTIONAL FINISHES
19	**Foundations**	
20	**Comfort Systems**	ELECTRIC BASEBOARD HEATING; CENTRAL COOLING SYSTEM FOR BUILDING
21	**Plumbing**	CONVENTIONAL
22	**Electrical**	CONVENTIONAL
23	**Furnishings**	
PRODUCTION		
24	**Offsite Production**	WOOD FRAME; MECHANICAL SYSTEMS
25	**Onsite Production**	
26	**Onsite Construction**	FOUNDATION; ERECTION
27	**Labor**	
28	**Labor Training Programs**	
29	**Community Involvement**	
ECONOMICS		
30	**Construction Costs**	
31	**Financing Methods**	
32	**Useful Life**	
MANAGEMENT		
33	**Proposer Organization**	CORPORATION
34	**Internal Functions**	PRODUCTION
35	**External Functions**	
36	**Market Area**	200-MILE RADIUS OF PITTSBURGH
37	**Delivery Rate**	
38	**Consumer Protection**	
GENERAL		
39	**Major Innovative Concepts**	
40	**Codes**	ADAPTABLE TO ALL NATIONAL CODES

C. A. Fielland

PROPOSER

C. A. Fielland, Inc., Tampa, Florida
Gus Nick Paras, Architect
Pittsburg Testing, Testing Laboratory
Fielland and Colvin, Inc., Engineers

This proposal, reaching across the full range of housing types, uses an innovative structural shell described as a filament-wound module with integral coloring and waterproofing characteristics. The system, similar to that advanced by the Architectural Research Laboratory of the University of Michigan, provides for a filament coating with binding resin wound on a forming surface called a mandrel. Advantages include use of composite structural materials, specially formed plastic for particular purposes, and specific application of materials to given requirements.

Architecturally, the module shape is easily altered, providing a variation in exterior configuration. A variety in grouping of various housing types on a single site is readily achieved. Use of the module in multistory construction requires a fire barrier to be placed at maximum floor area, these elements serving as shear walls in the structural frame. The modules are stacked a minimum of two stories for low-rise and also two stories in high-rise between structural elements. The depth or length of the unit can vary to meet architectural requirements, with the shell form extended to provide balconies and exterior spaces.

The shell serves as a weather envelope and space enclosure. In high-rise construction, precast concrete encloses core and circulation areas; a means of lifting and placing modules into the core within the structural framework will be developed. The floor subsystem consists of plywood on spacers with chases placed just under the finish floor for wiring, plumbing, and mechanical services.

Heated and cooled air is supplied through an underfloor plenum from a package unit attached to the outside of the module and is powered electrically.

Interior partitions are the sandwich-panel type, constructed of phenolic resin-impregnated honeycomb kraft-fiber stock, faced on both sides with gypsum. The outside to outside thickness is 2 1/2 in.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN, SUBURBAN
2 Density Range	1 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; PARTICULARLY SOUTHEASTERN U.S.
5 Planning Concepts	PLANNED UNIT DEVELOPMENT; URBAN CLUSTERS; GREEN BELT BUFFER; COMMON OPEN SPACES
6 Nonresidential Functions	RECREATION FACILITIES; LAUNDRY; CAR REPAIR FOR SELF-HELP
7 Circulation	SEPARATE PEDESTRIAN AND VEHICULAR CIRCULATION
8 Site Planning Services	
9 Community Involvement	ASSIST LOCAL GROUPS; PLAN EDUCATION NEEDS; SAMPLE GROUP ATTITUDES
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 3 BEDROOMS
13 Design Selection	
14 State of Development	DESIGN STAGE REQUIRING RESEARCH & DEVELOPMENT
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	FILAMENT-WOUND SELF-SUPPORTING SHELL MODULE; FRAME-SUPPORTED FOR HIGH-RISE
17 Exterior Elements	WOOD-FRAME WALLS WITH WEATHER-RESISTANT FINISH; FIBERGLASS-SURFACED SHELL
18 Interior Elements	GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL
20 Comfort Systems	HEATING & COOLING THROUGH UNDERFLOOR PLENUM FROM OUTSIDE PACKAGED UNIT
21 Plumbing	CONVENTIONAL; CENTRAL CORE IN HIGH-RISE
22 Electrical	CHASES UNDER FLOOR FOR WIRING
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULES; PREFAB COMPONENTS
25 Onsite Production	
26 Onsite Construction	
27 Labor	
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP
ECONOMICS	
30 Construction Costs	$12,423 PER UNIT
31 Financing Methods	
32 Useful Life	30 TO 35 YEARS—SHELL
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	CONTINUOUS WOUND-GLASS FILAMENT-RESIN SHELL MODULE
40 Codes	

First Investors of Illinois

PROPOSER

First Investors of Illinois, Inc., Springfield, Illinois

AFFILIATES

Lauchner, Maslauski & Associates, Architects; Lincoln Financial Corporation; Metro Structures, Inc., Plant Construction; Martin Modules, Inc., Sales Subsidiary.

BUILDING SYSTEMS		
11	Housing Types	SINGLE-FAMILY; MULTIFAMILY; COMMERCIAL STRUCTURES
14	State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH AND DEVELOPMENT, PROTOTYPE, & TESTING
BUILDING SUBSYSTEMS		
16	Structure	MODULES OF RIGID STEEL FRAME, FIBERGLASS-REINFORCED PLASTIC WALL & ROOF PANELS
18	Interior Elements	PLYWOOD SUBFLOOR; FIBERBOARD CEILING; PLYWOOD INTERIOR PARTITIONS
20	Comfort Systems	ALL ELECTRIC HEATING & VENTILATION; OPTIONAL COOLING
21	Plumbing	COPPER & PLASTIC PIPING; PREMOLDED FIBERGLASS PLUMBING FIXTURES
PRODUCTION		
24	Offsite Production	VOLUMETRIC MODULE
ECONOMICS		
31	Financing Methods	FINANCIAL CORPORATION FORMED TO MAKE INTERIM LOANS & PERMANENT FINANCING
32	Useful Life	
MANAGEMENT		
33	Proposer Organization	CORPORATION
34	Internal Functions	FINANCING, DEVELOPING, BUILDING, & OPERATING PLANT FACILITIES FOR FRANCHISED MODULES; LAND DEVELOPMENT
35	External Functions	DESIGN; SALES
36	Market Area	MIDWEST
37	Delivery Rate	ONE MODULE PER ASSEMBLY LINE PER 2-HOUR TIME PERIOD
GENERAL		
40	Codes	CONSTRAINING CODES ANTICIPATED

This proposal advances a plan for the prefabrication of steel frame modules. The proposer utilizes standard steel beams, in the traditional mode, for a rigid frame and undercarriage structure. Floor decking material is of plywood. The wall and roof systems entail use of fiberglass reinforced wall and roof panels. Various minor moldings would be of the same materials. A variety of formulations of polyester resins is under consideration.

Insulation will be accomplished through use of rigid polystyrene foam. Foamed-in-place sandwich panels of polyurethane are also applicable as an additional cost-reducing feature. Although more conventional methods are not eliminated, interior finishes are planned with vinyl facing on plywood for ease of maintenance. Many prefinished wall and roof applications are also offered.

Mechanical systems include electric heating with optional cooling, and the plumbing system makes use of copper and plastic piping and premolded fiberglass plumbing fixtures.

The proposer plans a franchised dealer organization which will, in addition to vending the manufactured product, acquire real estate, both developed and undeveloped, with a view toward full modular development and resale.

Fischbach and Moore

PROPOSER

Newbridge Electric Company, Inc., Subsidiary of Fischbach and Moore, Electrical Contractors, Plainview, New York.

The application of managerial and technical methods through which a reduction in both cost and need for skilled manpower in residential electrical installation work is proposed by this electrical contractor. The proposer offers to cooperate with firms seeking assistance in this field through a network of offices over much of the United States.

BUILDING SUBSYSTEMS		
22	Electrical	MANAGERIAL & TECHNICAL SERVICES FOR ELECTRICAL INSTALLATIONS
MANAGEMENT		
33	Proposer Organization	CORPORATION
34	Internal Functions	MANAGERIAL & TECHNICAL SERVICES FOR ELECTRICAL INSTALLATIONS

Freeman Group

PROPOSER

The Freeman Group, Washington, D.C.
Jefferson Townhouse Corporation, Richmond, Virginia
Associated Innercity Developers, Inc., Philadelphia, Pennsylvania
Caffes Organization, Washington, D.C.

AFFILIATES

The Budd Company; Norair Engineering Corporation; General Bronze Corporation

A systems approach to housing construction using proven materials and existing fabrication plants is proposed here. With mobilization of extensive black participation in construction and ownership, along with union organizations, the proposed system is expected to achieve rapid construction of a variety of housing types with minimum labor and costs. The system is expected to accommodate all types of housing from one to four bedrooms in size, and from single-family detached to multifamily high-rise. There are no restrictions as to topography, climate or codes.

The building system consists of standard steel parts fabricated into unit-sized volumetric modules, which can be shipped from factory to site for placement on conventional pier foundations. The modules are framed on one side by steel vierendeel trusses, cross connected by a steel space frame which supports the floor and ceiling. Walls and partitions are of prefinished, shop-fabricated steel panels. Electrical, plumbing, and mechanical systems are of conventional materials, integrated in wall panels and the unit module at the factory.

With the complete use of standardized parts, the system can be fabricated in existing large scale plants with sophisticated tools, or in a variety of small scale shops with simple tools. Thus, the need for large-scale capital investments is reduced, and the work load can be distributed to avoid delays and provide off-season employment.

Cost savings are expected in shortened transportation, in compacted container modules, in reduction of number of building parts, and in extensive use of self-help.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	BLACK PARTICIPATION IN REVISING HOUSING ORDINANCES & CONSUMER ACCEPTANCE
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	
14 State of Development	DESIGN STAGE REQUIRING COMPLETE DEVELOPMENT
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	STEEL-FRAME WITH METAL CURTAIN WALL PANELS
17 Exterior Elements	
18 Interior Elements	
19 Foundations	
20 Comfort Systems	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
21 Plumbing	PREFABRICATED WHERE APPROPRIATE & INTEGRATED INTO SYSTEM
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	STEEL TRUSSES; FACILITY CORES; PANEL CURTAIN WALLS
25 Onsite Production	
26 Onsite Construction	STRUCTURAL FRAME; BOLTING OF PANELS ON FRAME
27 Labor	UNSKILLED AT FACTORY & ONSITE
28 Labor Training Programs	ON-THE-JOB TRAINING
29 Community Involvement	USE OF EXTENSIVE BLACK PARTICIPATION IN CONSTRUCTION; SELF-HELP
ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN; DEVELOPMENT; MANAGEMENT
35 External Functions	PARTICIPATION OF ORGANIZED LABOR IN OWNERSHIP
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

Hackett Housing Systems, Inc.

PROPOSER CONSORTIUM

Hackett Housing Systems, Inc., Prime Contractor, Washington, D.C.

Marshall Erdman & Assoc., Inc., Prototype Construction, Washington, D.C.

AFFILIATES

Arthur Anderson & Company, Financing, Mortgages; Skidmore, Owings & Merrill, Architects-Engineers; Quanta Systems Planning Corporation

A community development plan is proposed which entails land acquisition, architectural services, and program management. Site planning would be vested in locally selected design teams with complete community participation in planning. Proposed units are single-family detached or attached of two to five bedroom sizes to be selected by prospective occupants from a set of standard plans. Clusters of thirteen units an acre are visualized, with adaptability to most all topography and climate. The proposer plans production facilities for basic fabrication which would service an area within a radius of 300 miles.

The building system is anticipated to be of a wood frame volumetric module, with wood siding, kitchen-bath module, painted or paneled gypsum board interiors with conventional foundations designed to local site conditions. Heating, air conditioning and ventilation are conventional, produced as self-contained units at the factory. Electrical systems are integrated with the building system and necessitate single hook-up on-site. Plumbing is a factory fabricated module inclusion of conventional design.

Extensive use is planned of both skilled and unskilled local labor at factory and site locations. The proposer plans to instigate training at the local level to provide both skilled and unskilled labor.

Financing is to be made available in conventional, proposer-supplied, and equity participation modes.

Summary Information

SITE SYSTEM

1 Site Situation	SUBURBAN; RURAL
2 Density Range	4 TO 13 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO MOST NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	DAY CARE CENTER
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; STREET GRID; SIDEWALKS
8 Site Planning Services	LOCAL SELECTED DESIGN TEAM
9 Community Involvement	COMMUNITY PARTICIPATION IN PLANNING
10 Utilities	CONVENTIONAL

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12 Unit Variations	2 TO 5 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	PRODUCTION PLANT, DESIGN STAGE; BUILDING SYSTEM DEVELOPED BUT NOT MARKETED
15 Community Involvement	OPPORTUNITY FOR LOCAL PARTICIPATION & INVESTMENT

BUILDING SUBSYSTEMS

16 Structure	WOOD VOLUMETRIC MODULES
17 Exterior Elements	WOOD SIDING
18 Interior Elements	KITCHEN-BATH MODULE; PAINTED OR WOOD PANELED GYPSUM BOARD PARTITIONS
19 Foundations	CONVENTIONAL; DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	CONVENTIONAL; FACTORY-FABRICATED SELF-CONTAINED UNIT
21 Plumbing	CONVENTIONAL; FACTORY-FABRICATED MECHANICAL MODULE; PLASTIC PIPING WHERE APPROPRIATE
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY; SINGLE ELECTRICAL HOOKUP
23 Furnishings	

PRODUCTION

24 Offsite Production	BEDROOM MODULE; MECHANICAL MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATION; MODULE PLACEMENT UTILITY HOOK-UPS
27 Labor	UNSKILLED & SKILLED
28 Labor Training Programs	TRAINING FOR SKILLED & UNSKILLED LABOR
29 Community Involvement	LOCAL LABOR IN FACTORY; SELF-HELP FINISHING OF INTERIOR

ECONOMICS

30 Construction Costs	$6,875 FOR 2 BEDROOM UNIT OF (720 SQ. FT.)
31 Financing Methods	CONVENTIONAL; PROPOSER SUPPLIED; EQUITY PARTICIPATION
32 Useful Life	STRUCTURAL SYSTEM—100 YEARS; INTERIOR WORK, MECHANICAL & ELECTRICAL SYSTEM—50 YEARS

MANAGEMENT

33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; ARCHITECTURAL DESIGN; LAND ACQUISITION; COMMUNITY DEVELOPMENT
35 External Functions	FINANCING; CONSTRUCTION; SITE PREPARATION
36 Market Area	300 MILE RADIUS OF FACTORY
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Robert Hansen

PROPOSER

Robert Hansen, Planner-Architect-Engineer, Jenkintown, Pennsylvania

The house proposed in this system, 32 ft. X 28 ft. in size, would afford only the essential features of good quality plus the basic amenities, including air conditioning. Two bedrooms are provided, the larger for the children, a smaller one, with private entrance to the bathroom, for the parents. Across the back of the house is a large living-dining area, facing onto an outdoor living area, this in turn oriented to a private rear yard.

Under the concept proposed, 10 of these houses would be sited on an acre-sized lot, each having its own driveway and parking area, with entrance to the house from the driveway. In the rear, the private yards meld visually to give an effect of open space.

In keeping with the income level of the proposed occupants, self-help through interior painting and installation of cabinetry, trim, and added partitions (to make the children's bedroom into two, for example) would be possible.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN OR OTHER APPROPRIATE AREA
2 Density Range	10 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	
5 Planning Concepts	PLANNED UNIT DEVELOPMENT
6 Nonresidential Functions	
7 Circulation	SEPARATE VEHICULAR CIRCULATION
8 Site Planning Services	
9 Community Involvement	USERS TO BE INVOLVED IN PLANNING; INVOLVEMENT OF LOCAL CITY PLANNING BODIES
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	2 BEDROOMS
13 Design Selection	
14 State of Development	OFFERED FOR DEVELOPMENT UNDER CONTRACT
15 Community Involvement	OWNERS; CITY PLANNING BODIES, LOCAL DEVELOPERS, CONTRACTORS, LABOR UNIONS
BUILDING SUBSYSTEMS	
16 Structure	(SYSTEM NOT RELEASED)
17 Exterior Elements	
18 Interior Elements	MODULAR COMPONENTS: CONVENTIONAL FINISHES
19 Foundations	
20 Comfort Systems	CONVENTIONAL HEATING & COOLING
21 Plumbing	
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	SYSTEM COMPONENTS & PRODUCTS FROM NUMEROUS SOURCES
25 Onsite Production	ASSEMBLY OF COMPONENTS & PRODUCTS
26 Onsite Construction	INTERIOR FINISHING
27 Labor	UNSKILLED FOR INTERIOR FINISHING & BUILT-INS; LOCAL CONTRACTORS & DEVELOPERS
28 Labor Training Programs	TO BE DEVELOPED
29 Community Involvement	TO BE DEVELOPED
ECONOMICS	
30 Construction Costs	$10,000 PER DWELLING UNIT OF 896 SQ. FT.
31 Financing Methods	CONVENTIONAL
32 Useful Life	CONVENTIONAL
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	PLANNING & DESIGN
35 External Functions	PERFORMANCE OF DEVELOPMENT CONTRACT
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	MOTIVATING OWNER TO SELF-HELP FINISHING
40 Codes	

David B. Heard

PROPOSER

David B. Heard, Civil Engineer, Waban, Massachusetts

Investigation, evaluation and comparison of plastic and reinforced-plastic housing units, manufactured both in the United States and abroad is proposed. The proposer submits that such an investigation is required because improvement in housing in past years has been largely restricted to mechanical areas such as appliances and power tools for construction, whereas new, and often progressive materials, such as plastics, have not had consideration or acceptance.

The proposer would compare the various systems now on the market on the basis of cost, adaptability to mass production, livability (that is, comfort and convenience of the occupants), durability and maintenance.

Further, purchase and erection of systems determined to be superior would follow for the purpose of full-scale field testing. Finally, the units, which through test prove to be the best would then be put in to manufacture and marketing.

Summary Information

MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	PROPOSES INVESTIGATION & EVALUATION OF EXISTING PLASTIC HOUSING UNITS; SUBSEQUENT TESTING & MANUFACTURING

International Programs

PROPOSER

International Programs, Pratt Institute, Brooklyn, New York

Proposed is a program to erect two to eight-story reinforced-concrete apartment buildings for a housing project to be constructed south of Tel-Aviv, Israel, the housing to be specifically for occupancy by Jewish war victims, many of whom currently are living in the United States and Canada.

All the buildings are to be constructed of factory precast concrete elements, including walls, floor/ceiling panels, stairways, stair towers, and elevators. These are assembled onsite into a load-bearing structure, with adoption of a modular 10-ft. x 10-ft. x 8-ft. structural dimension assuring design flexibility and ease of placing and joining. Exterior enclosure is effected by factory prefabricated insulated sandwich panels. Interior finish is off-the-form concrete for walls, floors, and ceiling, with the presumption being made that occupants may wish to engage in self-help by painting to their own taste.

All mechanical services for the apartment units will be provided by prefabricated units, which will be shipped to the site, ready for installation, including unitized bathroom and kitchen/laundry modules, and packaged central heating/cooling units for an entire building.

Summary Information

SITE SYSTEM

1 Site Situation	SUBURBAN

BUILDING SYSTEMS

11 Housing Types	MULTIFAMILY HIGH-RISE (2 TO 14 STORIES)

BUILDING SUBSYSTEMS

16 Structure	PRECAST REINFORCED CONCRETE WALL & FLOOR/CEILING PANELS
17 Exterior Elements	PREFABRICATED INSULATED SANDWICH PANELS
18 Interior Elements	STAIRS; STAIRTOWERS; ELEVATORS; OFF-THE-FORM CONCRETE FINISH
19 Foundations	
20 Comfort Systems	PACKAGED CENTRAL HEATING/COOLING UNITS
21 Plumbing	UNITIZED BATHROOMS; KITCHEN/LAUNDRY MODULES
22 Electrical	PREFABRICATED
23 Furnishings	

PRODUCTION

24 Offsite Production	PANELS; STAIRTOWERS; MECHANICAL MODULES; INSULATED SANDWICH PANELS
25 Onsite Production	
26 Onsite Construction	ASSEMBLY OF PANELS; INSTALLATION OF MECHANICAL SYSTEMS
27 Labor	
28 Labor Training Programs	
29 Community Involvement	SELF-HELP INTERIOR FINISHING

SUBURBAN; RURAL

SINGLE-FAMILY DETACHED; ADAPTABLE TO ALL TYPES

FLEXIBLE OPEN PLANNING VARIATIONS

G SYSTEM IN DESIGN STAGE REQUIRING DEVELOPMENT

RAME, PLYWOOD-SKIN FLOOR, CEILING & WALL PANELS

CONVENTIONAL FINISHES

CONVENTIONAL

PANELS

FOUNDATION; ERECTION OF PANELS

UNSKILLED ONSITE

SELF-HELP LABOR

$4000 PER DWELLING UNIT (1600 SQ.FT.)

PARTNERSHIP

Lakeland Homes

PROPOSER CONSORTIUM

Lakeland Homes, Inc., Palo Alto, California
Foamcor Corporation, Benecia, California

The innovation in this proposal for combining conventional materials by conventional building processes lies in the projected onsite location of the assembly work. Construction work is performed in a production and manufacturing area immediately adjacent to subdivision sites, with equipment placed in sheds and the work processed through these temporary installations. The finished panels are moved onto the site and erected with a minimum of skilled labor; some hand work is necessary in finished processes.

This concept is based on 4-ft. X 8-ft. modular wall sections constructed of wood for framing and polyurethane foam for insulation. These are combined to form the total weather envelope. Flexibility is gained by changing the internal unit framing or external layouts. Addition of subflooring results in cubes that are the building blocks of the self-supporting module system. Standard lumber sizes and grades are employed. Economies are realized from the use of standard materials, mill cut, formed into the modular units, and unskilled labor is used in many of the production stages.

Advanced plumbing and electrical techniques are combined with closely controlled manufacturing procedures. A feature of this proposal is the production of completely prefabricated bathroom assemblies ready for incorporation with the basic modules into the dwelling unit. Laundry facilities will be in a separate building from the dwellings themselves. All electrical conduits, wiring, and outlets will be installed within the modules.

Competitive bidding among local contractors for the site work is contemplated. Some semiskilled labor will result from on-the-job training, but much of the work will be performed by unskilled crews.

Summary Information

SITE SYSTEM

1 Site Situation
2 Density Range
3 Topography
4 Climate
5 Planning Concepts
6 Nonresidential Functions RECREATION, SOCIAL & COM
7 Circulation SEPARATION OF
8 Site Planning Services PROPOSE
9 Community Involvement
10 Utilities

BUILDING SYSTEMS

11 Housing Types
12 Unit Variations
13 Design Selection
14 State of Development PRODUCTION F
15 Community Involvement

BUILDING SUBSYSTEMS

16 Structure
17 Exterior Elements
18 Interior Elements
19 Foundations CONVENT
20 Comfort Systems
21 Plumbing
22 Electrical
23 Furnishings

PRODUCTION

24 Offsite Production
25 Onsite Production
26 Onsite Construction FO
27 Labor
28 Labor Training Programs
29 Community Involvement

ECONOMICS

30 Construction Costs
31 Financing Methods
32 Useful Life DWELLING—40 YRS; INTERIOR—5

MANAGEMENT

33 Proposer Organization
34 Internal Functions
35 External Functions
36 Market Area
37 Delivery Rate
38 Consumer Protection

GENERAL

39 Major Innovative Concepts
40 Codes

J.T. Industries

PROPOSER

J.T. Industries, Brewster, New York

A modularized, prefabricated, panel system is proposed for construction. Aimed at the owner or builder or occupier, the system is claimed to be flexible in design arrangement, the components easy to put up, and easy to take apart, remodel or modify, and economical.

The basic module of the system is a 4-ft. x 8-ft. panel of wood framed construction, with an exterior skin of plywood, and an interior panel which is snapped-in in place and may be removed later for access to water, electric wiring and other lines which are run through predrilled holes in the studs near ceiling level. The panels are bolted together through predrilled holes in the studs, with a neopreme or foamed-filled gasket assuring a weathertight joint. The panels are bolted through the base plate to the foundation or slab. Other modular panels incorporate windows and doors.

Since all components in the system may be handled by two men, and once joined together become self-supporting, they are expected to be particularly suitable for self-help construction, with the owner/builder possibly subletting foundation work, electrical inspection, and hook-up.

Summary Information

SITE SYSTEM	
1 Site Situation	SUBURBAN; RURAL
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED; ADAPTABLE TO ALL TYPES
12 Unit Variations	
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM IN DESIGN STAGE REQUIRING DEVELOPMENT
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD FRAME, PLYWOOD-SKIN FLOOR, CEILING & WALL PANELS
17 Exterior Elements	
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL
20 Comfort Systems	
21 Plumbing	
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	PANELS
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ERECTION OF PANELS
27 Labor	UNSKILLED ONSITE
28 Labor Training Programs	
29 Community Involvement	SELF-HELP LABOR
ECONOMICS	
30 Construction Costs	$4000 PER DWELLING UNIT (1600 SQ.FT.)
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	PARTNERSHIP
34 Internal Functions	
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

Lakeland Homes

PROPOSER CONSORTIUM

Lakeland Homes, Inc., Palo Alto, California
Foamcor Corporation, Benecia, California

The innovation in this proposal for combining conventional materials by conventional building processes lies in the projected onsite location of the assembly work. Construction work is performed in a production and manufacturing area immediately adjacent to subdivision sites, with equipment placed in sheds and the work processed through these temporary installations. The finished panels are moved onto the site and erected with a minimum of skilled labor; some hand work is necessary in finished processes.

This concept is based on 4-ft. X 8-ft. modular wall sections constructed of wood for framing and polyurethane foam for insulation. These are combined to form the total weather envelope. Flexibility is gained by changing the internal unit framing or external layouts. Addition of subflooring results in cubes that are the building blocks of the self-supporting module system. Standard lumber sizes and grades are employed. Economies are realized from the use of standard materials, mill cut, formed into the modular units, and unskilled labor is used in many of the production stages.

Advanced plumbing and electrical techniques are combined with closely controlled manufacturing procedures. A feature of this proposal is the production of completely prefabricated bathroom assemblies ready for incorporation with the basic modules into the dwelling unit. Laundry facilities will be in a separate building from the dwellings themselves. All electrical conduits, wiring, and outlets will be installed within the modules.

Competitive bidding among local contractors for the site work is contemplated. Some semiskilled labor will result from on-the-job training, but much of the work will be performed by unskilled crews.

Summary Information

SITE SYSTEM	
1 Site Situation	SUBURBAN
2 Density Range	120 DWELLING UNITS PER ACRE
3 Topography	
4 Climate	
5 Planning Concepts	CLUSTERS
6 Nonresidential Functions	RECREATION, SOCIAL & COMMERCIAL FACILITIES; HOBBY SHOPS; AUTO REPAIR SHOPS
7 Circulation	SEPARATION OF PEDESTRIAN AND VEHICULAR CIRCULATION; CUL-DE-SACS
8 Site Planning Services	PROPOSER'S DESIGN WILL BE REVIEWED BY PLANNING COMMISSION
9 Community Involvement	
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 3 BEDROOMS
13 Design Selection	
14 State of Development	PRODUCTION FACILITY—DESIGN STAGE; BUILDING SYSTEM—DESIGN STAGE
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTED WOOD-FRAME VOLUMETRIC MODULE
17 Exterior Elements	CONVENTIONAL FACTORY-APPLIED FINISHES
18 Interior Elements	CONVENTIONAL FACTORY- AND SITE-APPLIED FINISHES
19 Foundations	CONVENTIONAL—SLAB-ON-GROUND OR FOUNDATION BEARING WALLS
20 Comfort Systems	
21 Plumbing	FACTORY-FABRICATED BATHROOM ASSEMBLY
22 Electrical	INTEGRATED WITH BUILDING SUBSYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	
25 Onsite Production	MODULE (TEMPORARY FACILITY ADJACENT TO SITE)
26 Onsite Construction	FOUNDATIONS; MODULE PLACING; UTILITY HOOKUPS; FINISHING
27 Labor	SEMISKILLED; UNSKILLED
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS & SUBCONTRACTORS
ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	DWELLING—40 YRS; INTERIOR—5 YRS; EXTERIOR—5 YRS; ELECTRICAL AND MECHANICAL—10 YRS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

James S. Latenser

PROPOSER

James S. Latenser, Spokane, Washington

AFFILIATES

Idaho Forest Industries, Inc.; Building & Construction Trades Council; Pacific Realty

A basic three-bedroom dwelling, originally developed for the leisure home market, is proposed for housing on scattered lots.

The house, 26 ft. 8 in. x 37 ft. 4 in., is of wood post-and-beam construction with a conventional gabled roof and is site-erected, piece-by-piece, following detailed instructions which refer to each piece in the house package by number. Every component is precut with no need for cutting or fitting onsite, and consequently with no waste. Site erection of the basic shell, including partitions, is accomplished by a local contractor, with the simplicity of the process making possible self-help by the owner.

Roof decking, floor, and walls of the home are single thickness (1 5/8 in.) tongue-and-groove western whitewood planking and may be left exposed in its natural rough-faced finish for both interior and exterior walls, although an insulation and cladding package is available as required for exterior wall finish. Shingles or other roofing may be applied over the roof deck at the owner's option, with a panel adhesive recommended as weather protection should permanent roofing be delayed.

Plans for the home indicate a plumbing wall (these parts being available as a separate package) against which are backed all fixtures in the bathroom on one side, and kitchen sink and laundry facilities on the other.

A plant for cutting, shaping, marking and shipping of the basic home package is in operation, with the unit presently being marketed, primarily in the Pacific Northwest.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	3 BEDROOM
13 Design Selection	
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM BEING MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	WOOD POST & BEAM CONSTRUCTION; CONVENTIONAL GABLED ROOF
17 Exterior Elements	ROOF DECKING
18 Interior Elements	OPTIONAL CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; CONCRETE PIERS WITH SPREAD FOOTINGS
20 Comfort Systems	SPECIAL AIR HANDLING UNITS FOR HEATING & AIR CONDITIONING
21 Plumbing	PLUMBING WALL FOR KITCHEN & BATH FACILITIES
22 Electrical	ELECTRICAL WALL
23 Furnishings	
PRODUCTION	
24 Offsite Production	WOOD COMPONENTS; PLUMBING WALL; ELECTRICAL WALL
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ASSEMBLY OF PREPACKED ELEMENTS; UTILITY HOOK-UPS
27 Labor	UNSKILLED
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP
ECONOMICS	
30 Construction Costs	$13,500 PER UNIT INCLUDING SITE DEVELOPMENT
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ENGINEERING; DESIGN
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Andrew Longaker

PROPOSER

Andrew Longaker and Associates, San Antonio, Texas.

Tilt-up hollow-core concrete panels, factory fabricated, constitute the principal feature of this proposal for speedy construction of single-family and multifamily low-rise housing. The panel cores are filled with thermal insulating material, and an iron perimeter, or frame, is provided to support the panel as it is trucked to the site. This surface also is brought into use for welding panel connections at the site. The panels are cast in 4-in. and 6-in. thicknesses, providing a load-bearing element suitable for two-story construction.

Wall and door frames and electrical and plumbing lines are embedded in the panel pour. The finished unit is approximately 60 percent heavier than conventional housing, the proposer claiming this as a distinct advantage under hurricane or tornado conditions. Roof slabs are of the same basic construction with adhesive-bonded conventional finishes. Ceiling areas are faced with acoustical materials. Interior wall finishes can be painted, prefinished plywood glued to the concrete surface, or vinyl wall covering. Exterior wall surfaces are exposed concrete varied in texture, color, and decoration by the addition of special aggregate.

A premolded, packaged bathroom unit is proposed. The mechanical system for heating is a wall gas-fired furnace without transmission ducts.

The firm has had experience in erecting nonhousing buildings with this preformed panel system and now proposes to apply the developed techniques to the housing field. Regular bank financing is available for this purpose. Distribution would be through a broker network.

Summary Information

SITE SYSTEM	
1 Site Situation	CLEARED LOTS BETWEEN BUILDINGS
2 Density Range	25 TO 70 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	RECREATIONAL FACILITIES; COMMERCIAL & SOCIAL FACILITIES OPTIONAL
7 Circulation	CUL-DE-SACS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	
13 Design Selection	
14 State of Development	PRODUCTION PLANT, DESIGN STAGE; BUILDING SYSTEM, REQUIRES DEVELOPMENT
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SITE ERECTED CONCRETE PANELS
17 Exterior Elements	CONCRETE FINISHES
18 Interior Elements	CONVENTIONAL FINISHES; BATHROOM MODULES
19 Foundations	CONVENTIONAL
20 Comfort Systems	GAS FIRED WALL HEATER; INTEGRATED VENTILATION; AIR CONDITIONING OPTIONAL
21 Plumbing	PACKAGED BATHROOM UNIT
22 Electrical	CONDUITS CAST IN WALL PANELS
23 Furnishings	
PRODUCTION	
24 Offsite Production	PANELS; PLUMBING & ELECTRICAL SUBSYSTEMS
25 Onsite Production	FOUNDATIONS
26 Onsite Construction	ASSEMBLY OF PANELS
27 Labor	SKILLED; SEMISKILLED; UNSKILLED
28 Labor Training Programs	
29 Community Involvement	SELF-HELP; LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$10.14 PER SQ. FT.
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURE—100 YEARS; PLUMBING—50 YEARS; HEATING—20 YEARS; COOLING—10 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM (TO BE FORMED INTO CORPORATION IF CONTRACTED)
34 Internal Functions	
35 External Functions	
36 Market Area	100-MILE RADIUS
37 Delivery Rate	15 MINIMUM—125 MAXIMUM DWELLING UNITS PER MONTH
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	CONSTRUCTION SYSTEM
40 Codes	

Irving Merritt

PROPOSER

Irving Hugh Merritt, Architect, Metuchen, New Jersey

An aluminum-framed single family structure, designed and fabricated around a 24-ft. x 24-ft. module is proposed by this architect. Facilities within any house produced under this concept would be divided into living, dining, and kitchen areas in one module, and bedrooms in another, with still a third module incorporating garage, storage, and utility-laundry room.

By combining the modules side-by-side, or abutting a common foyer, a single-level configuration is achieved; or, by making provision for a staircase, the modules may be stacked to form a two-story house. The bedroom modules being designed in two or three room plans, the number of bedrooms in any single home may range from two to six depending upon the number and type of modules used.

The modules are to be paneled on the exterior, with a variety of designs being available for architectural variety, contrasting with the top and bottom aluminum trim brand. Interior wall paneling similarly is available in a choice of finishes and designs. Roofing for the structures may be hipped or flat, depending upon whether the optional architectural treatment is Colonial, Georgian or contemporary.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	2 TO 6 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DESIGN COMPLETE
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	ALUMINUM FRAME 24 FT. X 24 FT. MODULE
17 Exterior Elements	ROOF; EXTERIOR ASSORTED PANELING
18 Interior Elements	STAIRCASE; PARTITIONS
19 Foundations	
20 Comfort Systems	
21 Plumbing	
22 Electrical	
23 Furnishings	
PRODUCTION	
24 Offsite Production	COMPONENTS & ALUMINUM-FRAME MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ERECTION OF SEVERAL MODULES ADJACENT TO EACH OTHER
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	HOUSE DESIGNS
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

Richard A. Peltier

PROPOSER

Richard A. Peltier, Williamsville, New York

The proposer turned to the aerospace industry and oceanography to borrow concepts for developing innovative methods of panel fabrication and materials. The untested plan projects two intersecting hemispherical domeroof elements, supported by two intersecting cylindrical wall bases forming a dwelling unit in the shape of a figure 8. The basic material would be glass-reinforced plastic or plastic-reinforced honeycomb formed in a one-step process.

The roof would be composed of six interchangeable spherical sectors. Walls may be integral or segmented and composed of concrete, fiber, or glass-reinforced materials. Openings could be cut out after erection. Exterior wall finish would be permanent pigment or sprayed epoxy, and a wide variety of interior finishes is suggested.

Heating would be supplied by gas-fired furnaces, either through baseboard radiation or plenum chambers with distribution through ceiling tile punched with randomly spaced holes. If a hot water system is used, it is proposed that hot tap water be drawn from the furnace. First and second floors would constitute separate heat zones.

The proposal calls for new methods of joint fastening, caulking, adhesive and insulation applications, floor covering, and wall and roof erection, but the techniques are not detailed. The type of construction proposed is adaptable to new city locations and would require reconditioning of public attitudes toward acceptance of form and appearance.

A major part of the proposal involves vendor capabilities and cost-reduction potentials in applying highly specialized aerospace and oceanographic materials and processes to high-volume dwelling construction.

Summary Information

SITE SYSTEM	
1 Site Situation	NEW TOWN; RURAL
2 Density Range	100 SINGLE-FAMILY DETACHED DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; CIRCULAR COMMUNITY MODULES; COMMON OPEN SPACES
6 Nonresidential Functions	PARK; PLAY & SHOPPING FACILITIES; SCHOOL, LIBRARY & COMMUNITY CENTER
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR CIRCULATION; RADIAL RESIDENTIAL STREETS
8 Site Planning Services	
9 Community Involvement	
10 Utilities	CONVENTIONAL
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED
12 Unit Variations	
13 Design Selection	
14 State of Development	BUILDING SYSTEM—FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE, FIBER-, OR GLASS-REINFORCED PLASTIC WALL PANELS; OPTIONAL VOLUMETRIC MODULES
17 Exterior Elements	CYLINDRICAL WALLS & DOME ROOM; PORCHES
18 Interior Elements	SUSPENDED CEILINGS; OPTIONAL ENTIRE ROOM MODULES; FIBER OR PLASTIC FINISHES
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE SITUATIONS
20 Comfort Systems	GAS-FIRED FURNACE HEATING; OPTIONAL HOT WATER BASEBOARD OR CEILING PLENUM
21 Plumbing	OPTIONAL DOMESTIC HOT WATER SUPPLIED BY FURNACE UNIT
22 Electrical	CONVENTIONAL
23 Furnishings	OPTIONAL BUILT-IN OR PORTABLE MODULAR SHELF UNITS
PRODUCTION	
24 Offsite Production	WALL & ROOF PANELS OR MODULES; MODULAR SHELF UNITS; PACKAGED HEATING UNIT
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; PANEL OR MODULE PLACEMENT; UTILITIES HOOKUPS
27 Labor	UNSKILLED & SKILLED FOR PLANT PRODUCTION; UNSKILLED FOR ONSITE INTERIOR FINISHING
28 Labor Training Programs	
29 Community Involvement	LOCAL CONTRACTORS; LOCAL PLANT PRODUCTION; LOCAL CONSTRUCTION
ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	DESIGN & APPLICATION OF INNOVATIVE MATERIALS; FABRICATION CONCEPTS
40 Codes	CONFLICTS ANTICIPATED, REQUIRING TEST & DEMONSTRATION AND/OR CODE WAIVER

Pioneer Homes

PROPOSER

Pioneer Homes, Division of Up-Right, Inc., Berkeley, California

AFFILIATES

Michael Goodman, Architect

A self-help concept wherein the homeowner contributes up to 25 percent of the total cost of the dwelling unit in work-equity is a principal feature of this proposal. The proposed system, already developed and being marketed, involves the factory manufacture of conventional wood panel components and site erection by the tilt-up process. The method accommodates two-story three-bedroom units and single-story two-bedroom units. Interior walls are assembled from precut parts and faced with gypsum board. Exterior wood frame walls are finished in wood paneling or metal applications. These components are formed into standard modules measuring 33 ft. x 19 ft. 6 in.; two of the modules are joined to form a single dwelling unit.

A maximum volume production of 5,000 units per year is projected.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2 Density Range	UP TO 25 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	CONVENTIONAL; UNDERGROUND WIRING
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	2 TO 3 BEDROOMS
13 Design Selection	STANDARD PLAN ONLY
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM MARKETED
15 Community Involvement	USER EVALUATION PROGRAM
BUILDING SUBSYSTEMS	
16 Structure	WOOD FRAME WALL, FLOOR & ROOF COMPONENTS
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	
20 Comfort Systems	CONVENTIONAL
21 Plumbing	CONVENTIONAL; DISTRIBUTION SYSTEM INTEGRATED WITH BUILDING SUBSYSTEM
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYBSYSTEMS
23 Furnishings	
PRODUCTION	
24 Offsite Production	PANELS & COMPONENTS
25 Onsite Production	
26 Onsite Construction	TILT-UP OF PANELS
27 Labor	UNSKILLED LABOR; SKILLED SUPERVISION AT FACTORY & ONSITE
28 Labor Training Programs	
29 Community Involvement	SELF-HELP LABOR; LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$17,500 PER UNIT FOR 20 TO 30 PROTOTYPES; $15,000, 1,000 UNITS PER YEAR (BEST RATE)
31 Financing Methods	NATIONAL HOUSING PARTNERSHIP PLAN FOR LARGE SCALE PRODUCTION
32 Useful Life	STRUCTURE- 50 YEARS OR MORE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPERS; FRANCHISERS; LICENSORS
35 External Functions	CONSTRUCTION; ARCHITECTURAL DESIGN
36 Market Area	
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR BEST RATE; 5,000 MAXIMUM PER YEAR
38 Consumer Protection	1-YEAR GUARANTEE BY CONTRACTOR ON HEATING & AIR CONDITIONING EQUIPMENT
GENERAL	
39 Major Innovative Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Riebe Enterprises

PROPOSER

N.J. Riebe Enterprises, Inc., General Contractors, Yuma, Arizona

A steel rigid-frame system is used as the basic structure in this proposal. The proposer approaches the problem of providing volume housing by concentrating on the outer shell of the dwelling unit only. No interior elements in the proposed system will be load bearing, resulting in total flexibility of interior arrangement. Room division will be obtained through the use of free-standing wardrobes and the prepackaged kitchen and bathroom modules.

The planning module shows a basic 4-ft. x 8-ft. panel used in covering the steel frame; 36-in. ribbed, galvanized, enameled panels comprise the roof deck. This housing, constructed on concrete slab-on-ground foundations, is provided from stock building modules for handling by local contractors.

Principal feature of the Riebe method is the absence of interior layout; the system proposes no fixed partitions or closets, in fact, no fixed rooms. The dwelling unit is expandable and features three standard prefabricated panels in the wall shell.

The bathroom and kitchen components are completely prefabricated when they leave the factory, ready for easy hookup at the building site. One innovation is the proposed storage areas under beds.

It is estimated that 5,000 units per year can be turned out at maximum production rate. More than that already have been manufactured and erected on a field-constructed basis. The proposer would franchise the production concept to local contractors.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL TYPES OF SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED
12 Unit Variations	2 TO 4 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14 State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEMS DEVELOPED & MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	STEEL WALL PANELS; STEEL SKELETON; PREFINISHED RIBBED GALVANIZED ROOF PANELS
17 Exterior Elements	NON-STRUCTURAL EXTERIOR WALLS
18 Interior Elements	PARTITIONS, KITCHEN/BATH CORE; PARTITION WARDROBES
19 Foundations	SLAB-ON-GROUND WITH GRADE BEAMS
20 Comfort Systems	CONVNETIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
23 Furnishings	BUILT-IN STORAGE WALLS; FREE STANDING WARDROBES; UNDER-BED STORAGE AREAS
PRODUCTION	
24 Offsite Production	WALL AND ROOF PANELS; KITCHEN/BATH UNITS; STORAGE & FURNITURE UNITS
25 Onsite Production	
26 Onsite Construction	FOUNDATION; FRAME; PLACING OF PANELS
27 Labor	SEMI-SKILLED AT FACTORY
28 Labor Training Programs	ON-THE-JOB TRAINING IN MANUFACTURING PROCESS
29 Community Involvement	USE OF LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$7,223 PER UNIT; 5,000 UNITS PER YEAR (BEST RATE)
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	ALL
35 External Functions	
36 Market Area	
37 Delivery Rate	5,000 DWELLING UNITS PER YEAR (BEST RATE)
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	FACTORY INTEGRATED KITCHEN/BATH CORE
40 Codes	

William R. Singer

PROPOSER

William R. Singer, Jr., Yalesville, Connecticut

The proposer offers a building system based on a self-supporting volumetric module which is a 10-ft. cube. He designates these cubes as building blocks and states that they may be clustered and stacked to form rooms and entire living units at low cost.

The concept is based on a 5-ft. module technology and would utilize components already available. The cube-shaped module would be steel-framed, with sandwich core panels and plastic glazing.

Summary Information

BUILDING SYSTEMS	
11 Housing Types	
12 Unit Variations	
13 Design Selection	
14 State of Development	BUILDING SYSTEM—DESIGN STAGE REQUIRING FURTHER DEVELOPMENT
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTING STEEL FRAME VOLUMETRIC MODULE WITH SANDWICH PANELS
MANAGEMENT	
33 Proposer Organization	INDIVIDUAL
34 Internal Functions	DESIGN
35 External Functions	
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

Nelson Spoto

PROPOSER

Nelson Spoto, AIA, CSI, Architect, Los Angeles, California

Citing its experience in fields ranging from residential and commercial construction to facilities for nuclear and aerospace development and alluding to the experience of its associates, this architectural firm is prepared to enter into a team arrangement, if desirable, in order to develop immediate designs for prototype construction of new housing.

Summary Information

MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ARCHITECTURAL-ENGINEERING RESEARCH, DEVELOPMENT & DESIGN SERVICES

Stanford Builders

PROPOSER

Stanford Builders, Inc., (Subsidiary of Gold Seal International, Inc.), San Jose, California.

Proposed is a housing system based on buildings of modular design constructed from modular sandwich panels erected on a rigid steel frame. A variety of floor plans and varying types of housing are possible, but emphasis is placed mainly on detached structures.

The concept originally was developed for use on Guam, and the resultant building therefore is considered to be much stronger than required in most regions of the United States. The panels consist of a 3-in.-thick core of polyurethane, covered by an exterior skin of textured aluminum, and finished on the inside with prefinished, tempered hardboard. The panels, factory-produced in several sizes for variety of layout and configuration, are used for both walls and flat roofs, and may be used for the floor system, as well, where the topography precludes a slab foundation.

The panels are fitted together by use of aluminum extrusions with rigid, permanently colored vinyl trim over any visible connections (such as at the junction of partitions to exterior walls). Floors will be finished with resilient flooring, or optional carpeting. Cabinetry of vinyl-surfaced particalboard is shipped to the site knocked-down and assembled and installed by local crews. Partitions are of prefinished, tempered hardboard.

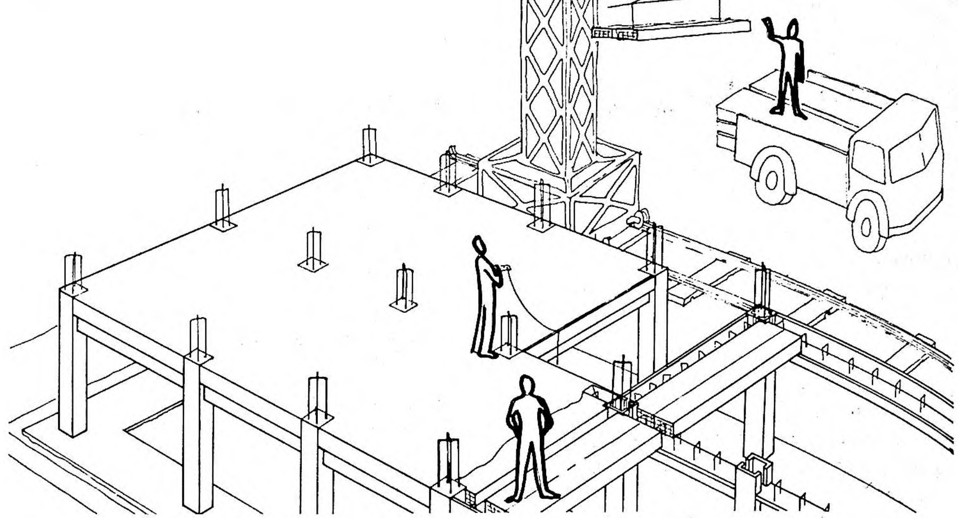
All utility lines for the system are under the slab, with plastic pipe being used for drainage and galvanized iron or copper for water lines. All above floor plumbing will be enclosed by double partitions for ready access in the event of malfunction. The rooms will be cooled by unit air conditioners, although a central, under-the-slab system can be installed as an option.

The modular, panelized system is completely developed, but not presently being marketed in the United States. However, a volume production rate of 2,600 units per year is projected.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL CLIMATES
5 Planning Concepts	COMMON GREEN SPACES
6 Nonresidential Functions	RECREATIONAL FACILITIES
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED (ADAPTABLE TO ATTACHED & MULTIFAMILY LOW-RISE)
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
14 State of Development	FULLY DEVELOPED BUT NOT BEING MARKETED IN UNITED STATES
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	STRESSED-SKIN WALL, FLOOR & ROOF PANELS (URETHANE CORE); STEEL FRAME
17 Exterior Elements	
18 Interior Elements	HARDBOARD PARTITIONS; BUILT-IN CABINETRY
19 Foundations	CONCRETE SLAB FLOOR/FOUNDATION
20 Comfort Systems	UNIT AIR CONDITIONERS OR OPTIONAL CENTRAL SYSTEM UNDER THE SLAB
21 Plumbing	UNDER-SLAB PLASTIC DRAINAGE, IRON OR COPPER WATER LINES; ENCLOSED ABOVE-FLOOR
22 Electrical	DISTRIBUTION LINES UNDER THE SLAB
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULAR SANDWICH PANELS; STEEL FRAMING
25 Onsite Production	
26 Onsite Construction	FOUNDATION; ERECTION OF STEEL FRAME & PANELS; UTILITY HOOK-UPS
27 Labor	UNSKILLED FOR PLANT & CONSTRUCTION
28 Labor Training Programs	ON-THE-JOB TRAINING
29 Community Involvement	USE OF LOCAL UNSKILLED LABOR
ECONOMICS	
30 Construction Costs	$11,604 PER UNIT , 2,600 UNITS PER YEAR (BEST RATE)
31 Financing Methods	CONVENTIONAL OR PROPOSER SUPPLIED
32 Useful Life	STRUCTURE—50 TO 70 YEARS; MECHANICAL & ELECTRICAL—30 TO 40 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	OVERALL PLANNING, PRODUCTION, & CONSTRUCTION
35 External Functions	
36 Market Area	
37 Delivery Rate	2,600 HOMES PER YEAR (BEST RATE)
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

Structurapid System



PROPOSER

Gaburri Structurapid System, Alassio (Savona) Italy (Original Proposer: Indian Creek Construction, U.S. Representative for Structurapid, New York, New York.

A proprietary structural framing system is proposed to help reduce costs of high-rise multifamily housing. Compared with conventional cast-in-place concrete construction, savings of up to 15 percent are claimed for the system, which consists of factory-cast concrete beams and columns.

The savings claimed for the system result primarily from the speed of erection which the prefabricated components make possible. The erection cycle starts after foundations have been completed, with crane placement of the columns and most other components of the system. The location of first floor columns are marked by the stub ends of reinforcing cages which protrude from the footings. The hollow-core, precast columns are slipped over the reinforcing cages which seat them on previously leveled bearing surfaces in the foundation. The reinforcing cages are sufficiently rigid to hold the columns erect without external support. Beams are then fitted to the columns; the beams are basically T-shaped sections with stirrups protruding from the top, a vertical leg at both ends becoming a tongue-like protrusion. This tongue fits into a vertical groove in the top of the column, resulting in an accurate and quickly made connection. With the beams fitted into the columns, the hollow core is filled with a stone concrete and extensions of the column reinforcing cages are placed for the seating of the columns for the next floor.

After columns are filled, floor slab panels are placed—these may be of any type, a typical example being precast hollow floor planks. The floor slabs are supported on a lip formed at the top of the T beams and concrete is placed between adjacent slabs encasing reinforcement protruding from the beams, tieing beams and completed slabs into a structural, monolithic entity. Beams of the perimeter of the building have a slab high vertical edge or spandrel which serves as a form and becomes part of the completed slab. With slabs in place and completed, the cycle is repeated for the next floor.

Contributing further to the construction time savings is the fact that no scaffolding, shoring, reshoring or formwork is required. The system is estimated to reduce overall building costs by 3 percent.

A plant for manufacture of components, originally developed in Italy, is now in operation and the system is currently being marketed.

SITE SYSTEM		
1	Site Situation	URBAN
4	Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS		
11	Housing Types	MULTIFAMILY HIGH-RISE
13	Design Selection	SELECTION FROM STANDARD PLANS
14	State of Development	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEM BEING MARKETED
BUILDING SUBSYSTEMS		
16	Structure	PRECAST CONCRETE BEAMS, COLUMNS & PANELS
19	Foundations	CONVENTIONAL; SLAB
PRODUCTION		
24	Offsite Production	COLUMNS, BEAMS, PANELS
26	Onsite Construction and Erection	FOUNDATIONS; ERECTION OF COLUMNS; BEAMS, PANELS; UTILITY HOOK-UP
ECONOMICS		
30	Construction Costs	ESTIMATED SAVINGS OF 15% ON STRUCTURE, 3% ON TOTAL BUILDING COST
MANAGEMENT		
33	Proposer Organization	CORPORATION
34	Internal Functions	U.S. REPRESENTATIVE FOR SYSTEM DEVELOPER
GENERAL		
39	Major Innovative Concepts	BUILDING SYSTEM: PRECAST CONCRETE FRAMING, ERECTION CYCLE

R. L. Sweet Lumber Company

PROPOSER

R. L. Sweet Lumber Company, Kansas City, Kansas

AFFILIATES

Construction Loan Company; Park Development Company

This proposal describes a partial plant operation, featuring the assembly of precut lumber, with much of the structural and finishing work done at the building site. It is contemplated that more and more of the field work will be moved into the shop to effect greater economies. The system presently in operation produces three housing units per day (single shift) but this could be increased substantially for larger market demands. The proposal runs to single-family detached units only.

The plant process consists of machine nailing into subassemblies lumber that has been precut and marked piece by piece. Packages shipped include materials for the final unit except for foundation, mechanical and electrical installations, paint, resilient floor covering, and ceramic tile. The walls are in panelized form with insulation in place. All split-jamb door units and window units are preassembled and shipped ready for installation. The field work thus entails rough erection, installation of plumbing, heating and electrical systems, application of siding, wallboard and trim, flooring, and paint finishing.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	2 & 3 BEDROOMS
13 Selection Method	FROM STANDARD PLANS
14 State of Development	COMPLETED DEVELOPED & BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure	WOOD PANEL & FRAME COMPONENTS
17 Exterior Elements	SIDING
18 Interior Elements	PARTITIONS, FLOORING
19 Foundations	CONVENTIONAL; REINFORCED CONCRETE
20 Heating, Ventilating, Air Conditioning	CENTRAL GAS FORCED AIR FURNACE
21 Plumbing	CONVENTIONAL PLASTIC DRAINAGE PIPE
22 Electrical	CONVENTIONAL
PRODUCTION	
24 Offsite Production	PRECUT & PREASSEMBLY OF FRAME & PANEL COMPONENTS
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF STRUCTURE; INTERIOR & EXTERIOR FINISHING
27 Labor	UNSKILLED AT PLANT
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$10,458, 500 UNITS PER YEAR (AT BEST RATE)
31 Financing Methods	CONVENTIONAL
32 Useful Life	TOTAL STRUCTURE—40 TO 50 YEARS
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	OVERALL PRODUCTION
35 External Functions	ONSITE CONSTRUCTION BY LOCAL CONTRACTORS
37 Production Rate	3 HOUSING UNITS PER DAY (SINGLE SHIFT); 500 UNITS PER YEAR (BEST RATE)

Torus Corporation

PROPOSER

Torus Corporation, San Francisco, California

AFFILIATES

Norman T. Gilroy and Associates, Architects-Planners; Donald J. O'Leary & Associates, Economic and Market Analysis; T. I. Properties Corporation, Financial Support; P.P.G. Industries, Research and Testing.

Three basic volumetric modules—molded repetitively from a rigid, cement-like, fiber-reinforced, plasticized, impervious, insulative material—comprise, along with foldable utility cores, interior partitions, and cabinetry, the components of the proposed housing system.

The 3 basic modules (weather envelopes) combine or adapt to fit a wide range of floor plans and site situations, and an innovative, proprietary installation system permits them to be sited directly on only roughly prepared ground, with conventional foundations being unnecessary, representing a considerable savings in costs. The resultant intimate relationship of the units to the ground combined with an innovative mounded landscaping technique operates to preserve privacy and a feeling of open landscape and to enhance the natural environment.

The nerve center for the housing system is the foldable core unit which incorporates major appliances and fixtures for bathroom and kitchen, instant hot water generation, and low-pressure sewage handling. Associated with it is a baseboard electric-conduit distribution and heating system, with heating either by electric induction, or by underfloor plenum distribution of hot air. Related to the utility core is the concept of combining all site services in a precast or site-extruded sidewalk-curb section, making connection of the various services simple and quick and also reducing clutter and obstructions on the site or in the street.

The proposed system is in the final stages of research. Manufacture and distribution of the units is expected to be through 12 plants located across the country, the first one probably to be on the West Coast. Patents are pending on the major innovative concepts embodied in the proposal.

Summary Information

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
10 Utilities	LOW-PRESSURE SEWAGE HANDLING SYSTEM; PRECAST CURB DISTRIBUTION SYSTEM
BUILDING SYSTEMS	
11 Housing Types	
12 Unit Variations	
13 Design Selection	
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION, & TESTING
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULES OF CEMENT-LIKE, FIBER-REINFORCED PLASTICIZED INSULATION
17 Exterior Elements	
18 Interior Elements	FOLDABLE UTILITY MODULE; PARTITIONS
19 Foundations	UNNECESSARY
20 Comfort Systems	
21 Plumbing	ELECTRIC BASEBOARD OR UNDER FLOOR PLENUM FORCED AIR HEAT DISTRIBUTION;
22 Electrical	
23 Furnishings	FOLDABLE UTILITY CORE MODULE
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES
25 Onsite Production	PLACING OF MODULES
26 Onsite Construction	
27 Labor	
28 Labor Training Programs	
29 Community Involvement	
ECONOMICS	
30 Construction Costs	
31 Financing Methods	
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	RESEARCH & TESTING
35 External Functions	DESIGN & PLANNING
36 Market Area	
37 Delivery Rate	
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	

type A proposals

UNRELEASED INFORMATION

The following is a listing of proposers who, because of proprietary interests or for other reasons, did not release their proposal data for publication.

Albers Manufacturing Co., Inc., Artesia, California
Alodex Corporation, Memphis, Tennessee
Alphatec Corporation, Washington, D.C.
American Eagle, Div. of Tamko, Joplin, Missouri
American Novawood Corporation, Lynchburg, Virginia
American Trico Company, Phoenix, Arizona
Andes & Roberts Construction Co., Independence, Missouri
BRS Industries, Miami, Florida
Basic Dwellings, Inc., Claremont, California
Babak Systems, Inc., Dayton, Ohio
Baugh & Coody, Inc., Albany, Georgia
Harry Boswell Associates, Hyattsville, Maryland
W. S. Bowers Company, Seattle, Washington
Bressler & Reiner, Washington, D.C.
Built Environment Corporation, The, Washington, D.C.
Harry E. Burns, Jr., & Associates, Jacksonville, Florida
Camus, Ltd., Farnham, Surry, England
Chambers & McGregor, Inc., Houston, Texas
Circle Real Estate, Inc., Severna Park, Maryland
Classic Homes, Aliquippa, Pennsylvania
Community Systems Group, Boston, Massachusetts
Continental Homes Inc., Roanoke, Virginia
Coremode, Inc., San Carlos, California
Creative Housing, Inc., Rochester, Minnesota
Davis Computer Systems, Inc., New York, New York
Dukor Industries, Inc., Redwood City, California
Dyna-Strux, Inc., Tucson, Arizona
Economy Forms Corporation, Des Moines, Iowa
Robert D. Essert, Poughkeepsie, New York
Fisher, Moore & Starr, Davis, California
Full-O-Pep, Inc., Bloomington, Indiana
Futurama Homes, Inc., Miami Beach, Florida
Golden State Consortium, Long Beach, California
Hallet Homes, Inc., Albuquerque, New Mexico
Harlee-Quattlebaum Construction Co., Inc., Florence, South Carolina
Harper-Drake & Associates, Inc., Milwaukee, Wisconsin
Housing Systems Company, Ventura, California
Jackbilt, Inc., Burbank, California
Jal-Donn Modular Building, Inc., Westlake, Ohio
Jonathan Housing Corporation, Chaska, Minnesota
Walk Jones/Mah & Jones, Inc., Memphis, Tennessee
Justus Contracting Co., Inc., Indianapolis, Indiana
Ketai Company, Inc., Southfield, Michigan
Kilps Realty, Inc., Hales Corner, Wisconsin
Larwin Company, Beverly Hills, California
G. R. Leischner Construction Co., Seattle, Washington
Locus Homes International, Brussels, Belgium
Low Income Section Housing Corporation, Lebanon, Virginia
Luxury Manufacturing and Supply Co., Oklahoma City, Oklahoma
MSH Development Corporation, Rochester, New York
Paul Maag & Associates, Flushing, New York
Maurice E. Maloney Systems, Inc., Buffalo, New York
W. J. Maxwell, Virginia Beach, Virginia
Metropolitan Structures, Inc., Chicago, Illinois
Milligan Industries, Inc., Livonia, Michigan
Modufab Corporation, Fort Lauderdale, Florida
Modular Constructors, Inc., Woburn, Massachusetts
Modular Homes Corporation, Detroit, Michigan
Modular Housing Systems, Inc., Selingsgrove, Pennsylvania
Modular Manufacturing Co., San Francisco, California
Modular Space Corp., Ann Arbor, Michigan
Modulux, Inc., Newark, California
R. D. Monroe Construction Co., Inc., Shawnee Mission, Kansas
Moore & Lee, N. Little Rock, Arkansas
Municipal Housing Development Corporation, Newington, Connecticut
Myers Brothers Construction Co., Inc., Los Angeles, California
New Dawn Development Corporation, Houston, Texas
Northwest Homes, Chehalis, Washington
Nu-Scientific Industries, Inc., Livingston, Tennessee
U. S. O'Connor, Stockton, California
Gilbert Oliver, San Francisco, California
Truman A. Olson, Inc., Shevlin, Minnesota
Otis International Inc., Dallas, Texas
Potlatch/Speedspace, San Francisco, California
Pre/Built Homes, Inc., Detroit, Michigan
Precon Corporation, Cleveland, Ohio
Neil Prescott, Fresno, California
R & B Manufacturers, Lemon Grove, California
Eric Ravndal III, Realtor, Winter Park, Florida
Charles A. Reese, Ellicott City, Maryland
Sampen, Inc., Houston, Texas
Sanford Enterprises, Inc., Pomano Beach, Florida
Schickel Research, Birmingham, Michigan
Schumacher and Associates, Kansas City, Missouri
Space-Crete, Chicago, Illinois
Standard Systems, Inc., Anaheim, California
Structural Plastics Corporation, Osseo, Minnesota
Synestructics, Inc., North Hollywood, California
Taylor Marchant Construction Co., Columbia, South Carolina
Terrabuilding Systems, Inc., Salt Lake City, Utah
Uniblock, Inc., Dutton, Michigan
United Module, Inc., Benton, Illinois
Vaughan Associates, Washington, D.C.
Waldron, Goldstein & Britton, New York, New York
Weir Development Company Inc., Dayton, Ohio
Winston Industries, Inc., Double Springs, Alabama
XL, Inc. (Implex Corporation), Harrisburg, Pennsylvania
Y.A.N., Sheboygan Falls, Wisconsin
Yetter Homes, Inc., Savannah, Georgia

type B proposals

COMPLETE INFORMATION

A. A. M., Inc.

PROPOSER

A.A.M., INC., Cincinnati, Ohio

This corporation, in association with a supplier of building products, proposes to expand the scope of its present operations in the Cincinnati, Ohio area in order to produce, on a volume basis, housing for low-income families. Municipal authorities have pledged support in the securing of building sites for such projects, and the housing units proposed for erection on these sites are stated as fulfilling all the requirements established by the Department of Housing and Urban Development.

BUILDING SYSTEMS	
14 **State of Development**	PRODUCTION FACILITIES—UNSPECIFIED; BUILDING SYSTEM—COMPLETELY DEVELOPED & BEING MARKETED
15 **Community Involvement**	

MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	PRODUCTION; ERECTION
35 **External Functions**	DESIGN

ACS Company, Inc.

PROPOSER

ACS Company, Inc., Honolulu, Hawaii

The essential element of this proposal is a special patented adhesive joint used for joining together prefabricated wood-framed floor, wall, and roof panels. It is estimated that construction of buildings with this system has resulted in cost reductions ranging from 12 to 18 percent and one-third savings in construction time.

The adhesive-component-system joint is a semicircular, two-element device, consisting of male and female halves which fit together and are secured by a waterproof adhesive. The joint may be used to join wall panels having both skins attached. It can be milled by any lumber mill from 2-in. x 3-in., 2-in. x 4-in., 2-in. x 6-in., or 2-in. x 8-in. lumber at a very slight premium in price over standard framing lumber, and it may be incorporated in any size panel.

Although panels joined by the joint system may be prefabricated with conventional nail fastening, the use of adhesive is recommended both for the labor savings which accrue and the greater resultant strength. Adhesives properly used, as in this joint system, produce a structure four times stronger than nailing would produce.

Field experience indicates that unskilled labor can successfully assemble housing components joined by this system. This leads to effective self-help potential by prospective owners, with additional self-help steps being painting, setting cabinets, laying floor tile, and installing some fixtures and hardware.

An added advantage of the joint system is that, in making future modifications, the hazard of possible saw damage is eliminated, there being no nails in the construction.

BUILDING SYSTEMS	
14 State of Development	JOINT SYSTEM DEVELOPED & BEING MARKETED IN HAWAII
BUILDING SUBSYSTEMS	
16 Structure	FLOOR, WALL & ROOF PANELS JOINED BY A SPECIAL SEMICIRCULAR JOINT APPLIED TO WOOD FRAME CONSTRUCTION WHEREBY PREFABRICATED PANELS CAN BE SITE ERECTED
PRODUCTION	
24 Offsite Production	FLOOR, WALL & ROOF PANELS USING TRADITIONAL FASTENING METHODS OR ADHESIVES
26 Onsite Construction and Erection	ERECTION OF PANELS
27 Labor	UNSKILLED
28 Labor Training Programs	TECHNICIANS TO TRAIN UNSKILLED LABOR FOR A FEE
29 Community Involvement	LOCAL CONTRACTORS; SELF-HELP LABOR
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	JOINT SYSTEM DESIGN
35 External Functions	STRUCTURAL ENGINEERING; MECHANICAL ENGINEERING
GENERAL	
39 Major Innovative Concepts	JOINT DESIGN; ADHESIVES, INSTEAD OF NAILS, TO JOIN PREFABRICATED PANELS
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Abreu & Robeson

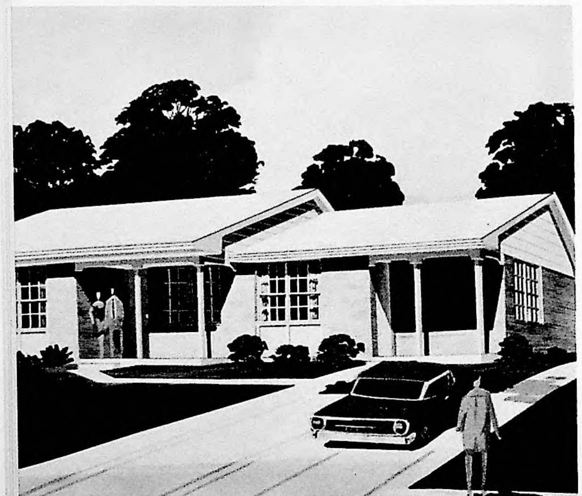
PROPOSER

Abreu & Robeson, Inc., Architects & Engineers, Atlanta, Georgia

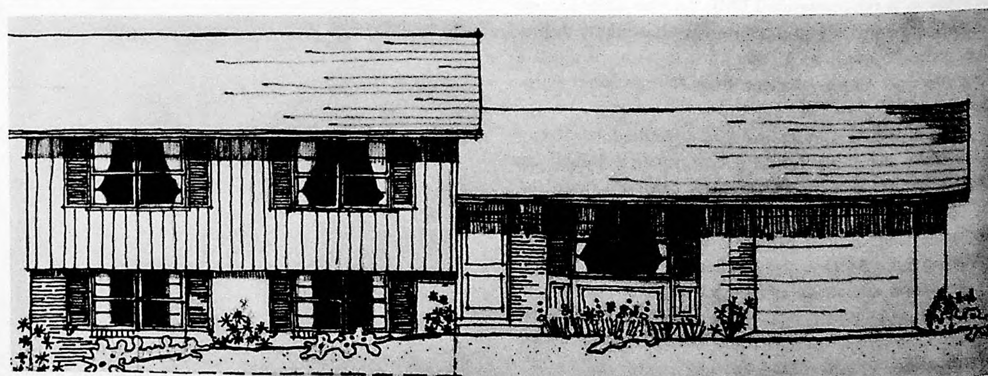
New administrative procedures are proposed here, with emphasis on quick acquisition of sites, and design freedom and latitude for architect/engineers.

Housing under this proposal can be constructed in the conventional manner with options offered for on-site shop fabrication or factory manufacture of components such as walls, partitions, and trusses. No major cost savings are cited. Brick exteriors are indicated for the proposed single-family detached and attached housing units.

Prebuilt components include kitchen cabinets, shower enclosures, storage units, heat duct subsystems and packaged mechanical units. The housing units are of platform frame construction with conventional wood applications. Interior partitions are painted and exterior walls are sheathed with 1/2-in. insulation board before brick veneering. A conventional slab-on-ground foundation with perimeter footings is specified. Central heating is supplied by either gas or electricity.



SITE SYSTEM	
1 Site Situation	URBAN RENEWAL
2 Density Range	5 TO 12 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	
6 Nonresidential Function	DAY CARE CENTER; MAINTENANCE SHOPS; RECREATION AREA
7 Circulation	CUL-DE-SACS; THROUGH STREETS; SEPARATE VEHICULAR AND PEDESTRIAN CIRCULATION
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
BUILDING SYSTEMS	
11 Housing Type	SINGLE-FAMILY DETACHED & ATTACHED
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FROM STANDARD PLANS
BUILDING SUBSYSTEMS	
16 Structure	PLATFORM FRAME CONSTRUCTION WITH CONVENTIONAL WOOD APPLICATIONS
19 Foundations	CONVENTIONAL SLAB-ON-GROUND WITH PERIMETER FOOTINGS
20 Comfort Systems	FACTORY-BUILT HEATING DUCT SYSTEM
21 Plumbing	ELECTRICAL OR GAS HOT WATER GENERATION IN BUILDING; COPPER & CAST IRON PIPING
PRODUCTION	
24 Offsite Production	WALLS, PARTITIONS & TRUSSES
25 Onsite Production	WALLS, PARTITIONS & TRUSSES
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF COMPONENTS; UTILITY HOOK-UPS; FINISHING
29 Community Involvement	USE OF LOCAL LABOR
ECONOMICS	
30 Construction Costs	$14.50 PER SQ. FT.
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN
GENERAL	
39 Major Innovative Concepts	NEW ADMINISTRATION PROCEDURES FOR RESIDENTIAL HOUSING PROCESS



Advocate Community Development

PROPOSER

Advocate Community Development Corporation, Philadelphia, Pennsylvania

AFFILIATES

Veland and Junker, Architects

The proposer corporation is composed of members of the Church of the Advocate (Philadelphia), residents of inner-city areas, senior citizens, housewives, college students, and others who have joined in proposing a housing concept responsive to the particular needs of the prospective occupants. In addition to furnishing the physical housing itself, they anticipate furnishing employment, perhaps, in addition to the self-help potential in the units themselves, by setting up locally owned and manned woodworking firms for manufacture of kitchen cabinets, stairs, and interior partitions. Various committees of the residents would be organized to further community goals, drawing upon community resources and opinion in implementing many desirable social goals, including training of the unskilled in both crafts and office work.

The housing system proposed is designed to meet two basic criteria: (1) the capability to incorporate increasing numbers of prefabricated components, as they become available, at lower costs than conventional elements; and (2) allow maximum opportunity for individualization of units within a structural framework which is economically and speedily erected. The structural system, of self-supporting precast concrete bearing walls and floor and roof panels, is predicated on close control of dimensional tolerances, so that present and future components made to similar tolerances can be interchangeable. The factory-produced components are erected speedily with a minimum of onsite labor, because they fit accurately and are readily joined to form a sound, structural entity.

Within the living space provided, large areas of clear space afford initial variety of interior layout and subsequent modification. Further individualization is afforded by the nonbearing front and rear exterior walls which close in the living space formed by the pairs of party walls and floor elements. These may be of prefabricated wood, metal, or masonry construction, in a variety of finishes, with a typical exterior being redwood plywood. The structural elements, of standard manufacture presently available on the market, consist of 6-in. thick hollow concrete planks for floor and roof panels, and 8-in. thick solid planks for the bearing walls. Interior finishes may be varied, using conventional materials. Options such as awnings, storage shelters, and porch enclosures also are available.

Kitchen and bathroom cores in the two-story row-house structures will be stacked vertically to simplify utility runs and to lower costs, with crane placement of these completely packaged units foreseen for the future.

Recognizing the conditions often found in redeveloped, inner-city areas, with the soil being unstable and permeated with debris and rubble, the proposer recommends a concrete caisson foundation system. Three caissons would typically support a 16-ft. to 20-ft. long concrete party wall, the wall spanning, as a beam, from caisson to caisson, thus eliminating need for a grade beam.

SITE SYSTEM	
1 Site Situation	URBAN
2 Density Range	10 TO 20 UNITS PER ACRE
3 Topography	UP TO 5% SLOPES
4 Climate	TEMPERATE ZONES
5 Planning Concepts	CLUSTER DEVELOPMENT
9 Community Involvement	COMMITTEES TO DETERMINE USER NEEDS; LOCAL PLANNING ADVISORY GROUP
BUILDING SYSTEMS	
12 Unit Variations	3 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEM DEVELOPED & PROTOTYPE BEING CONSTRUCTED
15 Community Involvement	SPECIAL COMMITTEES OF SENIOR CITIZENS, HOUSEWIVES, TO DETERMINE USER NEEDS
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE PARTY WALLS; HOLLOW CONCRETE FLOOR & ROOF PANELS
17 Exterior Elements	NONBEARING FRONT & REAR WALLS; AWNINGS; STORAGE SHELTERS; PORCH ENCLOSURES
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; CONCRETE CAISSON WITH CONCRETE PARTY WALL SERVING AS BEAM
21 Plumbing	KITCHEN & BATHROOM CORE UNIT
23 Furnishings	BUILT-IN & FREE STANDING
PRODUCTION	
24 Offsite Production	KITCHEN & BATH CORES
25 Onsite Production	PANEL COMPONENTS
26 Onsite Construction and Erection	FOUNDATIONS; ASSEMBLY OF PANEL ELEMENTS
27 Labor	UNSKILLED
28 Labor Training Programs	TRAINING IN CONSTRUCTION TRADES; REAL ESTATE; LAW; OFFICE MANAGEMENT
29 Community Involvement	LOCAL LABOR; CONTRACTORS; SELF-HELP
ECONOMICS	
30 Construction Costs	$12.90 PER SQ. FT.
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	ORGANIZATION & MANAGEMENT
35 External Functions	DESIGN; PRODUCTION; CONSTRUCTION

Adlerstein Associates

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 4 BEDROOMS (FLEXIBLE)
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH
15 Community Involvement	FAMILIES CAN ACQUIRE ADDITIONAL HOUSING UNITS AS NEEDED OR RELEASE UNITS AS SIZE OF FAMILY DECREASES
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL ARCHITECT
34 Internal Functions	MANAGEMENT; ARCHITECTURAL CONTROL
GENERAL	
39 Major Innovative Concepts	EXPANDABLE & REDUCABLE LIVING UNITS THROUGH USE OF CONNECTING DOORS

PROPOSER

Adlerstein Associates, Architects, Valley Stream, New York

Design of multifamily housing based on the "mingle" plan is proposed. The "mingle" housing concept is a deliberate, reasoned attempt to reverse the trend toward mobility, which has led to a fragmentation of family life as it was once known in this country.

Under the "mingle" concept, generations once more could live within the same dwelling unit without the economic dislocations which often militate against this, because rooms could be added or subtracted from the family dwelling as required, thus obviating the need to seek a completely new dwelling as the family increases or decreases.

The type of housing proposed is to be achieved by designing multifamily low- or high-rise structures so that a series of interconnecting doors and carefully positioned sleeping units makes each unit potentially expandable from an efficiency apartment to a four-bedroom dwelling. Thus, a young couple, starting with an efficiency apartment, might over the years add one, then more bedrooms as the children arrive, and, when the grandparents come to join them, add still another. As the oldest child grows, and leaves home, they could remove one and then more bedrooms as the family once again reverts to just two or three persons.

Prefinished, removable wall paneling might contribute also to the effectiveness and attractiveness of units, with each family selecting the interior finish of its choice, thus giving a feeling of permanence and individuality to each dwelling unit. The expandable housing plan concept could be implemented through rental arrangement, cooperative purchase, or condominium plans.

Allen & Hoshall

PROPOSER CONSORTIUM

Diversified Engineering Company, Prime Contractor, Memphis, Tennessee

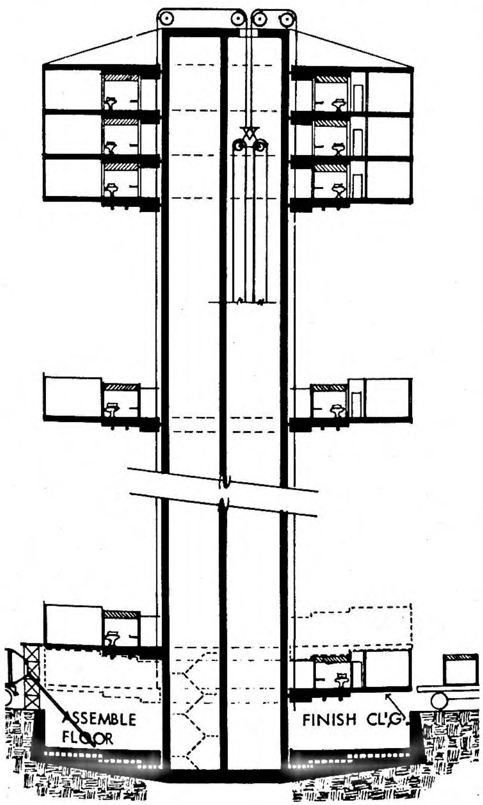
Robert Lee Hall & Assoc., Architects, Inc., Memphis, Tennessee

Allen and Hoshall, Consulting Engineers, Memphis, Tennessee

Reduced in-place costs of up to 50 percent for high-rise apartments are projected for the hoisting method of construction proposed, when mass-produced components are used. The patented system put forward, which is completely developed and being marketed, consists of a round core tower, around which are constructed at ground level, circular floor slabs, each slab being hoisted up the tower as completed. The floor slabs, structural entities in themselves, are supported by the central core structure from which they radiate.

Basic to the concept is the application of assembly-line organization and rationale in a vertical direction. This is applied to the core itself with an ascending platform functioning as the work station from which materials are fed up the core in a relatively completed state. The floor slabs, on the other hand, are completely manufactured (presumably cast in situ, of reinforced concrete) at a ground-level work station, with the completed slabs moving up the line (which is, in fact, the central core).

The floor slabs also serve as a lifting platform for the many prefabricated components (such as partitions and mechanical systems) with which each floor of apartments is completed, once the slabs are structurally secured to the core. In addition to supporting the floor slabs, the central core furnishes circulation for access to the dwelling units (via elevator, stairwells and landings) and serves for vertical distribution of utilities and services.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	VARIABLE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PARKS & PLAYGROUNDS ARRANGED AROUND CIRCULAR STRUCTURES
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 3 BEDROOMS (FLEXIBLE)
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM DEVELOPED & BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure	CIRCULAR CONCRETE OR STEEL FLOORS; CENTRAL STRUCTURAL CORE TOWER
17 Exterior Elements	CONVENTIONAL COMPONENTS & FINISHES
18 Interior Elements	CONVENTIONAL COMPONENTS & FINISHES
19 Foundations	UNIT TYPE FOUNDATION; ADVANTAGEOUS EXCEPT IN AREAS THAT REQUIRE STEP FOOTINGS
20 Comfort Systems	CONVENTIONAL
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL
PRODUCTION	
24 Offsite Production	COMPONENTS (BATHROOM & KITCHEN ASSEMBLIES; PARTITIONS; ETC.)
25 Onsite Production	PRECAST CONCRETE FLOOR SLABS; PREASSEMBLY OF COMPONENTS
26 Onsite Construction and Erection	ASSEMBLY OF COMPONENTS & ERECTION OF CORE & FLOORS
29 Community Involvement	SELF-HELP COMPLETION OF FINISH & DECOR
ECONOMICS	
30 Construction Costs	10% TO 50% SAVINGS OVER CONVENTIONAL PROJECTED
32 Useful Life	BASIC STRUCTURE—50 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	MANAGEMENT; ARCHITECTURAL DESIGN; ENGINEERING; CONSTRUCTION
35 External Functions	COMMUNITY PLANNING
GENERAL	
39 Major Innovative Concepts	TOWER HOIST METHOD; FLOOR SLABS HOISTED AROUND A ROUND CORE TOWER
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Allied Consultants

PROPOSER

Allied Consultants, Inc., Houston, Texas

The proposer organization, made up of ten member-firms in disciplines ranging from architecture, engineering, and marketing through real estate and public relations, proposes to accomplish research to establish criteria for developing housing in a new city, which will serve low-income families.

The proposed research would start with the low-income families, themselves, in order to determine basic housing desires and needs. This information would aid architectural-engineering specialists in designing various sized single-family and multifamily living units. Study of these designs would determine module sizes into which the living units could be subdivided.

With the basic units established, a product search would be made to find new products or methods which would result in variety and cost savings. The architect-engineer team would then study the application of these materials in relation to building and maintenance costs.

The research would then be handed over to the structural engineering team which would seek answers to design of both substructures and superstructure of the module in terms of achieving reduced weight, adequate strength, ease of handling, both during transport and during site erection, and reduced first cost and maintenance costs. Mechanical and electrical engineering teams similarly would seek the best solutions for their respective systems in relation to the basic module selected.

With the research to this point having produced a marketable, acceptable and economically feasible unit, attention would be turned to ways of achieving a truly rationalized manufacturing and assembly procedure. Explored would be a computerized system of scheduling output from bonded warehouses, to satellite manufacturing plants, to a dual-line assembly plant for the modules, followed by alerting of transportation and erection crews at the site.

Investigation would be followed to means of planning for the site, the city, and the inhabitants themselves. The information produced from the research must enable planners to design a completely new city so that it operates as a unit, with each part complementing the other. The proposer group feels that its research also must involve solving of many inter-related problems—employment opportunities, recreational outlets, social patterns, group activities.

Finally, acknowledging the importance of financing in any approach to providing housing, research will be directed to solving the perennial problem of how to pay for a solution to housing shortages.

SITE SYSTEM	
1 Site Situation	DEVELOPMENT OF NEW CITY
5 Planning Concepts	FUTURE DEVELOPMENT OF NEW CITY DETERMINED FROM RESEARCH
9 Community Involvement	STUDIES OF RECREATIONAL FACILITIES & USER NEEDS; RESIDENT TRAINING PROGRAMS; SCHOOLS
BUILDING SYSTEMS	
11 Housing Types	FUTURE DEVELOPMENT THROUGH RESEARCH OF APPROPRIATE HOUSING TYPES
12 Unit Variations	DEVELOPMENT OF BASIC MODULE SIZES FOR APPROPRIATE LIVING UNITS
15 Community Involvement	RESEARCH OF LOW-INCOME FAMILIES TO DETERMINE HOUSING DESIRES & NEEDS
BUILDING SUBSYSTEMS	
16 Structure	STUDY OF MASS-PRODUCED MODULAR LIVING UNITS; DEVELOPMENT OF VOLUMETRIC MODULES
20 Comfort Systems	FUTURE DEVELOPMENT OF CENTRAL PLANT
21 Plumbing	FUTURE DEVELOPMENT OF CENTRAL MECHANICAL FACILITIES
PRODUCTION	
24 Offsite Production	RESEARCH & DEVELOPMENT OF MANUFACTURING & ASSEMBLY PROCESS FOR COMPLETE MODULES
ECONOMICS	
30 Construction Costs	RESEARCH OF COSTS
31 Financing Methods	RESEARCH OF FINANCING
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	RESEARCH TO ESTABLISH CRITERIA FOR ALL PHASES OF THE HOUSING PROCESS

Allis-Chalmers

PROPOSER CONSORTIUM

Allis-Chalmers, Manufacturing, Milwaukee, Wisconsin
Harper-Drake & Associates, Inc., Architects, Milwaukee, Wisconsin.

This proposal suggests the need for comprehensive research and development in the broad areas of housing concept definition, component and subsystem elements, prototype system design, prototype system construction and evaluation, and production. Studies also would be undertaken in the less exact fields of interaction of various housing types with occupants and environment, size limits of living spaces, and the relation of users to water supply and waste disposal. The development of prototype hardware for major components of systems and subsystems would require 2 years; the construction and evaluation of prototype living units would require approximately 3 1/2 years after start of the program.

The study would be carefully oriented to take full account of the ability of energy sources, water supply and waste-handling facilities to keep up with Breakthrough production goals. The first task would be the examination of basic requirements and constraints to better define the problems of system design. The housing system to be researched is a living unit made up of several spaces or volumes for the existence of the human being or family unit. Flexibility would be a primary requirement of such a housing system.

Various design concepts would be explored to relate the dwelling unit to the housing complex and the housing complex to the many variations of site environment. The types of housing units involved would include single-family detached and attached as well as multifamily low- and high-rise.

The proposer would examine advanced technologies outside the housing field for possible developments readily adaptable to shelter construction.

Other elements of the proposed study include effectiveness criteria, compliance with requirements and constraints, economics of use, departures from present practices, refinement of conceptual designs, selection of centerline concepts, and identification of areas requiring further research.

SITE SYSTEM	
1 Site Situation	STUDY OF ALL HOUSING SITUATIONS
3 Topography 4 Climate 5 Planning Concepts	DEFINITION OF LIMITATIONS ON LOCATION & OPERATION OF LIVING UNITS TO PREVENT FURTHER DESTRUCTION OF NATURAL RESOURCES; ADVANCED VARIABLE RADIATIVE TECHNIQUES EXAMINED AS MEANS TO ADAPT TO CLIMATIC CHANGE; STUDY BALANCED ENVIRONMENT FOR MAN AND NATURE; ESTABLISH LIMITS ON ALLOWABLE POLLUTION
6 Nonresidential Functions 9 Community Involvement	STUDY OF INTERACTIONS OF HOUSING TYPES WITH OCCUPANTS AND WITH SURROUNDING NATURAL POLITICAL & SOCIAL ENVIRONMENT; CONCEPTS OF DWELLING UNIT-TO-HOUSING-TO-SITE ENVIRONMENTS
10 Utilities	SINGLE ENERGY SYSTEM; CENTRAL HEATING WATER & WATER TREATMENT; SYSTEMS APPROACH TO ENERGY DEMANDS; AUTOMATED GARBAGE HANDLING
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	TWO OR MORE CONCEPTUAL DESIGNS FOR EACH OF THE HOUSING TYPES
13 Design Selection	STANDARD PLANS WITH OPTIONS IN ULTIMATE PRODUCTION VERSIONS OF HOUSING
14 State of Development	PROPOSED STUDY OF HOUSING CONCEPT DEFINITION
15 Community Involvement	NEEDS RELATED TO VARIOUS SYSTEMS & SUBSYSTEMS; STUDIES OF USER PATTERNS, HABITS, AND TRADITIONS
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	STUDY OF LIGHTWEIGHT HIGH-STRENGTH STEELS, MARAGING STEELS, CORROSION RESISTANT MATERIALS, PLASTICS, HONEYCOMB & FOAM SANDWICH PANEL MATERIALS; SELECTIVE SURFACE TREATMENT TO VARY THE RADIATIVE CHARACTERISTICS; PLASTICS IN ALL FORMS OF INDUSTRY FOR POSSIBLE EXTENSION TO HOME BUILDING; CRYOGENICS ADVANCES FOR THERMAL INSULATION
20 Comfort Systems	DEFINE ENERGY REQUIREMENTS; POSSIBLE USE OF SMALL STEAM BOILER PER UNIT; TRADE-OFF STUDIES OF OPTIMUM ENERGY/INSULATION SYSTEM
21 Plumbing	REQUIREMENTS OF WATER PURITY, HARDNESS & QUANTITY AND WASTE DISPOSAL; STUDY OF GARBAGE COMPACTING & MODULAR SEWAGE SYSTEMS PER UNIT
22 Electrical	NATURAL-GAS-FIRED OR HEATING-FUEL-FIRED STEAM BOILER POWERING STEAM-DRIVEN ELECTRICAL GENERATOR PER HOUSING UNIT
PRODUCTION	
24 Offsite Production	STUDY OF AUTOMOTIVE INDUSTRY PROCESSES, TECHNIQUES, & MATERIALS; STUDY OF EFFECTS OF MASS PRODUCTION ON INDIVIDUALITY; COMPUTER-CONTROLLED PRODUCTION
ECONOMICS	
30 Construction Costs	PARAMETRIC STUDIES OF ECONOMIC MERITS OF PROPOSED CONCEPTS; SENSITIVITY ANALYSIS BASED ON OWNER'S OR USER'S COST AS PRIMARY DEPENDENT VARIABLE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; ADVANCED TECHNOLOGY; MANUFACTURING TECHNIQUES; MARKETING; DEVELOPMENT CAPABILITIES
35 External Functions	COORDINATION WITH BUILDING INDUSTRY; HUMAN NEEDS; ADVANCED BUILDING TECHNIQUES
GENERAL	
39 Major Innovative Concepts	USE OF ADVANCED TECHNOLOGY & PRODUCTION, MARKETING, & MANAGEMENT TECHNIQUES; SYSTEMS APPROACH TO LIVING UNIT & ENVIRONMENTAL DESIGN

American Standard

PROPOSER

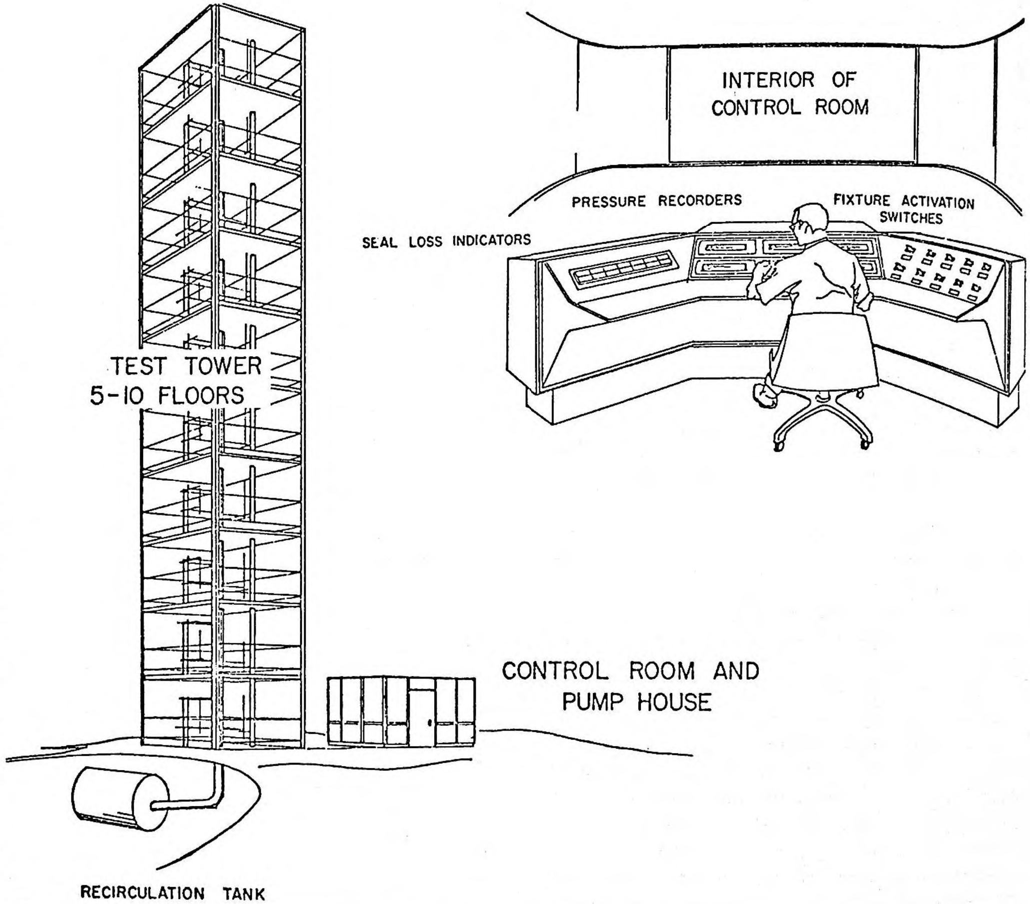
American Standard, Inc., Research & Development Center, New Brunswick, New Jersey

The English single-stack system and the Sovent system—two plumbing waste systems which have been developed overseas and promise considerable savings if adopted in this country—are probable subjects of a proposed research program. The overall purpose of the research would be evaluation of innovative waste systems to determine their suitability for this country, and investigation into the possibility of combining the best functional qualities of all into a superior system which would have the lowest possible cost and which could be installed in minimum time with minimum labor skills.

Noting that sanitary services and underground drainage account for as much as 10 percent of total building construction costs, the proposer of this research suggests that there should be strong incentive for its successful conclusion in a system which will be economical and yet of a high standard of quality.

The proposed research would be in two phases. Phase I would consist of a broad study of the problem, analysis and evaluation of the innovative systems selected for further study, and preparation of a testing program, including recommendations for test facilities and methods. As part of Phase I, it is anticipated that both an English single-stack system and a Sovent system will be designed using domestic fittings and piping; and possibly a third system would be designed, incorporating some features of each and of other systems.

Phase II of the research project will be actual testing and comparative evaluation of the several innovative systems and a conventional system in a specially constructed test tower, five to ten stories high, in which flow conditions can be simulated for up to 20 floors. All plumbing and appliances will be those in standard use today, so that the only variables to be tested will be the actual plumbing waste systems themselves.



BUILDING SUBSYSTEMS	
21 **Plumbing**	RESEARCH & TESTING OF SINGLE STACK & SOLVENT WASTE SYSTEMS SINGLY & IN COMBINATION, TO SIMPLIFY SYSTEM & ENABLE MASS PRODUCTION OF COMPLETE PLUMBING WASTE SYSTEMS.
PRODUCTION	
24 **Offsite Production**	COST STUDY OF NEW PRODUCTION TECHNIQUES FOR PLUMBING WASTE SYSTEMS
ECONOMICS	
30 **Construction Costs**	PROPOSED RESEARCH TO MINIMIZE CONSTRUCTION COSTS IN HOUSING
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	MANAGEMENT; RESEARCH; TESTING PLUMBING WASTE SYSTEM

Amstore

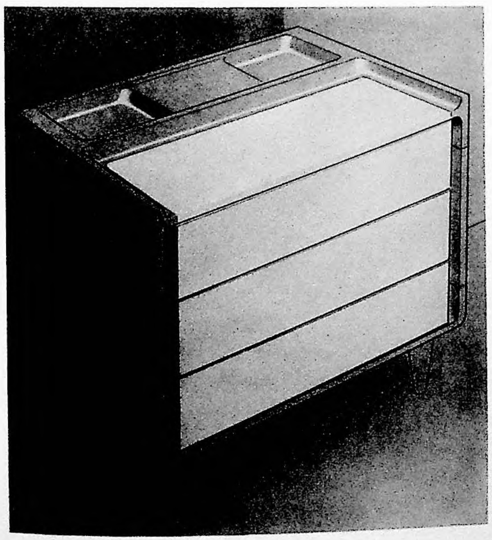
PROPOSER

Amstore Corporation, Muskegon, Michigan

Factory-produced plastic furniture and partitions are proposed as a cost-saving feature for Operation Breakthrough housing. The proposer would manufacture the products in a three-phase operation involving plastic furniture, plastic partitions, and the combination of these in an interior wall assembly. Material to be used is structural foam in an injection molding process with the introduction of expanding gas to form a cellular structure. This provides an end product with a density below that of resin. The innovation here is in the combination of foaming with the injection mold.

The materials and foaming process were selected by the proposer for durability of product and economies of manufacture. Lower machine pressures are required, contributing to lower end-product cost. The furniture line proposed includes desks, vanities, chests and kitchen cabinets; it is estimated 30 pieces can be molded per hour. Several advantages over wood are listed in addition to cost savings: high impact resistance, surfaces that will not chip, crack, or break, and an unlimited variety of shapes, colors, and surface textures.

Usable floor space could be increased by 5 sq. ft. per sleeping unit with use of the built-ins over conventional detached furniture. The fixed items can be financed under the mortgage. The proposer would test acceptance by using juries of low- and moderate-income prospective users.



BUILDING SYSTEMS	
14 State of Development	PRODUCTION PROCESS & BUILDING ELEMENTS REQUIRE RESEARCH, DESIGN, DEVELOPMENT & TESTING
15 Community Involvement	IDENTIFICATION OF NEEDS BY CONSUMER REACTION & TEST JURIES
BUILDING SUBSYSTEMS	
18 Interior Elements	DEVELOPMENT OF MOLDED FOAM PLASTIC PARTITIONS & INTEGRATED FURNITURE; HIGH IMPACT SURFACES; CONVENTIONAL PLASTIC FINISHES
23 Furnishings	MOLDED FOAM PLASTIC BUILT-IN FURNITURE INCLUDING DESKS, VANITIES, CHESTS, KITCHEN CABINETS
PRODUCTION	
24 Offsite Production	BUILT-IN FURNITURE; PARTITIONS; COMBINED FURNITURE & PARTITION UNITS
26 Onsite Construction and Erection	INSTALLATION OF BUILT-IN FURNITURE, PARTITIONS & COMBINED UNITS
29 Community Involvement	INSTALLATION BY NEIGHBORHOOD CONTRACTORS & SUBCONTRACTORS
ECONOMICS	
30 Construction Costs	$40.00 PER PLASTIC CHEST, COMPARED WITH $60.00 FOR SIMILAR WOODEN CHEST; COST OF PLASTIC PARTITION LESS THAN FOR WOOD FRAME OR MASONRY UNITS
31 Financing Methods	PROPOSER SUPPLIED & CONVENTIONAL
32 Useful Life	IN EXCESS OF COMPARABLE CONVENTIONAL FURNITURE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; RESEARCH, DESIGN, DEVELOPMENT & TESTING; FINANCE; PRODUCTION
35 External Functions	PROFESSIONAL ADVICE TO ASSIST IN IDENTIFYING NEEDS
37 Delivery	30 PIECES PER HOUR AT CENTRAL PLANT
GENERAL	
39 Major Innovative Concepts	INJECTION MOLDING OF STRUCTURAL PLASTIC FOAM FOR FURNITURE & PARTITIONS
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Andro Corporation

PROPOSER

Andro Corporation, Janitrol Division, Columbus, Ohio

In this proposal, minor modifications would be made to the proposer's present components line to produce modular air-integrated and regulated units. The result would be two standardized systems for single-family and multifamily housing units: (1) an integrated heating and air conditioning system; (2) an air distribution and return manifold system which would form the skeleton framework for presized utility rooms or closets. Presently available parts could be assembled in this way to service up to 1,800 sq. ft. of living space; research and development would produce designs for similar systems to serve larger areas. Ancillary support units to provide quality improvement of air supply are available and could be used readily as added installations.

No labor problems are expected in the systems' use, but jurisdictional troubles could be encountered with module installations. The proposed system presently is in the design stage, using gas as the energy source. Components include heat exchangers, compressors, blowers, fans, and distribution ducts. Applications for both single-zone and multizone air control are being developed.

The systems are proposed for factory manufacture with field installation activities reduced to a minimum. Access to outside walls would be a requisite unless duct venting techniques are developed. Rooftop installations are described as being desirable.

BUILDING SYSTEMS	
14 **State of Development**	COMPONENTS CURRENTLY BEING MARKETED; MINOR MODIFICATIONS WILL BE MADE TO EXISTING COMPONENTS TO DEVELOP IMPROVED SYSTEMS
BUILDING SUBSYSTEMS	
20 **Comfort Systems**	DEVELOPMENT OF PRESIZED, INTEGRATED AND REGULATED, FACTORY-MADE HEATING, AIR CONDITIONING AND AIR DISTRIBUTION SYSTEMS; SINGLE AND MULTIZONE OPTIONS
PRODUCTION	
24 **Offsite Production**	HEATING, AIR CONDITIONING, AND AIR DISTRIBUTION FACILITIES
26 **Onsite Construction and Erection**	MINIMUM FIELD INSTALLATION REQUIREMENTS
ECONOMICS	
30 **Construction Costs**	2½ TON 50,000 BTU CAPACITY UNIT AT BEST RATE OF 10,000 UNITS PER YEAR: $420.00
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DESIGN & PRODUCTION OF HEATING, AIR CONDITIONING, & AIR DISTRIBUTION SYSTEMS

Apollo Franchise

PROPOSER

Apollo Franchise Corporation, Chandler, Arizona

The utilization of a cell-form system to build a reinforced concrete single-family homes, townhouses, and apartment units at a claimed savings in building costs of approximately 20 percent is proposed. The cell-form is a patented modular-sized form, about the size of an average room, three of which are required to form an average living unit.

Transported to the site by common carrier, they are subsequently self-powered by a hydraulic system, with 10 workers being required to service each. One carriage can handle two sets of forms. Accounting in part for the construction time saved by the cell-form is the mechanism at its core, by which the inner forms are stripped from the newly cast walls and collapsed uniformly in upon themselves. This permits rapid pulling and reuse of the forms.

Lightweight concrete is used, with reinforcement being supplied in prefabricated mats of welded bars, for further time savings on the job.

SITE SYSTEM	
1 **Site Situation**	UNDEVELOPED, URBAN
BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
BUILDING SUBSYSTEMS	
16 **Structure**	REINFORCED CONCRETE ROOM-SIZED MODULES
PRODUCTION	
24 **Offsite Production**	CELL FORM; PREFABRICATED REINFORCING
26 **Onsite Construction and Erection**	CONCRETE CASTING IN CELL FORM
MANAGEMENT	
33 **Proposer Organization**	CORPORATION

Applied Research

PROPOSER

Applied Research of Cambridge, Ltd., Cambridge, England

The system here proposed anticipates four major fields of computer operation: Geometric investigation of housing layout; Exhaustive exploration of internal plan forms in housing; Application of the environmental package in a residential context; and Cost evaluation of housing layout. Each is in a different stage of development with the program entirely written for the geometric investigations. More theoretical work is required, however. The theoretical part of the plan forms is well advanced but not complete; the environmental package segment is operational but must be augmented for housing field use. A program is being run for cost evaluation of housing layout.

The geometric investigation model will assess abstract properties of site shape and size for impact on site layout, will explore options in housing layout, and will evaluate preacquisition of housing land. It also acts as a site development module in the comprehensive model of housing layout mechanisms.

The second broad area of computer application is in development of house plans by an established method. The programmed machine is capable of generating all possible house plans within a specified set of spatial, dimensional, and topological criteria. Further development is required for application as the unit design module. After receiving performance criteria, the computer calculates plans, producing all arrangements of rooms, satisfying requirements as to dimension, shape, and placement. One purpose of this work is to explore consequences of changes in present building standards. A mathematical model is now in use for the study of performance of office buildings, but it can be adapted to housing without complicated adjustment.

The scope of the environmental package program includes natural lighting, artificial lighting, heat flow calculation, and acoustic evaluation. This model is not run as a sequence of isolated routines, but as an integral system. Thus the effects of design decisions may be observed throughout the entire environmental spectrum.

Inputs for the cost evaluation procedure involve space standards, per-square-foot costs, garaging, number of children per household by age, playspace, open space and road space requirements, land values, occupancy structure, distribution of occupancy into bulk forms, bulk-form-type definitions and control variables. The program is used widely in the United Kingdom to check costs, as a research tool, and to aid designers in assessing implications of design decisions in home layouts.

The end product of the proposed services will be a comprehensive suite of computer programs for demonstrating and evaluating quantifiable aspects of alternative housing designs, systems, and layouts.

SITE SYSTEM	
5 Planning Concepts	COMPUTER GEOMETRIC INVESTIGATION OF HOUSING SITE LAYOUT
8 Site Planning Services	COMPUTERIZED
BUILDING SYSTEMS	
12 Unit Variations 13 Design Selection	COMPUTER GENERATION OF INTERNAL PLAN FORMS IN HOUSING; SIMULATION OF OFFICE PATTERNS APPLIED TO HOUSING CIRCULATION; APPLICATION OF ENVIRONMENTAL COMFORT CONSIDERATIONS
14 State of Development	CONCEPTUAL; COMPUTER PROGRAM FOR GEOMETRIC INVESTIGATIONS OPERATIONAL
15 Community Involvement	COMPUTER APPLICATION TO STUDY ENVIRONMENTAL CONSIDERATIONS INCLUDING USER NEEDS
BUILDING SUBSYSTEMS	
20 Comfort Systems 23 Electrical	COMPUTER APPLICATION TO ENVIRONMENTAL STUDY; CALCULATION OF HEAT FLOWS, ACOUSTICAL ANALYSIS, & STUDY OF ARTIFICIAL & NATURAL LIGHTING
ECONOMICS	
30 Construction Costs	COMPUTER COST EVALUATION OF HOUSING LAYOUT, INTERIOR & EXTERIOR SPACE STANDARDS, LAND VALUES, & STRUCTURE OCCUPANCY
MANAGEMENT	
33 Proposer Organization	CORPORATION (LIMITED)
34 Internal Functions	CONDUCT INVESTIGATIONS; EVALUATE; REPORT FINDINGS & RECOMMENDATIONS
35 External Functions	PROGRAMMING; COMPUTER WORK
GENERAL	
39 Major Innovative Concepts	COMPUTER PROGRAMS FOR DEMONSTRATION & EVALUATION OF HOUSING DESIGN, SYSTEMS, AND LAYOUTS

Associated Home Builders

PROPOSER

Associated Home Builders of Greater Eastbay, Inc., Berkeley, California

AFFILIATES

Stone and Youngberg, Financing Consultants; Howard Ellman of Brobeck, Phleger & Harrison, Attorney; Herman D. Ruth & Associates, General Consulting and Research

Proposed is a feasibility study of utilizing tax allocation financing for necessary community development and improvements in conjunction with new residential construction and thus concomitantly reducing the cost of housing.

The rationale of this proposal is that in many parts of the country approximately $3,500 is spent on the development of facilities such as sewers, streets, parks, fire hydrants, and other services which, while not actually part of the house lot, are needed to make that lot usable. While these expenditures are pertinent to the development of private housing, they may also be regarded as a capital cost of community development. If these costs, therefore, were to be met through tax allocation financing, the cost of housing to the purchaser might be reduced by an equivalent amount, thus qualifying many more families for home ownership.

The proposed research would be conducted through interviews with private developers, state legislators, local community officials, and members of industry who might be expected to purchase tax incremental financing instruments.

The work outlined would consist of investigation and evaluation of present tax incremental financing vehicles; evaluation of potential vehicles with communities and developers; and publication of detailed recommendations, examples, recommended instruments, model state statutes, and local implementation regulations.

BUILDING SYSTEMS	
14 State of Development	RESEARCH PROPOSAL; WORK PLAN ORGANIZED
ECONOMICS	
30 Construction Costs	STUDY TO REDUCE COST OF HOUSING THROUGH TAX-ALLOCATION FINANCING FOR COMMUNITY DEVELOPMENT OF IMPROVEMENTS SUCH AS SEWERS, STREETS, PARKS, FIRE HYDRYANTS; EVALUATION OF PRESENT SYSTEMS; PUBLISHED RECOMMENDATIONS
MANAGEMENT	
33 Proposer Organization	TRADE ASSOCIATION
34 Internal Functions	CONDUCT OF STUDY: INTERVIEWS & RESEARCH WITH PRIVATE DEVELOPERS, STATE & LOCAL GOVERNMENT, PRIVATE INDUSTRY; PUBLISHED RECOMMENDATIONS
35 External Functions	LEGAL; FINANCIAL

Associated Home Builders

AFFILIATES:

Mason-McDuffie Company, Financial Consulting; Herman D. Ruth & Associates, Research

A study is proposed to determine how many more eligible home-buying families could and would buy new homes by utilizing a flexible repayment schedule, rather than the usual fixed-payment schedule.

The rationale behind this concept may be illustrated by the life insurance industry. Here, young families, needing the greatest protection at a time in life when earning power is only beginning, are protected by having premium rates set considerably lower than the average during the early years of the policy. Later, with increased earnings, the premiums become larger than average, although the overall payments over the life of the policy are the same as for fixed-rate premium schedules. The same concept of fluctuating, flexible mortgage payments applied to housing might bring new homes within the range of many more young families.

Other objectives of the proposed work would be study of problems of mortgage credit evaluation under such a system, preparation of a set of evaluation standards, and evaluation of the marketability of the loans to institutional investors.

The work program would consist of the following steps: development of a limited number of flexible repayment schedules; securing an FHA agreement to insure the limited number (probably 100) of actual loans which would be utilized in the study; development of criteria from a mortgage credit standpoint; development of a mortgage loan and marketing system; investigation of acceptability of variable loans with lending institutions; and evaluation of the success of the program, on an ongoing basis, with a brief annual report.

BUILDING SYSTEMS	
14 State of Development	RESEARCH PROPOSAL; WORK PLAN ORGANIZED
ECONOMICS	
30 Construction Costs 31 Financing Methods	STUDY, TESTING AND EVALUATION TO DETERMINE IF MORE FAMILIES COULD BUY NEW HOMES THROUGH UTILIZATION OF A GRADUATED FLEXIBLE MORTGAGE REPAYMENT SCHEDULE; STUDY OF CREDIT EVALUATION; EVALUATION OF MARKETABILITY OF LOANS AND LENDING INSTITUTION ACCEPTANCE
MANAGEMENT	
33 Proposer Organization	TRADE ASSOCIATION
34 Internal Functions	MANAGEMENT; RESEARCH
35 External Functions	FINANCIAL MANAGEMENT
GENERAL	
39 Major Innovative Concepts	GRADUATED FLEXIBLE MORTGAGE REPAYMENT SCHEDULE FOR YOUNG HOME BUYERS

Auerbach Corporation

PROPOSER

Auerbach Corporation, Palo Alto, California.

Performance standards for quality environments, alternative financing methods, and enhanced employment opportunities for low-income workers are features of this proposal. It suggests a major research effort in three areas: (1) Reconnaissance and Overview, (2) Analysis of Major Opportunity Areas, and (3) Objectives and Solutions--the Optimum System.

The research outlined would cover consolidation of current information on environmental quality and residence attitudes and behavior, preparation of a model of this information as environmental performance standards, and preparation of standard models appropriate to needs, performances, and life-styles of differing market segments. Results would be weighted to generate insights into social-physical factors. These, in turn, would provide inputs, incentives, or constraints for the other areas—financing alternatives and employment opportunities.

The study further is expected to generate models for providing capital at several steps in the housing process: manufacturer capitalization, labor, materials, utility and community services, land acquisition, user lease and purchase, maintenance cost, remodeling, and resale. The criteria for evaluating each alternate model for financing would be profitable dollar return on investment and delivery of maximum social benefits. The study would emphasize formulas that pass on cost benefits to the user while enhancing (not diminishing) environmental quality.

The third phase, employment opportunities, would study new methods of enabling workers to apply hours worked toward home ownership for themselves. Proposed is the review of existing sweat equity programs and the suggestion of ways of integrating these, along with stock purchase and profit-sharing plans, into totally new financing mechanisms. A whole new industry is envisioned, one that can assimilate and accelerate entry into the economic mainstream for the disadvantaged. Properly programmed, such an industry will provide a ladder of skills to make best use of the underemployed. The action plan finally derived would then include: (1) definition of the employment/equity/ownership program as a venture opportunity, (2) venture objectives in terms of dollar profit and social benefits, (3) criteria for performance, (4) opportunity risks, and (5) opportunity costs including budgets, time, manpower, and money.

Any criteria so developed would be accompanied by recommendations for reaching stated goals on the basis of both short-term and long-term priorities.

SITE SYSTEM 9 **Community Involvement**	DETERMINATION OF ATTITUDES & BEHAVIOR OF USERS; PERFORMANCE STANDARDS FOR ENVIRONMENTAL QUALITY
PRODUCTION 29 **Community Involvement**	DEFINITION OF EMPLOYMENT/EQUITY/OWNERSHIP PROGRAMS; METHODS FOR WORKERS TO APPLY HOURS TOWARD HOME OWNERSHIP
ECONOMICS 31 **Financing Methods**	ALTERNATIVE FINANCING METHODS; PROVIDING CAPITAL FOR VARIOUS STAGES OF HOUSING PROCESS

Avtech, Inc.

PROPOSERS

Avtech, Inc., Planning, Design & Engineering, Chicago, Illinois
Sterling Industries, Inc., Manufacturer, Chicago, Illinois

This system employs many aerospace techniques to produce a completely integrated environmental structure whose basic materials are fiberglass reinforced plastics. The system is new to the building industry and is expected to open many jobs to new workers. The maximum flexibility of the system permits very high densities and it is proposed for single-family detached or attached clusters.

The structural system is a monococque shell of dual wall sandwich sections. Clamshell component walls are 2 1/2-in. thick, composed of a 2-in. core of sprayed-in-place urethane form bonded to inner and outer layers, each 1/4-in. thick. The layers are formed of fiberglass-reinforced polyester resin, gel-coated on the exposed surface. Components are joined with 1/2-in. steel bolts and nuts, compressing a neoprene primary weather-sealing gasket between them. A secondary gasket is attached around all joints to protect fasteners and to provide watertight joints.

An innovative feature is that of fixed windows throughout the structure. Glazing results from inserting single or double pane lights within a structural gasket. Reglazing is accomplished by unzipping the gasket, inserting a new pane, and rezipping it. The primary gasket is shop-applied and the external gasket is slipped on manually.

Partitions are of two types: honeycomb or foam cores surfaced with high-durability laminates. All components are molded and offer a variety of wall finishes. Floors are covered with polyolefin carpet and ceilings are acoustically treated. Cabinetry and some furniture items can be integrally molded, and stairs and stairwells are of one piece molded design. The system provides a building light in weight, no single components weighing more than 1,000 pounds, which holds down foundation costs. Anchor studs are required in all foundation systems. Erection processes are simple and can be accomplished with hand tools and a light crane.

SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2 Density Range	8 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PLANNED UNIT DEVELOPMENT, CLUSTERS
6 Nonresidential Functions	COMMON OPEN SPACES; MEETING HALLS; LAUNDRY FACILITIES; AUTOMATED POST OFFICE
7 Circulation	
8 Site Planning Services	PROPOSER GROUP IN CONCERT WITH LOCAL CITIZENRY & GOVERNMENT
9 Community Involvement	LOCAL CITIZEN REPRESENTATION IN PLANNING
10 Utilities	TRENCH-LAID SYSTEMS FOR WATER, SEWER, ELECTRICAL, TELEPHONE & COMMUNITY TV ANTENNA

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	FLEXIBLE
13 Design Selection	FLEXIBLE
14 State of Development	SYSTEM DEVELOPED & TESTED; MARKETING CHANNELS PROPOSED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	FIBERGLASS REINFORCED PLASTIC SHELL OF DUAL WALL SANDWICH SECTION COMPONENTS
17 Exterior Elements	GEL-COATED FIBERGLASS-REINFORCED POLYESTER RESIN EXTERIOR
18 Interior Elements	FIBERGLASS-REINFORCED POLYESTER INTERIOR; WALL FACE; HONEYCOMB PARTITIONS
19 Foundations	GRADE BEAM ON BELL FOOTINGS, OR OTHER.
20 Comfort Systems	OPERABLE VENTS; BETWEEN-LEVEL BOX SPINE CONTAINS HEATING/AIR CONDITIONING DUCTS
21 Plumbing	PREASSEMBLED; PVC OR COPPER PIPING; FRP SEPTIC TANK, UNITIZED MOLDED FIXTURES & SPACES
22 Electrical	SHEATHED CABLE INTERNAL WIRING PARALLELS PLUMBING; LIGHTING FACTORY INSTALLED
23 Furnishings	INTEGRALLY MOLDED FURNISHINGS

PRODUCTION

24 Offsite Production	COMPONENTS; UNITIZED KITCHEN/BATH; ALL OTHER ELEMENTS
25 Onsite Production	
26 Onsite Construction and Erection	FOUNDATION; JOINING OF COMPONENTS; FINISHES; UTILITY HOOK-UPS
27 Labor	UNSKILLED FOR ERECTION; SKILLED FOR ELECTRICAL, PLUMBING, ETC.
28 Labor Training Programs	APPROPRIATE SUPERVISION & TRAINING FOR UNSKILLED IN FIELD
29 Community Involvement	SELF-HELP ERECTION & FINISHING; LOCAL LABOR

ECONOMICS

30 Construction Costs	$11.00 PER SQ. FT., 1,000 UNITS PER YEAR (WITHIN 300 MILES OF CENTRAL FACILITY)
31 Financing Methods	PROPOSER SUPPLIED UPON HUD CONTRACT COMMITMENT.
32 Useful Life	NOT SUBJECT TO WEAR OR DETERIORATION; 45-YEAR MINIMUM WITH LITTLE MAINTENANCE

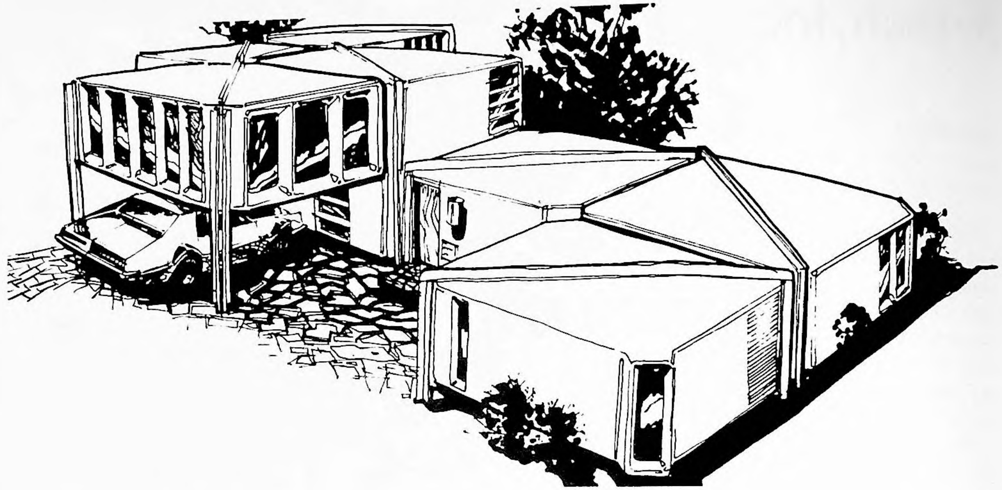
MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	PLANNING; DESIGN; INDUSTRIAL DESIGN; ENGINEERING; SALES; HOME ERECTION
35 External Functions	MANUFACTURING; FINANCE; MARKETING
36 Market Area	NATIONWIDE; WITHIN 1,000 MILES OF LOCAL PLANTS
37 Delivery Rate	60 UNITS PER WEEK, THREE SHIFT BASIS; ERECTION TIME 72 HOURS.
38 Consumer Protection	

GENERAL

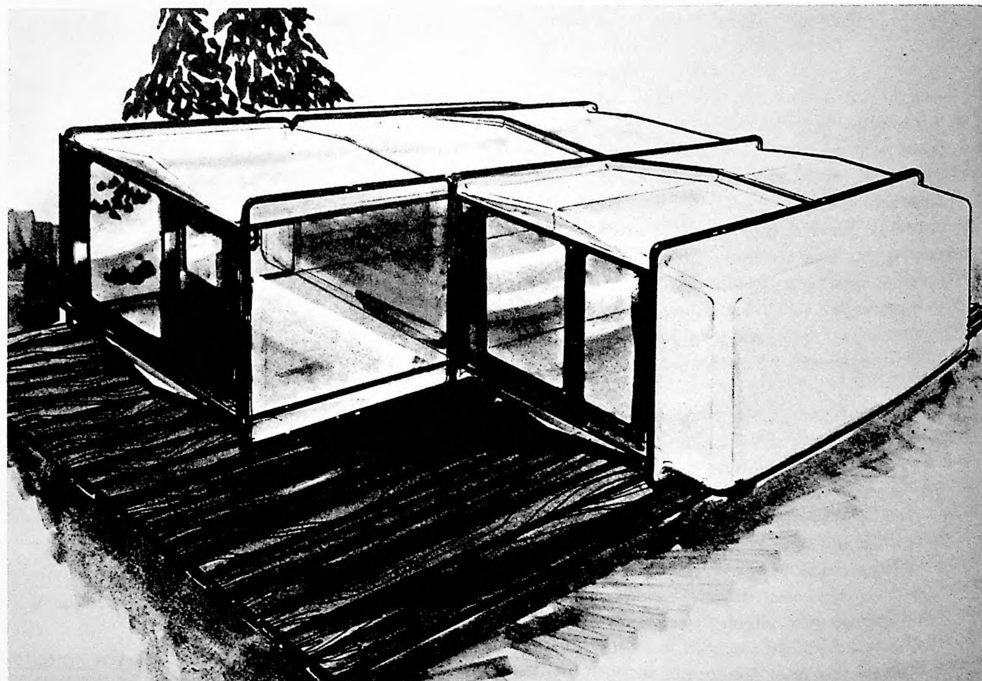
39 Major Innovative Concepts	PLASTIC PANEL SHELL; MOLDED MECHANICAL RECEPTICALS & FURNISHINGS
40 Codes	MATERIALS SUBSTITUTIONS WHERE REQUIRED BY CODES; CONTROLLED PERFORMANCE TESTS

Avtech, Inc. (continued)



Heating and air conditioning is in single-level compact configuration or can be multilevel with a fabricated box spine containing such elements as ducting and intakes. Fresh air ventilation is achieved through through-wall vents which permits the fixed glazing. Plumbing is specified as copper or PVC plastic pipe, and the entire plumbing subsystem can be shop assembled on a bench fixture. Fresh water inlet and sewer connections are stubbed out and capped for transportation to site, as is the stack. Electrical systems are based on aerospace practices, using plastic or aluminum-sheathed cable for internal distribution. Internal wiring parallels the plumbing system, comprising a unitized harness. Space for water heater and refrigerator are integrally molded, as are lavatory and kitchen sink.

Avtech, Inc.



PROPOSER

AVTECH Inc., Chicago, Illinois

AFFILIATES

KDI Corporation (Parent Company), Finance; Sterling Industries, Manufacturing; Environmental Technology Corporation, Marketers.

A monocoque shell of dual-wall, molded fiberglass construction is the structural component and design module of this factory-produced housing system. The basic shell, which is self-supporting and may be stacked to form high-rise structures, is assembled onsite from two of three fundamental three-dimensional elements. These elements are right triangular prisms. One of the prisms is open along the hypotenuse, but closed on all other planes. A second element is open along the hypotenuse and open also along one rectangular plane. A third is the mirror image of the second.

Because the prisms, or triangular half-shells, may be finished in a variety of colors and textures, their juxtaposition to form the modular room shells of a building offer the designer unusual architectural effects. The

Avtech, Inc. (continued)

elements are produced by the open mold process; the sandwich consisting of a layer of fiberglass-reinforced polyester (FRP), a urethane foam core, and another layer of FRP.

The half shells are joined together along the hypotenuse by 1/2 in. steel bolts which compress a neoprene primary weather sealing gasket between the components. A secondary gasket then is applied, protecting the fasteners and waterproofing the joint.

The shells are glazed with fixed windows which consist of single or double lights set within a structural gasket, an unusual feature being that they may be reglazed, simply by unzipping the gasket, replacing the light, and rezipping the gasket. The primary gasket is shop applied, the external gasket is placed manually.

The living units are finished inside with integrally molded cabinetry and some built-in furniture, these elements being highly desirable in that they are virtually maintenance free and clean with ease. For two-level arrangements, the staircase will be furnished as a one-piece molded element, occupying half of one of the rectangular grids, the treads being treated with a nonskid surface. The floors of the units will be polyolefin-carpeted.

Plumbing for the units will be furnished in a shop-assembled core, shipped as a unit to the site, and fitted in place prior to closure of the triangular half shells. Each triangular prism will be integrally wired, with field connections being made between elements with male-female-locking joiners (similar to those used in the aerospace industry), assuring a hermetically sealed, safe, and sound electrical connection. The modules will be heated by prewired, preinstalled electric baseboard elements. Fresh air is supplied through operable air vents.

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	ADAPTABLE TO HIGH DENSITY
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	SUITABLE FOR ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; CLOSE ADAPTATION TO TERRAIN
6 Nonresidential Functions	SYSTEM CAN BE USED AS DETACHED STRUCTURE SUCH AS STORAGE SHED & SHOP
7 Circulation	
8 Site Planning Services	BY PROPOSER WITH LOCAL CITIZENRY, LOCAL GOVERNMENT, & HUD
9 Community Involvement	COMMUNITY ASSISTANCE IN SITE PLANNING; LOCAL REAL ESTATE BROKERS
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DESIGN STAGE; FURTHER RESEARCH & DEVELOPMENT REQUIRED
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	FIBERGLASS-REINFORCED POLYESTER-URETHANE FOAM MODULES (3 PRISM-SHAPED ELEMENTS)
17 Exterior Elements	
18 Interior Elements	PARTITIONS; STAIRS; FLOOR
19 Foundations	CONCRETE FOOTINGS; STEEL ANGLE INCLUDED TO WHICH UNITS ARE BOLTED
20 Comfort Systems	BASEBOARD ELECTRIC HEAT; OPERABLE FRESH AIR VENTS; ZONED COOING UNITS
21 Plumbing	INTEGRATED PLUMBING CORE
22 Electrical	INTEGRATED IN MODULE; CONNECTIONS BY PLUG AND LOCK RING
23 Furnishings.	INTEGRALLY MOLDED

PRODUCTION

24 Offsite Production	MODULES; PLUMBING CORE; OTHER ELEMENTS
25 Onsite Production	
26 Onsite Construction and Erection	FOUNDATION; PLACING & JOINING OF PRISMATIC MODULES; UTILITY HOOK-UPS
27 Labor	UNSKILLED FOR ERECTION; NORMAL SKILLED TRADESMEN
28 Labor Training Program	
29 Community Involvement	SELF-HELP LABOR VERY FEASIBLE; LOCAL CONTRACTORS

ECONOMICS

30 Construction Costs	$9.00 PER SQUARE FOOT IN THE CHICAGO AREA FOR PROTOTYPES
31 Financing Methods	PROPOSER SUPPLIED (PARENT COMPANY)
32 Useful Life	AT LEAST 45 YEARS WITHOUT MAJOR ATTENTION

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN, DEVELOP, & PRODUCE BUILDING SYSTEM
35 External Functions	
36 Market Area	CHICAGO AREA FOR PILOT TESTING; EVENTUALLY NATIONWIDE; USE OF FRANCHISES
37 Delivery Rate	
38 Consumer Protection	

GENERAL

39 Major Innovative Concepts	PRISMATIC-SHAPED MOLDED STRUCTURAL COMPONENTS
40 Codes	CODE CONFLICTS EASILY RESOLVED BY MODIFICATION

Beamer/Wilkinson & Associates

PROPOSER

Beamer/Wilkinson & Associates, Oakland, California.

AFFILIATE

Don Prodanovich, Design and Construction.

Construction of at least two geographically separated demonstration installations of a patented, single-trench utility distribution system for residential projects is proposed by this firm of electrical and mechanical engineers. The demonstrations would embody the coordinated utility concept of the system's inventor, with the entire network being buried, both as a practical matter and from the standpoint of esthetics.

Typically, the system consists of a single, 30-in.-wide trench, located under the future sidewalk rather than under the street, with sanitary line, gas, primary electric, water, television, telephone, and secondary electric being buried successively, in that order, with each line being separated from the next by a layer of compacted earth. A single, narrow, lateral trench along the lot line would branch off the main trench to service four houses (two on each side of the street), thus reducing the usual multiplicity of trenches (often four to a lot) found in most subdivisions.

Repairs or alterations to the single-trench system are made by digging a trench to the side of the buried utilities, only to the depth required, and gaining access to the line being serviced or repaired without disturbing the others, the compacted earth holding them in position. Since emplacement of the various services would follow a precisely determined sequence, locating them for maintenance would be relatively simple.

In addition to the savings in maintenance costs and time anticipated for the system, first costs are expected to be substantially reduced, particularly with full cooperation of and coordination with all utilities, and preferably with trenching and backfilling being done as a single contract. Total installation costs are expected to be reduced up to one-third, with installation time being cut up to two-thirds.

SITE SYSTEM	
1 **Site Situation**	SUBURBAN
10 **Utilities**	DEMONSTRATIONS OF UTILITY DISTRIBUTION SYSTEM USING SINGLE TRENCH UNDER SIDEWALK AREA FOR PLACING PRIMARY AND SECONDARY ELECTRIC, TELEPHONE, GAS, WATER & SEWAGE DISTRIBUTION FACILITIES
PRODUCTION	
26 **Onsite Construction and Erection**	DIGGING OF TRENCH; ALIGNING OF FLEXIBLE CABLES WITH STAKES; BACKFILLING
MANAGEMENT	
33 **Proposer Organization**	PROFESSIONAL
34 **Internal Functions**	CENTRAL CONTROL

William Blackwell

PROPOSER

William Blackwell, Architect, San Francisco, California

Offered are four proposals, each one of which relates to cities and city life in general, and specifically to providing housing for low- and moderate-income city dwellers, while at the same time encouraging development of a viable and attractive community in which to live and work.

The first proposal concerns development of plans and specifications for single-family detached housing particularly suitable for utilization of limited frontage sites and steeply sloping land. A basic concept of these homes is that they are room-wide, 12 ft., 16 ft., or 18 ft., that the rooms are stacked above each other for vertical circulation, rather than side-by-side, eliminating the usual loss of space to corridors and hallways. Three different house sizes are proposed, in two versions of each, the resultant six models affording a range of housing.

Proposal No. 1

SITE SYSTEM	
1 **Site Situation**	URBAN (PARTICULARLY SUITABLE FOR LIMITED FRONTAGE LOTS)
2 **Density Range**	29 TO 50 UNITS PER ACRE
3 **Topography**	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS; SPECIFICALLY SUITABLE FOR STEEP SLOPES
7 **Circulation**	PARKING AT GRADE LEVEL OR BELOW GRADE LEVEL
BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY DETACHED
12 **Unit Variations**	3 TO 4 BEDROOMS
13 **Design Selection**	PLANS & SPECIFICATIONS
14 **State of Development**	TO BE DEVELOPED
BUILDING SUBSYSTEMS	
16 **Structure**	SPECIFICATIONS TO BE DEVELOPED
MANAGEMENT	
33 **Proposer Organization**	PROFESSIONAL
34 **Internal Functions**	DESIGN
GENERAL	
39 **Major Innovative Concepts**	ROOM WIDE UNITS STACKED FOR VERTICAL CIRCULATION RATHER THAN HORIZONTAL

William Blackwell (continued)

The second proposal pertains to study of a pattern approach to redevelopment housing. The interchanging of existing housing and new housing, based on a pattern which would provide flexibility of land use, would be investigated. The utilization of modular increments of land would be explored, the overriding concern being to arrive at an approach which would facilitate housing starts in the hard-core, urban renewal areas. In addition to San Francisco, the study would extend to five cities—Boston, Washington, Detroit, St. Louis, and Los Angeles—for corroborative purposes and to arrive at common denominators.

The third proposal concerns off-street parking. Here, a study would be made of the pattern of car ownership in six major cities, to determine relationship between income and ownership, and from this, to derive conclusions which may support elimination or reduction of parking requirements in certain urban areas. The concept behind this work is that the concomitant of car ownership—off-street parking—seriously inhibits new residential construction in many cities.

The fourth proposal is to undertake a long range study of the "city in theory," with the resultant report expected to provide a basis for effective legislation for urban and land development. The study would deal with the definition and organization of neighborhoods and clusters, based on walking distances, thus minimizing the need for cars. The establishment of appropriate densities to support essential facilities and the development of one-way street patterns would be investigated, as would ideal block sizes and location and spacing of public transportation. In addition to a report, the proposed activity would result in a small, scale model of a theoretical city.

Proposal No. 2

SITE SYSTEM	
1 Site Situation	RESEARCH OF URBAN RENEWAL—PATTERN APPROACH TO REDEVELOPMENT HOUSING
5 Planning Concepts	STUDY OF RESIDENTIAL & NONRESIDENTIAL FUNCTIONS WITHIN ONE BLOCK
6 Nonresidential Functions	STUDY OF COMMERCIAL, INSTITUTIONAL, RECREATIONAL, CHILD CARE CENTER
7 Circulation	SMALL BUSES; PARKING AT STREET LEVEL
9 Community Involvement	NO DISPLACEMENT OF RESIDENTS
BUILDING SYSTEMS	
11 Housing Types	STUDY & EVALUATION OF SUBSTANDARD STRUCTURES REQUIRING REHABILITATION OR DEMOLITION WITH REGARD TO NEIGHBORHOOD CHARACTERISTICS

Proposal No. 3

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL
5 Planning Concepts 6 Nonresidential Functions 7 Circulation	EVALUATION TO RESULT IN POSSIBLE REDUCTION OF OFF-STREET PARKING REQUIREMENTS; STUDY OF RELATIONSHIP BETWEEN INCOME, LOCATION, & AVAILABLE TRANSPORTATION
9 Community Involvement	INVESTIGATION OF CAR OWNERSHIP WITH RELATION TO INCOME & HOUSING

Proposal No. 4

SITE SYSTEM	
1 Site Situation	URBAN
2 Density Range	ESTABLISHMENT OF APPROPRIATE DENSITIES
5 Planning Concepts 6 Nonresidential Functions 7 Circulation	DEFINITION & ORGANIZATION OF: GEOMETRY OF NEIGHBORHOOD PLANNING—GRID STREETS, CLUSTERS, ONE-WAY STREET PATTERN; MODEL TO INVESTIGATE LAND USE; RELATION OF NEIGHBORHOOD TO: EDUCATIONAL, GOVERNMENTAL, RECREATIONAL, COMMERCIAL FACILITIES; APPROPRIATE BLOCK SITES; LOCATION & SPACING OF PUBLIC TRANSPORTATION
GENERAL	
39 Major Innovative Concepts	BASIS FOR EFFECTIVE LEGISLATION FOR URBAN & LAND DEVELOPMENT

Bolt, Beranek & Newman

PROPOSER

Bolt, Beranek & Newman, Cambridge, Massachusetts

AFFILIATES

Herbert L. Bogen and Associates, Architects

The proposer will develop a research and information system for refining design and construction standards for housing and related facilities. The proposer indicates that the system will enable the new and rehabilitated housing environments created under the Operation Breakthrough program to become increasingly more responsive to the needs, life styles, and tastes of low- and moderate-income families who have not had the opportunity to exercise their preferences in the housing market.

Inputs to this system will be developed from studies of low- and middle-income family housing needs and preferences. Client groups will be defined by socioeconomic variables such as family income, size, race and ethnic background and age, education, and occupation of household head. A second set of environmental variables will involve building types, form of tenure, personal and family interior space, private and communal outdoor space, community facilities, participation of the occupant in building the unit, as well as physical features of the neighborhood.

The client group and the environmental variables will be arranged to form an information matrix. This initial system will provide an accessible inventory of findings related to social and psychological implications of specific characteristics of the housing environment. This information will be used to update present design standards in the light of proven family needs and preferences.

Present literature indicates that in-depth studies should be made in the following areas: homeownership needs and preferences of large, low-income families; suitability of self-help or self-modified housing environments for low-income families; the extent to which high-density housing can more fully meet needs and tastes of heterogeneous client groups; and others dealing with specific arrangement of physical space.

Considerable updating of the data is planned, working from the findings of field researchers who are, themselves, representatives of the client groups under study. Short training and orientation courses for these field researchers will be conducted at the beginning of each study. Feedback from the field research will enable the contractor to refine further the design standards for housing before start of volume production, Phase III, of Operation Breakthrough.

SITE SYSTEM	
9 Community Involvement	INFORMATION SYSTEM & FIELD STUDIES TO ANALYZE USER NEEDS FOR SITE; STREETS, COURTYARD, PLAY AREAS
BUILDING SYSTEMS	
11 Housing Types	DEVELOPMENT OF RESEARCH & INFORMATION SYSTEM FOR REFINING DESIGN & CONSTRUCTION STANDARDS
15 Community Involvement	STUDIES TO DETERMINE USER NEEDS IN HOUSING DESIGN; FRIENDSHIP PATTERNS; INTRAFAMILY RELATIONS, GROUP PARTICIPATION
PRODUCTION	
28 Labor Training Programs	TRAINING PROGRAM FOR FIELD RESEARCHERS
29 Community Involvement	STUDIES TO DETERMINE SUITABILITY OF SELF-HELP
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	ESTABLISH INFORMATION SYSTEM; TRAINING; CONSTRUCT PROTOTYPE FOR SYSTEM ON DESIGN & CONSTRUCTION STANDARDS

Bolt, Beranek & Newman

PROPOSER

Bolt, Beranek and Newman, Inc.

The trend toward multifamily dwellings for better utilization of available land resources in urban areas brings with it the increased probability of noise as a serious cause of dissatisfaction. In a word, noise is likely to be a prime environmental problem in much new housing.

This proposal offers as a solution to the problem the development of a mathematical method by which sound transmission could be predicted for most partition and wall constructions. Thus, a designer could select construction materials that would have a satisfactory sound transmission loss, in addition to having the required load-bearing capacity, other structural characteristics, and fire rating.

The resulting predictions would be an added tool in the battle against noice—from both within and without the structure—beyond today's attempts to minimize noise transmission by discontinuous structural elements, use of dense materials such as concrete, or acoustical insulation.

The proposer intends to use its own analysis system, a method that has already been successful in predicting acoustical and vibrational response of rockets and other aeronautical structures. The system requires as input data only average properties of the structure and gives simple and readily interpreted results. In essence, this system describes the flow and distribution of power in a resonant system—which might include the noise source, the vibration field of the walls in the source room, the vibration field of the walls of the source and receiving rooms, and the sound field in the receiving room. Thus, instead of trying to isolate the components of the system and study them separately (as is usually done in traditional architectural acoustics), the method constitutes a systems approach to noise isolation problems.

A four-phase project is proposed:

(1) A study of how basic differences between aerospace and building structures may affect applicability of the proposer's system toward solving architectural acoustical problems;

(2) Calculation of sound transmission loss (TL) of single homogenous partitions in terms of their basic physical properties (such as surface weight, Young's modulus, damping factor, and size) to indicate how the system applies to basic architectural structures, and to determine why laboratory testing of a relatively small sample partition may not provide results generally applicable to other partition sizes;

(3) Calculation of the flanking transmission of sound through the structural path—a phase aimed at providing a theory that can produce quantitative data on flanking transmission;

(4) Calculation of the acoustical response of a single homogenous slab to a point-force excitation (such as the supports of vibrating machines). The proposer points out that it is of prime interest to know the vibration response of a floor slab to steady-state forces—thus to enable the designer to decide what degree of vibration isolation is necessary to keep sound levels in the room below to an established limit.

BUILDING SYSTEMS	
15 **Community Involvement**	STUDY OF NOISE AS A POTENTIAL DISSATISFYING ENVIRONMENTAL FACTOR IN MULTIFAMILY UNITS
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements**	PROPOSED SYSTEMS APPROACH TO THE STUDY OF NOISE ISOLATION RATHER THAN THE TRADITIONAL APPROACH BASED ON ISOLATED COMPONENTS; DEVELOPMENT OF A SIMPLE MATHEMATICAL METHOD TO PREDICT QUANTITATIVELY THE SOUND TRANSMISSION LOSS OF CONSTRUCTIONS IN TERMS OF THE AVERAGE PHYSICAL PROPERTIES OF CONSTRUCTION; CALCULATION OF TRANSMISSION LOSS (TL) OF PARTITIONS & FLANKING TRANSMISSION THROUGH STRUCTURAL PATHS
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	CALCULATION OF ACOUSTICAL RESPONSE OF CONSTRUCTIONS TO POINT-FORCE VIBRATIONS SUCH AS PRODUCED BY MECHANICAL EQUIPMENT & MACHINERY
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH & DEVELOPMENT IN ARCHITECTURAL ACOUSTICS & SOUND TRANSMISSION LOSS TO DETERMINE SOUND TRANSMISSION DESIGN CRITERIA FOR MULTIFAMILY STRUCTURES
GENERAL	
39 **Major Innovative Concepts**	APPLICATION OF STATISTICAL ENERGY ANALYSIS SYSTEM (DEVELOPED FOR AERONAUTICAL STRUCTURES) TO RESIDENTIAL STRUCTURES

H. S. Bowser

PROPOSER

H. S. Bowser, Owner-Designer, Santa Barbara, California

Proposal is made for a bathroom facility, designed for use as an extra in housing units, recommended particularly for remodeling projects, and also can be used in recreational and other facilities.

A complete bathroom unit is offered as a 4-ft. x 5-ft. module delivered to site on a pallet and completely equipped, ready for installation. The module also is offered in kit form as a do-it-yourself product. Standard materials and equipment will be used for basin, toilet, shower (34 in. x 34 in.), heating, lighting, and ventilating runs. Plumbing and electrical work is completed within the module, all with full performance warranty. Patents on the unit have been issued and are pending. Optionally, kitchen and laundry facilities can be included.

BUILDING SYSTEMS	
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
18 Interior Elements	COMPLETE BATHROOM MODULE
21 Plumbing	INTEGRATED IN MODULE
PRODUCTION	
24 Offsite Production	COMPLETE BATHROOM MODULE
25 Onsite Production	
26 Onsite Construction and Erection	PLACEMENT OF MODULE, UTILITY HOOK-UP
ECONOMICS	
30 Construction Costs	$398 PER UNIT (TARGET COST)
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN
35 External Functions	PRODUCTION
GENERAL	
39 Major Innovative Concepts	MODULE DESIGN
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

C. H. Brewer

PROPOSER CONSORTIUM

Charles H. Brewer, The Architects Office, New Haven, Connecticut
Student Community Housing Corporation, New Haven, Connecticut

A simple, wood-based roof panel system, using a triangle as its key, is proposed for study and could provide a very large self-help element in the production of single-family or multifamily low-rise mass housing. A further aim of the proposer is to develop a complete building system, based on the proposed roof panel system.

The triangular roof system is a subsystem with few parts that can be assembled in many ways to generate buildings of a variety of configurations. The system was originally developed in 1961 for simple, inexpensive, easily transportable, and quickly-assembled shelter that could be put together by unskilled volunteers in their first encounter with building construction. It is suggested that use of such a system, now further developed, would make possible the economic use of irregular land normally bypassed by builders for more suitable sites.

The system is made up of triangular, glued-laminated stressed-skin panels, prefabricated from structural grade 1/2-in. plywood mounted on 2-in. x 4-in. framing lumber. Panels are laid out on a 12-ft. x 12-ft. grid that can be expanded in any direction by following the roof panel configuration in 6-ft. increments. Used as a sloped surface, the panels are rated at a design load of 40 lb. per sq. ft., and can be attached to a variety of supporting systems such as stud, masonry, or post-and-beam walls. The roof system is essentially self-supporting over its span, though it requires lateral bracing every 12 ft. at panel joints. This requirement naturally subdivides the unit into 12-ft. modules, with partitions usually performing the bracing function—a versatile dimension in domestic construction. Larger interior spaces are possible, with ties or replacing partitions as supports.

The consortium suggests that interior finishes can be conventional: plaster or gypsum board, panneling, paint or tile. Underside of the panels can also be coated with foamed insulation, or thick batts; similar panels used for flooring could serve as an under-floor plenum, with little or no ductwork, for distribution of heat and cool air; the consortium has been exploring the possibility of using radiant ceiling panels connected by metallic tapes along panel edges—thus supplying roof, insulation, heating, and finished ceiling in one package.

SITE SYSTEM	
1 Site Situation	SUBURBAN; RURAL; SPECIAL SITUATIONS; LARGE IRREGULAR TRACTS
2 Density Range	4 TO 8 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERING POSSIBLE
6 Nonresidential Functions	RECREATIONAL FACILITIES, LAKE & BOATING
7 Circulation	SEPARATE VEHICULAR TRAFFIC CIRCULATION; CUL-DE-SACS
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE
14 State of Development	ROOF SUBSYSTEM DEVELOPED & BEING MARKETED; WALLS, FLOORS, FOUNDATIONS & MECHANICAL SUBSYSTEMS TO BE DEVELOPED
BUILDING SUBSYSTEMS	
16 Structure	WOOD FRAME-PLYWOOD ROOF PANELS; WOOD-STUD, MASONRY OR POST & BEAM WALLS
17 Exterior Elements	HOODED ROOF AREAS; CONVENTIONAL FINISHES
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; OR POSSIBLY A GRID OF SONOTUBES
20 Comfort Systems	FORCED AIR OR ELECTRIC RADIANT CEILING PANEL HEATING; INTEGRATED AIR PLENUM
23 Furnishings	BUILT-IN FURNITURE OPTIONS
PRODUCTION	
24 Offsite Production	ROOF PANELS; POSSIBLE STRUCTURAL ELEMENTS WITH INTEGRATED MECHANICAL SUBSYSTEMS
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF PANELS & SUB-SYSTEMS; FINISHES; UTILITY HOOK-UPS
27 Labor	ONSITE UNSKILLED LABOR FOR PANEL ERECTION; OWNER-CONSTRUCTORS USE OWN SKILLS
28 Labor Training Programs	SELF-HELP CONSTRUCTION MANUAL FOR OWNER-CONSTRUCTORS
29 Community Involvement	LOCAL COMMUNITY FRANCHISES FOR COMPONENT MANUFACTURE; SELF-HELP
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DEVELOPMENT OF TOTAL BUILDING SYSTEM & CONSTRUCTION MANUAL
35 External Functions	POSSIBLE FRANCHISES FOR MANUFACTURE & DISTRIBUTION
36 Market Area	ROOF SYSTEM EMPLOYED SUCCESSFULLY IN NEW ENGLAND AREA
GENERAL	
39 Major Innovative Concepts	TRIANGULAR ROOF PANEL SYSTEM; OWNER-CONSTRUCTOR INSTRUCTION MANUAL

Brick & Tile Service, Inc.

PROPOSER

Brick & Tile Service, Inc., Greensboro, North Carolina

AFFILIATES

John H. Isenhour, Jr., Ceramic Engineer & Plant Supervisor, Isenhour Brick & Tile Company

Further development of a system employing prefabricated brick bearing-wall panels for residential construction is proposed. For several years, the proposer has been engaged in research and development of a brick panelizing system. Laboratory work has been concluded and the casting by mechanized methods of brick panels, face up or down, has been proven to be feasible. A 4-ft. x 8-ft. panel has been developed which can be insulated and finished on the inside face, or a double wythe system with foamed polyurethane insulation between the wythes is also feasible. The research and development surrounding applicable mortars and grouts is currently nearing completion.

The program also includes development of precast foundation panels of two wythes with grout and reinforcing steel in the cavity space, forming horizontal grade beams. Beams would rest on circular piers around the building perimeter. Provisions also are being made for special corner units and units with vertical cores which will accept electric wiring and outlets.

The panel system is planned for use with prefabricated wood-frame floors and roof systems and interior frame partitions. Auxiliary panels of wood construction are planned for window and door openings, not supplied by the proposer, however.

Since the component design problems have been solved, the remainder of the program is addressed to the development of a completely automated system in limited plant operations. Major advantage of the proposed system is the heavy use of semiskilled and unskilled labor in most phases of the operation.

BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY DETACHED; ADAPTABLE TO SINGLE-FAMILY ATTACHED & MULTIFAMILY LOW-RISE
12 **Unit Variations**	3 BEDROOMS; ADAPTABLE TO 2 BEDROOMS
13 **Design Selection**	STANDARD PLANS
14 **State of Development**	PRODUCTION PLANT & BUILDING SYSTEM IN DESIGN STAGE
BUILDING SUBSYSTEMS	
16 **Structure**	BRICK LOAD-BEARING EXTERIOR & INTERIOR WALL PANELS; WOOD FRAME ROOF & FLOOR
17 **Exterior Elements**	BRICK EXTERIOR WALL FINISH; WOOD FRAME DOOR & WINDOW EXTERIOR WALL PANELS
18 **Interior Elements**	BRICK PANEL & WOOD FRAME PARTITIONS & FINISHES
19 **Foundations**	CONCRETE PERIMETER PIERS; PRECAST STEEL-REINFORCED BRICK PANEL GRADE BEAMS
20 **Comfort Systems**	ADAPTABLE TO ELECTRIC HEATING
22 **Electrical**	CENTRAL VERTICAL CORE INTEGRATED INTO WALL PANELS FOR WIRING, OUTLETS & SWITCH BOXES
PRODUCTION	
24 **Offsite Protection**	AUTOMATED BRICK PANEL PRODUCTION SYSTEM IN LIMITED PLANT OPERATION; WOOD PANELS
26 **Onsite Construction and Erection**	FOUNDATION PIERS; PANEL ERECTION
27 **Labor**	SKILLED FOR ERECTION; SEMISKILLED FOR INSPECTION & MANUAL OPERATIONS FOR ERECTION
28 **Labor Training Programs**	ON-THE-PROJECT TRAINING FOR SEMISKILLED FOR INSPECTION & OTHER MANUAL OPERATIONS
MANAGEMENT	
33 **Proposer Organization**	CORPORATION (TRADE ASSOCIATION)
34 **Internal Functions**	OVERALL MANAGEMENT; RESEARCH, DEVELOPMENT, TESTING; PRODUCTION FACILITIES; CONSTRUCTION; TEST PANEL PRODUCTION
35 **External Functions**	ARCHITECTURAL & MECHANICAL DESIGN
36 **Market Area**	NORTH CAROLINA
GENERAL	
40 **Codes**	SIMILAR SYSTEM ACCEPTABLE TO NORTH CAROLINA STATE BUILDING CODE FOR RESIDENTIAL CONSTRUCTION

Buckle-Shell Consultants, Inc.

PROPOSER

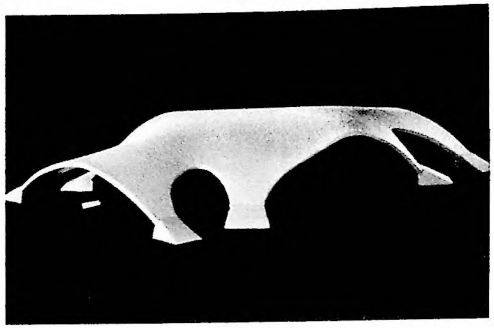
Buckle-Shell Consultants, Inc., West Lafayette, Indiana

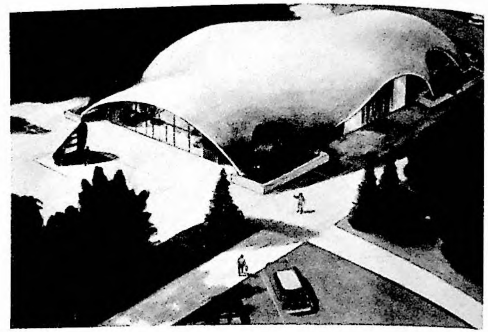
Further development of a self-supporting shell-form roof of plastic-sandwich construction is proposed. The roof structure can serve for single-family, multifamily low-rise, and community buildings such as offices, gymnasiums, and auditoriums.

The proposer organization's name derives directly from the method of mechanically forming the double-curved shell-form roof structures. The roof is normally fabricated onsite as a flat slab through edge-connection of foamed plastic boards (or it can be fabricated by in-place foaming). Then a skin of fiberglass-reinforced plastic, or other stress-carrying material, is sprayed or bonded to the top layer of this core and is finished in any desired color or texture. The resulting slab is then formed into a double-curved shell by buckling it with jacks anchored against concrete pads which are actuated after the center of the slab has been lifted slightly by a crane or an airbag. The jacks then force the center higher into the final shell form.

When this process is carried out at the site, the shell thus formed becomes the roof of the structure, with the pads against which the jacks were anchored becoming anchorages for the roof. Once the jack points are anchored to founcations, jacks are removed, and a stress-carrying skin is sprayed (or laid up) on the underside of the foamed-plastic core to complete the structural system.

The proponents point out that the roofs may be formed in many shapes and are completely self-supporting. At the present stage of development, it is believed that such shell roofs can be built in a great variety of shapes, and with considerable free span—almost any interior arrangement may be made below with nonbearing partitions. Another advantage is that redesign or rearrangement of interior space is simple, since all partitions are nonbearing.





SITE SYSTEM	
6 Nonresidential Functions	ROOF STRUCTURE ADAPTABLE TO NONRESIDENTIAL STRUCTURES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
13 Design Selection	FLEXIBLE
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH, DEVELOPMENT & TESTING
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF MECHANICALLY FORMED, DOUBLE-CURVED SHELL ROOF STRUCTURE WITH STRESS-CARRYING FIBERGLASS REINFORCED PLASTIC SKIN SPRAYED OR BONDED TO A PLASTIC FOAM CORE
PRODUCTION	
24 Offsite Production	ROOF STRUCTURES (OPTIONAL)
25 Onsite Production	ROOF STRUCTURE (OPTIONAL)
26 Onsite Construction and Erection	PLACING OR CONSTRUCTION OF ROOF STRUCTURE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN & IMPLEMENTATION OF ROOF SYSTEM CONCEPT
35 External Functions	CONSULTANT WORK
GENERAL	
39 Major Innovative Concepts	SHELL ROOF STRUCTURE OF REINFORCED PLASTIC SANDWICH CONSTRUCTION

C-3, Inc.

PROPOSER

C-3, Inc., Fairfax, Virginia

Development of a computer system is proposed, aimed chiefly at assisting real estate and builder and developer interests.

Nearly a dozen possibilities for computer assistance to the real estate, building, and development industry are enumerated. Close evaluation of these will determine which are to be selected for their maximum impact on the industry as a whole. Full automation of the selected subsystems then would proceed.

Heavily oriented toward the machine storage of building costs information, a central data bank will contain information on population growth, housing needs, population projections, average income of likely occupant and similar data for individual regions. Such a data bank would be updated regularly and made available to any subscriber via data lines. Government sponsorship is recommended. A correlary study will develop other aspects of computer application to these problems including determination of the amount of computer storage required by the average developer, access time requirements, privacy safeguards, form of computer terminal, requirements for high-speed data interchange and possible use of minicomputers.

A three-phase program is proposed. Phase I, requiring three months, will evaluate cost subsystems. Phase II, requiring one year for completion, will subject those subsystems suggested for automation in Phase I to multilevel evaluation. Phase III will implement the complete system, covering a period of 18 months to 3 years, depending upon the number and complexity of the cost subsystems.

Subsystems suggested for automation include: Cost estimates using factors developed by trade associations for a given area; market demand based on census and trade data; high speed analytical accounting, cash flow, etc.; critical path scheduling, program review and evaluation; inventory control; interchange of engineering data with other computers and manufacturers; site design; testing alternate configurations; site location analysis; correlations of population and needs; conformity to model codes.

SITE SYSTEM	
1 **Site Situation**	COMPUTER-ASSISTED ANALYSIS OF SITE LOCATIONS
2 **Density Range**	DETERMINATION OF MARKET DEMAND BASED ON DEMOGRAPHIC & TRADE DATA
3 **Topography**	DETERMINATION OF EFFECTS OF UNUSUAL SOIL CONDITIONS
4 **Climate**	POSSIBLE EVALUATION ITEM IN COMPUTER SYSTEM
5 **Planning Concepts**	CORRELATIONS OF POPULATION & NEEDS
8 **Site Planning Services**	COMPUTER ASSISTANCE IN SITE DESIGN; MODELING
9 **Community Involvement**	DEMOGRAPHIC DATA FOR PARTICULAR AREAS TO BE MADE AVAILABLE VIA CENTRAL DATA BANK
10 **Utilities**	
BUILDING SYSTEMS	
11 **Housing Types**	
ECONOMICS	
30 **Construction Costs**	COMPUTER SYSTEM TO PROVIDE COST SUBSYSTEMS DATA USING BUILDING & DEVELOPMENT TERMS AS PARAMETERS
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	COMPUTER SYSTEM DESIGN & EVALUATION; DATA COLLECTION & EVALUATION; DEVELOPMENT OF LAYMAN'S PROGRAMMING LANGUAGE
GENERAL	
40 **Codes**	AUTOMATION CAN INSURE CONFORMITY TO EXISTING OR AMENDED CODES

Carnegie-Mellon University

ECONOMICS		
30 Construction Costs		COMPUTERIZED PROCEDURE FOR PERFORMING ECONOMIC ANALYSIS OF INDUSTRIALIZED HOUSING SYSTEMS; COMPARISON OF VOLUME, SELLING PRICE & CAPITAL INVESTMENT; EFFECT OF INCENTIVE PROGRAMS; MARKET CONSTRAINTS; EFFECT OF DESIGN CHANGES; INTERACTIONS OF PLANT LOCATION, MARKET AREA & DELIVERY COSTS
MANAGEMENT		
33 Proposer Organization		EDUCATIONAL FACILITY
34 Internal Functions		COMPUTER PROGRAM FOR ECONOMIC ANALYSIS OF INDUSTRIALIZED HOUSING PRODUCTION
36 Market Area		MARKET ANALYSIS; RELATIONSHIP OF PLANT LOCATION, MARKET AREA, & DELIVERY COSTS
GENERAL		
39 Major Innovative Concepts		ANALYSIS TO DETERMINE CONSTRAINTS

PROPOSER

Carnegie-Mellon University, Pittsburgh, Pennsylvania

A computerized procedure for making economic analyses of industrialized housing systems is proposed. The basis of the procedure is a generalized analytical model of the interactions of economic variables and constraints encountered in the implementation of a housing system. The procedure would be general enough to make the following kinds of evaluations; (1) trade-off between volume, selling price, and capital investment; (2) economic viability of housing systems within prescribed market constraints; (3) effect of various incentive programs on feasibility of housing systems; (4) economic effect of design changes; and (5) interactions between plant location, market area, and delivery costs.

Primary variables for the models would include: investment, debt financing, amounts of skilled and unskilled labor, interest rate, selling price, production plant data, and costs of inventory, materials and transportation. The housing problem being of an immediate, pressing nature, no data estimates will be required for distant time periods (beyond 5 years), thus avoiding problems of obtaining reliable or unavailable data, often encountered in simulation models.

Data for the models would be obtained from government, banks, and proposers of the particular housing systems being studied. Market analysis to produce both consumer and financial data would augment these inputs.

Three generic types of housing systems could be studied: (1) centralized prefabrication such as mobile homes; (2) centralized prefabrication and onsite assembly, for example, vacation home packages; and (3) onsite prefabrication and assembly of the type used for conventional large-scale tract-built homes.

Overall result of the proposed work would be one or more analytical models incorporated into a single computer program, written in one of the more widely familiar programing languages. Given these models, the printout information could include minimum selling price, minimum volume necessary to maintain feasible operations, capital investment alternatives, and economic feasibility.

Carnegie-Mellon

BUILDING SUBSYSTEMS		
17 Exterior Elements 18 Interior Elements 20 Comfort Systems		PERFORMANCE STANDARDS FOR DEVELOPING BUILDING COMPONENT DESIGN; SELECTION OF BUILDING MATERIAL TO PROVIDE OPTIMUM ENVIRONMENTAL REGULATION; CONSIDERATION OF ENVIRONMENTAL FACTORS OF SOUND, HEAT, & STRUCTURAL REQUIREMENTS FOR BUILDING COMPONENT DESIGN
MANAGEMENT		
33 Proposer Organization		EDUCATIONAL FACILITY
34 Internal Functions		APPLICATION OF COMPUTER PROGRAM TO DEVELOP PERFORMANCE STANDARDS FOR BUILDING COMPONENTS

PROPOSER

Carnegie-Mellon University, Pittsburgh, Pennsylvania

A computer application is proposed to develop performance standards as a guide for building-component design. The ultimate purpose is to provide data to enable specifiers to designate materials or material elements that interact, rather than to specify each on an independent basis. The proposal deals with sound, heat, and structural requirements only, described as the critical environmental factors in housing construction.

Two principal questions are to be answered: (1) How can a building construction material be selected to provide optimal environmental regulation? (2) Given certain performance requirements, what materials are required to achieve this performance? The proposer has developed techniques, involving computer programing, for predicting performance of monolithic material systems. Phase I of the proposal will develop these techniques further, and Phase II will check the analytical results of the program against field performance. These results will be obtained by studying various prototypes of low-cost urban housing systems already built, and performance data also will be obtained from the Breakthrough prototype testing program.

A computer-oriented language must be structured for the model which is designated as Material Application to Environmental Regulation.

Carnegie-Mellon

PROPOSER

Carnegie-Mellon University, Pittsburgh, Pennsylvania

Research and testing of urethane as a building material is proposed, accepting the general assumption that polyurethane foam, either sprayed or poured, will be available as a general building material in the near future. The proposer asserts that questions concerning both economics and construction techniques must be answered prior to its successful utilization.

Studies in two general areas are proposed: (1) Exploration and comparative analysis of alternate forming and building processes for use of the material in exterior and interior walls and for roofs and ceilings. Studies into architectural detailing in connection with doors, windows, trim and cabinetry also must be undertaken in relation to maintenance, wear, and design considerations. Construction of small modules (approximately 16 ft. x 16 ft. x 8 ft.) will test different forming techniques, as well as the feasibility of incorporating electrical service, piping, and other utilities within the material. (2) Comparison of the quality of the various construction and detailing methods and related labor requirements should be undertaken to produce a better understanding of the economics of urethane construction.

Because of the lack of fundamental material-property information on the product, a number of small-scale tests also are proposed in an effort to determine certain material design parameters. These would include creep tests on composite beams, uniaxial tension tests to determine brittleness, shear deflection in the overall design, and uniaxial compression tests to check skin buckling.

BUILDING SYSTEMS	
11 **Housing Types**	LOW-DENSITY SINGLE-STORY & HIGH-DENSITY MULTISTORY HOUSING
14 **State of Development**	PROPOSED RESEARCH & TESTING ON USE OF URETHANE
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements**	RESEARCH & TESTING OF THE USE OF POLYURETHANE FOR STRUCTURAL PANELS FOR WALLS & ROOFS, VOLUMETRIC MODULES; STUDIES TO INCLUDE IMPLICATIONS OF LIGHTWEIGHT MONOLITHIC MATERIAL FOR ARCHITECTURAL FLEXIBILITY, INNOVATION & DETAILING; STUDIES OF INTERIOR WALL TREATMENT, CEILINGS & OPENINGS.
21 **Plumbing**	STUDIES OF IMPLICATIONS OF URETHANE MATERIALS ON PIPING
22 **Electrical**	STUDIES OF IMPLICATIONS OF URETHANE MATERIALS ON ELECTRICAL INSTALLATIONS
PRODUCTION	
24 **Offsite Production**	POSSIBLE RESEARCH ON PRODUCTION OF URETHANE PANELS
26 **Onsite Construction and Erection**	RESEARCH & TESTING OF PANEL ERECTION OF SITE FORMED VOLUMETRIC MODULES; STUDIES OF CARDBOARD, INFLATABLE, & METAL FRAME FORMS & TILT-UP PANEL FORMS
29 **Community Involvement**	STUDY OF POSSIBLE SELF-HELP HOUSING CONSTRUCTION
ECONOMICS	
30 **Construction Costs**	INITIAL STUDIES INDICATE POSSIBILITY OF MAJOR SAVINGS IN LABOR COSTS; STUDIES TO DETERMINE RELATIVE ECONOMIC BENEFITS
MANAGEMENT	
33 **Proposer Organization**	EDUCATIONAL FACILITY
34 **Internal Functions**	RESEARCH, ANALYSIS & TESTING OF URETHANE MATERIALS, COMPONENTS & CONSTRUCTION TECHNIQUES; MODELS; ECONOMIC STUDIES.

Carnegie-Mellon

PROPOSER

Carnegie-Mellon University, Pittsburgh, Pennsylvania

Use of a digital computer is proposed to determine acceptable housing at minimum cost in urban renewal areas, and to illustrate to private developers the return on investment they may expect for given values of sales, volume, selling price, and other variables. The automated process would bring greater efficiency than human calculation could provide in considering the desires of existing residents in the areas. Using existing techniques, the model, with data input on individual land parcels and characteristics of families to be accommodated, would search out optimum solutions in the redeveloping process. Output would specify building types, number of new units, number of rehabilitated units, and similar data for all land parcels programed, and at the same time would compute desired occupant payment levels. This would be done by correlating income and family size distributions with restrictions to determine who is elgible under each available housing program.

The approach is now being tested by the Urban Redevelopment Authority of Pittsburgh. Input data is obtained from government, banks and similar sources.

SITE SYSTEM	
9 Community Involvement	DATA COLLECTION ON LAND PARCELS & FAMILY CHARACTERISTICS TO DETERMINE DESIRES OF EXISTING RESIDENTS & OPTIMUM REDEVELOPMENT SOLUTIONS
BUILDING SYSTEMS	
14 State of Development	COMPUTER SYSTEM DEVELOPED & BEING TESTED
PRODUCTION	
24 Offsite Production	POTENTIAL EVALUATION OF ALTERNATIVE PLANT LOCATIONS BY USE OF DATA SYSTEM
ECONOMICS	
30 Construction Costs	COMPUTERIZED ECONOMIC ANALYSES OF INDUSTRIALIZED HOUSING SYSTEMS; MODEL OF CONSTRAINTS; ILLUSTRATION OF RETURN ON INVESTMENT; EMPHASIS ON COST/ENVIRONMENTAL BENEFITS.
MANAGEMENT	
33 Proposer Organization:	EDUCATIONAL FACILITY
34 Internal Functions	DEVELOPMENT OF COMPUTERIZED SYSTEM
GENERAL	
39 Major Innovative Concepts	COMPUTERIZED HOUSING SYSTEM ANALYSIS
40 Codes	CONSIDERED BY COMPUTER SYSTEM

Cates-Decker-Barber

PROPOSER CONSORTIUM

Cates-Decker-Barber & Associates, Architects & Engineers, Tyler, Texas

Further study is proposed of a building system concept based on the use of factory-fabricated and finished steel modular wall and roof panels, with interior panels of another material.

Emphasis for the proposed system is placed on simplicity in erection, so that home owners may have the option of doing certain portions of the work themselves. Though the system's use could be expanded to other types, application would be initially for single-family attached dwellings, with a volume production of 3,000 units per year suggested.

Exterior wall and roof panels are to be composed primarily of exposed steel, with a variety of possible finishes applied at the factory, but also with site-applied finishes such as wood or masonry possible. Among reasons for selecting the principal material are the fact that steel is not now in short supply, cost is relatively low, mass production and finishing techniques are more readily applied, and the material has high strength and durability while requiring less floor space in wall and partition thickness.

Wall and roof panels are to be insulated, sandwich construction, with preformed insulation board in 1-in. and 2-in. thicknesses—but thicknesses up to 4 in. are being considered, as are foamed-in-place urethane cores.

The proposer plans to assemble all underground waste lines in cast iron, in a preassembly plant either onsite or offsite, so that final installation can be by semiskilled labor. Interior plumbing is to be of plastic (PVC) pipe, installed above or in a cast-in-place concrete floor slab. Hot and cold water piping will be surface mounted and concealed by cabinet units where appearance is important.

The housing units are to contain a utility closet, which will house a hot water heater and a forced-air heating system.

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CUL-DE-SACS; COMMON OPEN SPACES
6 Nonresidential Functions	RECREATION BUILDING; DAY CARE CENTER; NURSING HOME; HOBBY BUILDING; POOL
7 Circulation	ELECTRIC CARTS OR TRAINS; SEPARATE CIRCULATION FOR CHILDREN & HANDICAPPED
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
9 Community Involvement	
10 Utilities	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED
12 Unit Variations	2 TO 3 BEDROOMS
13 Design Selection	
14 State of Development	PRODUCTION FACILITIES & BUILDING SYSTEM-DESIGN STAGE REQUIRING DEVELOPMENT
15 Community Involvement	

BUILDING SUBSYSTEMS

16 Structure	STEEL FRAME ROOF & WALL PANELS; SANDWICH FLOOR PANELS (FOAMED CORE; PLYWOOD SKINS)
17 Exterior Elements	FACTORY-APPLIED FINISHES; OPTIONAL SITE-APPLIED FINISHES; CARPORTS
18 Interior Elements	TERAZZO & VINYL TILE FLOORS; PARTITIONS
19 Foundations	CONVENTIONAL; SLAB-ON-GROUND, PIERS, WITH SPREAD FOOTINGS
20 Comfort Systems	GAS OR ELECTRIC HEATING & COOLING SYSTEM, INTEGRATED IN UTILITY CLOSET
21 Plumbing	INTEGRATED WITH BUILDING SYSTEM; PVC & CAST IRON PIPING
22 Electrical	FACTORY-INSTALLED WIRING; INTEGRATED WITH BUILDING SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	FLOOR, WALL & ROOF PANELS; MECHANICAL SYSTEMS
25 Onsite Production	
26 Onsite Construction and Erection	FOUNDATIONS; ASSEMBLY OF PANELS; UTILITY HOOKUPS
27 Labor	SKILLED; UNSKILLED; SEMISKILLED (PLUMBING INSTALLATIONS)
28 Labor Training Programs	
29 Community Involvement	SELF-HELP

ECONOMICS

30 Construction Costs	$8.00 PER SQ. FT.
31 Financing Methods	
32 Useful Life	STRUCTURE—80 YEARS; HV/AC—15 YEARS; INTERIOR—40 YEARS

MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN; PRODUCTION; CONSTRUCTION SUPERVISION
35 External Functions	CONSTRUCTION
36 Market Area	TWO DAYS TRAVEL BY TRUCK FROM FACTORY
37 Delivery Rate	3,000 UNITS PER YEAR
38 Consumer Protection	

GENERAL

39 Major Innovatice Concepts	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

CERT

PROPOSERS

Center for Environmental Research & Training, Blacksburg, Virginia
Trieschman Construction Company, Lake Providence, Louisiana

A study directed toward developing a thin-shell concrete construction system for single-family housing is proposed. The proposers suggest that the study would justify the assumption that such thin-shell construction—already adopted in Italy and other countries but restrained in the U.S. by code restrictions—can be produced by assembly-line methods. The building system to be studied combines framing and finishing, so that a thin shell consisting of 1 in. to 1 1/2 in. of cement grout and fine-wire reinforcing will provide necessary strength as well as provide finishing for interior and exterior walls, floors, and roofing.

It is contemplated that large rolls or mats of combined reinforcing mesh and rods could be stamped into desired shapes for different housing modules, tied together or tack-welded, and dipped into a rich cement grout to obtain the required coating. The dipped shells would then be moved on an assembly line to vats of grout combined with lightweight aggregates, and then moved through assembly and molding and curing processes until they emerged ready for loading for shipment to building sites.

Raceways would be provided at the bottom of each module for plumbing, electrical, and other services. The modules would be shipped as complete boxes with as much interior work as possible already installed.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF WIRE-REINFORCED THIN-SHELL CONCRETE; SELF-SUPPORTING MODULES
17 Exterior Elements	FINISHES TO BE INTEGRATED WITH STRUCTURAL SYSTEM
18 Interior Elements	CEMENT FINISHES TO BE INTEGRAL WITH STRUCTURAL SYSTEM
20 Comfort Systems	DISTRIBUTION SYSTEM TO BE INTEGRAL WITH STRUCTURAL SYSTEM
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	MOLDING OF THIN-SHELL MODULES
27 Labor	UNSKILLED
28 Labor Training Programs	INSTRUCTION FOR UNSKILLED & TEST OF EFFECTIVENESS OF INSTRUCTION
29 Community Involvement	SELF-HELP; STUDY TO DETERMINE EFFECTIVENESS OF USING UNSKILLED
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY-RESEARCH CENTER
34 Internal Functions	RESEARCH STUDY FOR DEVELOPMENT OF BUILDING SYSTEM
GENERAL	
39 Major Innovative Concepts	ASSEMBLY-LINE FACTORY MOLDING OF THIN-SHELL CONCRETE MODULES

Glean Chase

PROPOSER

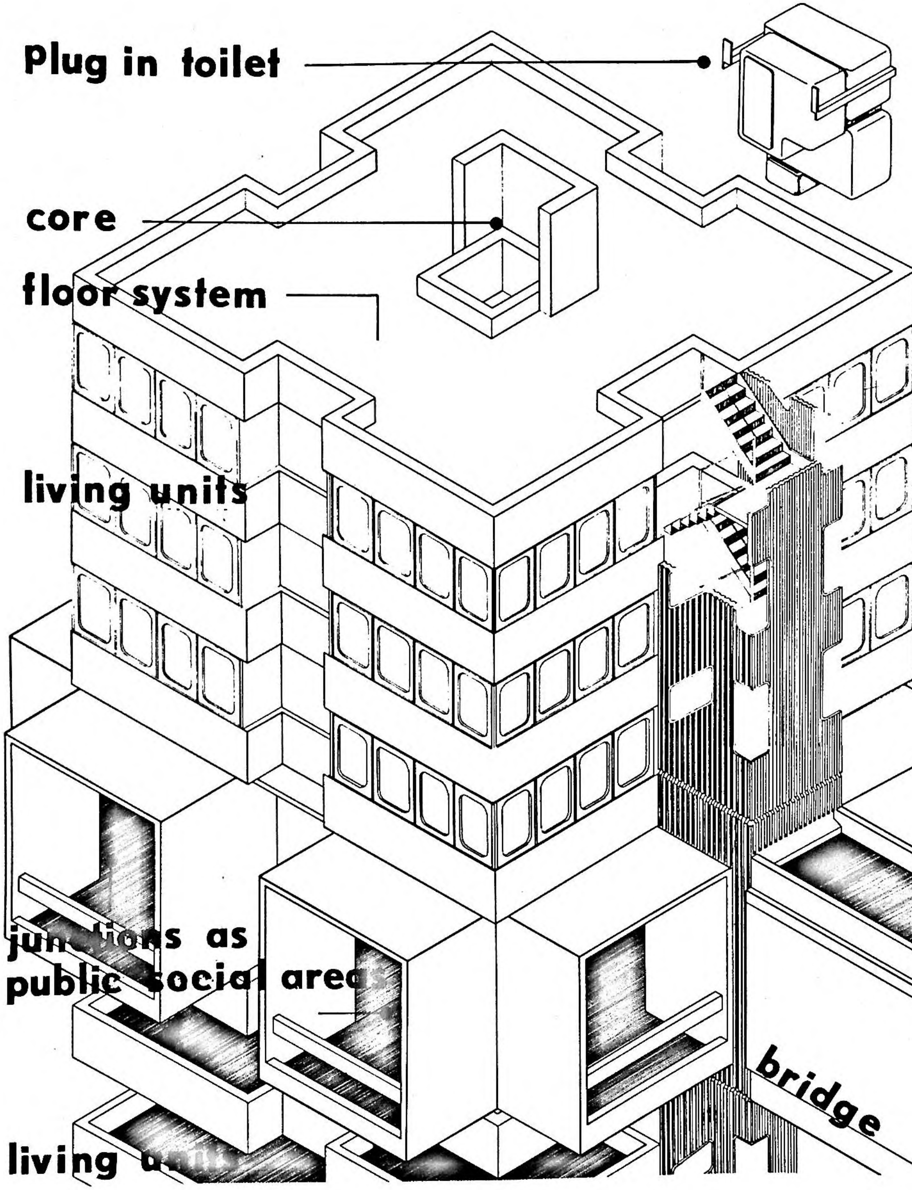
Glean Chase, Systems Planner, New York, New York

The concept of high-rise, multifamily housing, which can grow in response to increasing needs and the community's desire, is offered as a subject for research and development. Basically, this innovative approach to housing consists of reinforced concrete core units into which are slotted precast concrete floor slab components, thus creating around the core four floors of dwelling units, the entire four-floor complex then being jacked up to permit assembly of another four floors below it.

Growth of the building would be limited only by the capacity of the hydraulic or pneumatic jacks (built into the foundations) to lift the weight of the four-story units above them. Between each unit of four-level apartment living space (usually, one dwelling unit per floor) would be constructed bridging from one adjacent tower to another, with the space between the bridging, the core, and the apartments above and below becoming a junction or natural gathering place for neighbors in the adjacent units. Elevators would stop every fifth floor at this junction or bridge level, with residents walking up or down to their suites. In addition to being social places, the junctions could include community facilities such as small shops, cafes, telephones and public toilets.

All mechanical services for the dwelling units would be within the core of the tower on that level, or adjacent to it, with vertical distribution of utilities and possibly a few short horizontal runs simplifying and reducing the cost of this work. Another innovative service would be an automated food supply system, with small refrigerator units, filled to telephoned order at a supermarket below the housing complex, then being lifted vertically in a special shaft built between adjacent towers, and from there distributed laterally to kitchens in the dwelling units.

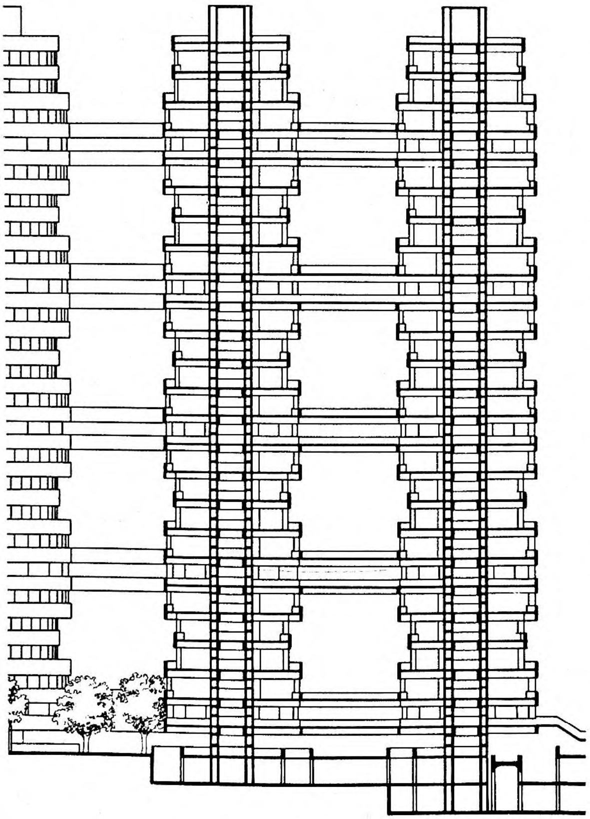
Two basic types of living clusters are envisioned. One would form square- or rectangular-in-plan apartments, with precast reinforced concrete floor slab and



Glean Chase (continued)

spandrel elements being cantileyered symetrically from a square core. The other would form circular-in-floor-plan units, with the floor being made up of 24 precast wedge-shaped slabs, slotted into a circular core. Weather enclosure would be effected in both types of units by infill of the space between the bottom of the floor unit and the top of the spandrel or parapet with window or nonbearing, prefabricated panels.

Foundations for the proposed high-rise complexes would be considered a responsibility of the state or federal government in development of land for urban housing.



SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN; NEW TOWNS
2 Density Range	INCREMENTAL GROWTH FROM 560 TO 2,966 DWELLING UNITS
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES; ESPECIALLY SUITED TO LOW BEARING SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CONTAINED COMMUNITY; HIGH-RISE CLUSTERS WITH INTERIOR COURTS; COMMON OPEN SPACES
6 Nonresidential Functions	RECREATION, COMMERCIAL, SOCIAL, & INDUSTRIAL FACILITIES
7 Circulation	ELEVATED BRIDGES; INTRACLUSTER VEHICULAR TRAFFIC UNDER PEDESTRIAN MALLS
10 Utilities	INTERCLUSTER RAPID TRANSIT; AUTOMATED FOOD SUPPLY FROM MARKET

BUILDING SYSTEMS

11 Housing Types	MULTIFAMILY HIGH-RISE
12 Unit Variations	FLEXIBLE; IDEALLY ONE LIVING UNIT PER FLOOR WITH POSSIBILITY OF TWO
13 Design Selection	FLEXIBLE
14 State of Development	BUILDING SYSTEM, CONCEPTUAL STAGE
15 Community Involvement	PARTICIPATION IN PLANNING DECISIONS

BUILDING SUBSYSTEMS

16 Structure	CORES OF 4 REINFORCED CONCRETE STACKED MODULES; CANTILEVERED CONCRETE FLOOR PANELS; JACKING SYSTEM
17 Exterior Elements	CONCRETE UPPER & LOWER WALL SECTIONS INTEGRAL WITH FLOOR PANELS; INTERCONNECTING BRIDGES
18 Interior Elements	SANDWICH PARTY WALLS; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; DESIGNED TO LOCAL CONDITIONS
20 Comfort Systems	CENTRAL HEATING DISTRIBUTION PROVISIONS IN CORE; WINDOW UNIT COOLING
21 Plumbing	PLUMBING CHASE & CONVENTIONAL KITCHEN & BATH UNITS IN CORE SECTIONS
22 Electrical	DISTRIBUTION SERVICE INCLUDED IN CORE; CONDUITS PROVIDED IN FLOOR DESIGN

PRODUCTION

24 Offsite Production	OPTIONAL FLOOR PANEL CASTING
25 Onsite Production	COMPONENT ASSEMBLY; OPTIONAL FLOOR PANEL CASTING
26 Onsite Construction and Erection	FOUNDATIONS; JACKING SYSTEM ERECTION; CORE CASTING OR CONSTRUCTION
29 Community Involvement	POSSIBLE OCCUPANT & SELF-HELP LABOR FOR DWELLING UNIT COMPLETION

MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	RESEARCH, DESIGN & DEVELOPMENT

GENERAL

39 Major Innovative Concepts	ERECTION & BUILDING SYSTEM; SITE SYSTEMS

Checchi

PROPOSER

Checchi & Company, Washington, D. C.

That the cooperative system of ownership and management of housing is under-utilized is the basic contention of the proposer, and to determine why this is so and what can be done about it is the purpose of the proposed research. It is pointed out that, of the 14 types of cooperatives established in this country today, comprising 37,200 organizations with 53.3 million members, housing accounts for only 680 organizations, with a combined total of only 173,000 family units.

The problem is to identify the critical constraints that are holding back this form of cooperative and to find strategic linkages, with the goal of increasing future housing output of this type by several orders of magnitude. Motivating this effort are the advantages that are claimed for cooperatives: aggregation of market, availability of management-organization, low administration and sales costs, and large scale purchasing economies.

The proposed research would consist of two phases. The first phase would involve intensive case studies of seven organizations: two housing cooperatives, three consumer cooperatives, and two industrialized builder-manufacturers with cooperative housing experience. Phase 2 (actually undertaken concurrently with Phase 1) would develop data and analysis or major actor groups which relate to the seven organizations studied in Phase 1. These groups would likely be composed of cooperative and housing industry organizations, consumer groups, investors, and state, local, and federal government agencies.

Projected output of the research would include, but not be limited to, preliminary findings such as: identification of constraints and linkages, development of criteria relating to low-cost, self-help strategies, identification of priority design criteria and marketing guidelines and guidelines relevant to public policy at governmental levels, and recommendations for improving cooperative education and communication among system managers and producers.

BUILDING SYSTEMS	
14 State of Development	FURTHER RESEARCH REQUIRED
PRODUCTION	
28 Labor Training Programs	RESEARCH ON TRAINING IN COOPERATIVE HOUSING DEVELOPMENT
29 Community Involvement	STUDY OF SELF-HELP LABOR
ECONOMICS	
30 Construction Costs	STUDY OF PURCHASING ECONOMIES
31 Financing Methods	RESEARCH STUDY OF NONHOUSING COOPERATIVES TO DETERMINE CONSTRAINTS ON USE OF COOPERATIVES IN HOUSING; DEVELOPMENT OF CRITERIA RELATING TO OWNERSHIP & EQUITY PARTICIPATION
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions 35 External Functions	STUDY OF HOUSING, CONSUMER COOPERATIVES, & INDUSTRIALIZED BUILDER-MANUFACTURERS WITH COOPERATIVE HOUSING EXPERIENCE TO IDENTIFY: CONSTRAINTS & LINKAGES; CRITERIA FOR SELF-HELP STRATEGIES & PRIORITY DESIGN CRITERIA; MARKETING GUIDELINES; GOVERNMENT POLICY GUIDELINES; & RECOMMENDATIONS FOR EDUCATION & COMMUNICATIONS

Clapp & Holmes

PROPOSER

Clapp & Holmes, Consulting Engineers, Harrisburg, Pennsylvania

Basic premise of the many-faceted approach to housing being proposed is that the American homeowner wishes to preserve his sense of integrity and individuality through choice of a home specially tailored to his own personal tastes.

Coordination of the design and construction of a model prototype city near Washington, D.C., is proposed by this firm of consulting engineers. The proposer would expect to collaborate with 50 architectural firms in the design and development of at least 100, possibly as many as 150, different types of systems and nonsystems approaches to housing, in a range of prices.

The many systems expected to be produced, however, would be developed using a basic module and in conformity with the standards set by FHA. Further, design procedures for all the housing units would give consideration to the possible interchangeability of modular components and to the possibility of the units being demountable. A specific architectural firm would be responsible for the overall arrangement of the housing units within the prototype city, working with city planners, landscape specialists, bankers, and municipal officials.

SITE SYSTEM	
1 Site Situation	DESIGN & CONSTRUCTION OF PROTOTYPE CITY NEAR WASHINGTON, D.C.
8 Site Planning Services	COLLABORATION OF 50 ARCHITECTURAL FIRMS WITH CENTRAL CONTROL WORKING WITH CITY PLANNERS, LANDSCAPE ARCHITECTS, BANKERS & MUNICIPAL OFFICIALS
BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE REQUIRING DESIGN, DEVELOPMENT & PROTOTYPE CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF BASIC MODULE TO BE ADAPTED TO 100 TO 150 SYSTEMS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	MANAGEMENT; COORDINATION
35 External Functions	RESEARCH 100 TO 150 TYPES OF HOUSING UNITS; PLANNING; DESIGN & CONSTRUCTION OF PROTOTYPE CITY

Clemson University

PROPOSER

Clemson University, Clemson, South Carolina

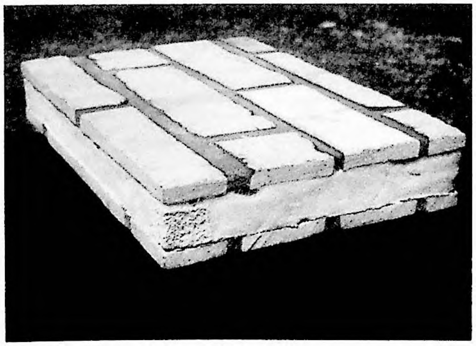
Proposed here is investigation of a system for mass producing houses using factory-assembled, wall-sized brick panels, erected onsite, along with other components. Although a large amount of background work into the feasibility of such a system already has been completed, and a prototype structure made with the brick panels has been erected, additional study is proposed to develop the system fully.

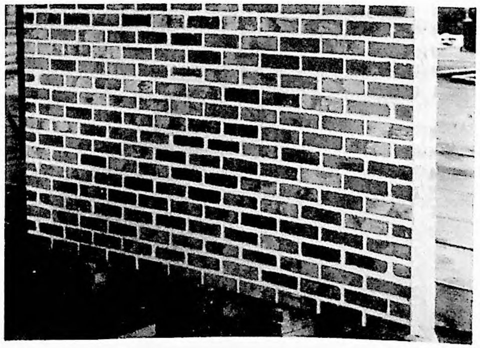
The basic component of the proposed system typically is a panel 5 in. thick, 8 ft. high and 8 ft. long, consisting of exterior and interior courses of 2-in. thick brick and a 1-in. thick core of foamed urethane, the construction melded together by an adhesive slurry. Until now, the panels have been hand-assembled by unskilled workers, using guides on a horizontal bed to ensure correct placement, but machine assembly obviously demands investigation.

The panels, which may be assembled in sizes up to 12 ft. x 16 ft. (for two-story homes) are structurally self-supporting, without metal reinforcement in one-story structures, and have excellent insulation characteristics, both thermally and acoustically. Interior finishes to date have included plaster, composition board, and glazed blocks.

The study proposed would cover six broad areas: materials, module properties, housing design, manufacturing plant design, structural and erection systems, and cost evaluation. The materials investigation would concentrate particularly on adhesives (of particular importance in relation to manufacture of the basic brick panel itself) and would include study of fill material for the cavity between brick courses, metal-skin roofing systems, and manufactured ceramic walls—the latter two being other principal components of the proposed housing system.

SITE SYSTEM	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED; STUDY OF HOUSING DESIGN
14 State of Development	PANELS TESTED, SYSTEM REQUIRES FURTHER RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	STUDY OF PREFABRICATED BRICK PANEL SYSTEM INCLUDING MODULE PROPERTIES, MATERIAL & ADHESIVE INVESTIGATIONS, INVESTIGATION OF VARIOUS FILLS PROPERTIES, DEVELOPMENT OF METAL SKIN ROOFING SYSTEM, INVESTIGATION OF WALL TYPES & FINISHES
19 Foundations	STUDY OF DESIGN OF EASILY ADAPTABLE FOUNDATIONS
20 Comfort Systems	POSSIBLE INCLUSION OF HEATING SYSTEM IN FOUNDATION
21 Plumbing	POSSIBLE INCLUSION OF PLUMBING IN FOUNDATION
22 Electrical	INTEGRATED INTO PANELS
PRODUCTION	
24 Offsite Production	STUDY OF FACTORY FOR PANEL PRODUCTION
26 Onsite Construction and Erection	PROPOSED FOUNDATIONS; ASSEMBLY OF PANELS; MECHANICAL HOOK-UPS
ECONOMICS	
30 Construction Costs	COST ANALYSIS: $71.14 FOR 64-SQ.-FT. WALL PANEL
32 Useful Life	100 YEARS
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	RESEARCH & DEVELOPMENT OF BRICK PANEL SYSTEM





Clemson University

PROPOSER

Clemson University, Clemson, South Carolina

A "design-in," at which prospective occupants would express their opinions on housing needs relative to their family situation, is one of the many research activities that would form part of the planning study proposed for rural areas. Objective of the research is the development of low-cost housing for nonurban, low-income families in South Carolina. The study would be concentrated in the Southeast, but results of the study would have some applicability for many rural sections of the country.

Methods of gathering data would include: daily-use diaries of housing facilities by representative households which might produce useful design criteria; a mobile center (in a refurbished trailer) through which citizen participation will be encouraged in terms of suggestions, attitudes, and opinions on materials, designs and other alternatives; use of existing neighborhood centers and community action agencies for similar contact; and establishment of data-gathering and polling places in more remote regions of the state.

Determination of the structure of rural villages is expected to be produced by the research, with answers being sought relating to such factors as (1) village location, (2) village size, (3) economic structure of a village, and (4) housing standards to be maintained. As a further result, a housing system capable of providing an expandable single-family unit or a high-density megastructure will be sought, with exploration to be made of the use of sleeping modules, rather than numerous bedrooms, as a possible cost saver.

The potential utility of homeowners associations in relation to rural housing also will be studied, as will avenues for maximum utilization of self-help housing systems, with the goal being to bring housing within the reach of the greatest possible number of citizens.

SITE SYSTEM	
1 Site Situation	RURAL PLANNING STUDY IN SOUTH CAROLINA TO DETERMINE STRUCTURE, SIZE & LOCATION OF RURAL VILLAGES
9 Community Involvement	STUDY OF INTRA-VILLAGE RELATIONS; RESEARCH ON SOCIAL PATTERNS & COMMUNITY ORGANIZATIONS
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	POSSIBLE DEVELOPMENT OF SLEEPING MODULES TO REPLACE NUMEROUS BEDROOMS
14 State of Development	CONCEPTUAL STAGE
15 Community Involvement	USER NEEDS STUDIES TO DETERMINE DESIGN & FACILITIES; "DESIGN-IN" FOR PROSPECTIVE OCCUPANTS; INTERVIEWS
PRODUCTION	
27 Labor	UNSKILLED
28 Labor Training Programs	INSTRUCTIONS IN VARIOUS SKILLS
29 Community Involvement	STUDY OF MAXIMUM UTILIZATION
ECONOMICS	
30 Construction Costs	STUDY OF ECONOMIC STRUCTURE OF VILLAGE
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	CONDUCT OF RURAL PLANNING STUDY TO DETERMINE CHARACTERISTICS OF VILLAGE
GENERAL	
39 Major Innovative Concepts	IDENTIFICATION OF VILLAGE STRUCTURE & EXTENSIVE COMMUNITY INVOLVEMENT CONCERNING NEEDS
40 Codes	DETERMINATION OF LEVEL OF HOUSING STANDARDS TO BE MAINTAINED FOR RURAL AREAS

Cleveland Consulting

PROPOSERS

Cleveland Consulting Corporation, Industrial and Government Consultants, Washington, D.C.
Bunting Sterisystems, Inc., Manufacture and Design, Bridgeport, Conn.

A coaxial cable transmission system combining communications, security surveillance, and television reception is proposed for use in low- and moderate-income apartment projects. Basic to the system, developed originally for hospitals and nursing homes, is the single, small-diameter (less than 1/4 in.) coaxial cable which acts as a carrier for all the electrical signals required, including all 12 VHF TV channels, 70 UHF channels, plus intercommunication and any other signals required, without any mutual interference.

Exterior doors would be equipped with camera, microphone, and electronically controlled opener, which the tenant could activate after having viewed the visitor on the living unit's built-in TV, both sight and sound pre-empting the entertainment TV program on command. The system also will have built-in capabilities for transmitting EKG and all physiological monitoring from any apartment over the same coaxial system to any location.

The television sets and circuitry for the entire system would be solid state for instantaneous operation when switched on, an imperative in connection with security functions. Continual preheating of the cathode of the 19-in. picture tube would afford instant warm-up of this component. The system would be powered remotely by a low-voltage supply from a distribution cabinet on each floor or located centrally for a cluster of garden apartments.

SITE SYSTEM	
10 **Utilities**	COAXIAL CABLE TRANSMISSION SYSTEM PROVIDING COMMUNICATION, SECURITY SYSTEM & TV RECEPTION
BUILDING SUBSYSTEMS	
22 **Electrical**	COAXIAL CABLE TRANSMISSION SYSTEM PROVIDING COMMUNICATION, SECURITY SYSTEM & TV RECEPTION
ECONOMICS	
30 **Construction Costs**	$4,800 PER UNIT
32 **Useful Life**	COMPONENTS—7 TO 10 YEARS; PICTURE TUBE—6 YEARS
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEVELOPMENT OF COAXIAL CABLE COMMUNICATIONS—SECURITY—TELEVISION SYSTEM FOR HOUSING
GENERAL	
39 **Major Innovative Concepts**	DEVELOPMENT OF COAXIAL CABLE COMMUNICATIONS—SECURITY—TELEVISION SYSTEM FOR HOUSING

Community Systems By Perini

PROPOSER

Perini Corporation, Boston, Massachusetts

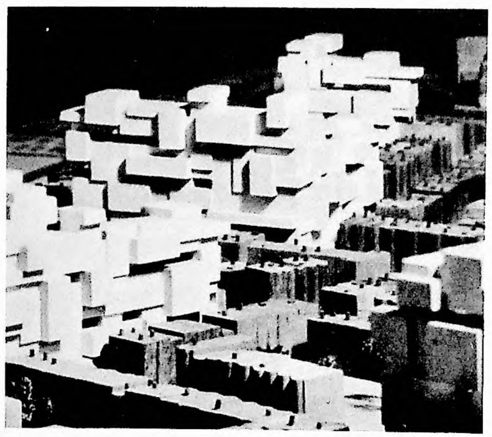
Use of "negative" space and patented space-frame system of housing made up of precast concrete panels, joined by special locking devices, are embodied in the proposal submitted. Through the concept of building on "negative" space, such as over existing streets, alleys, and yards, the proposer offers a solution to the increasingly pressing problem of finding room for housing in urban areas. Through the panelized space frame system, a structural system is offered that will meet the special needs of such center-city high- and low-rise construction.

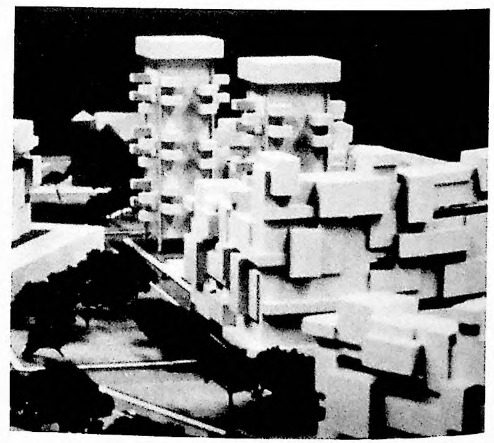
The proposed use of "negative" space may require legislation for the right of eminent domain in order to obtain air rights over both public and private property, and to cause vacating of older properties slated for later demolition. Basic to the concept of utilization of "negative" space is the almost complete rebuilding of a viable community, without disruption of existing living patterns and neighborhood activities. This is accomplished by an ordered sequence of: (1) construction of new housing over "negative" space, often on air rights if the street below is to remain open; (2) systematic relocation of dwellers from old structures to the new units; and (3) after new housing has been prepared, so that no one is made homeless, demolition of the old structures, creating new, wider open space for the enjoyment of all.

The precast, reinforced concrete panels of the system are particularly suited to building over "negative" space since they can be assembled into a great variety of architectural shapes and configurations, and can span over and fit into almost any space available. Special steel locking devices cast into panels cause the assembled panels to act as a self-supporting, statically indeterminate space frame, with the panels therefore not only acting structurally, but also enclosing space for architectural purposes.

The system lends itself to an industrialized manufacturing approach, using unskilled labor on a repetitive basis. The panels may be cast onsite, or they may be factory-produced and readily transported to the site.

SITE SYSTEM	
1 Site Situation	URBAN
5 Planning Concepts	USE OF NEGATIVE URBAN SPACE THROUGH AIR RIGHTS
7 Circulation	EXISTING STREET SPACE TO BE DEVELOPED THE SAME AS OTHER NEGATIVE URBAN SPACE
9 Community Involvement	ELIMINATION OF UNNECESSARY RELOCATION OF URBAN FAMILIES DURING CONSTRUCTION
BUILDING SYSTEMS	
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH & DEVELOPMENT
15 Community Involvement	SHAPE OF COMMUNITY EVOLVES WITH THE NEIGHBORHOOD PEOPLE'S NEEDS
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE PANELS JOINED ONSITE
17 Exterior Elements	GLASS & CONCRETE PANELS
18 Interior Elements	PREFABRICATED INTERIOR WALLS & PARTITIONS
19 Foundations	NEW LINE GROUND LOAD DISTRIBUTION SYSTEM OF REINFORCED CONCRETE
PRODUCTION	
24 Offsite Production	POSSIBLE PRECAST CONCRETE WALL, CEILING, & FLOOR PANELS
25 Onsite Production	POSSIBLE PRECAST CONCRETE WALL, CEILING, & FLOOR PANELS
26 Onsite Construction and Erection	FOUNDATION; JOINING OF PANELS; PLACING OF CORE UNITS
27 Labor	PRODUCTION & ERECTION REQUIRES MINIMUM SKILL
29 Community Involvement	NEIGHBORHOOD PARTICIPATION IN CONSTRUCTION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	ARCHITECTURE; URBAN PLANNING
GENERAL	
39 Major Innovative Concepts	UTILIZATION OF "NEGATIVE URBAN SPACE"; EMINENT DOMAIN ADVOCATED





Community Systems Development

PROPOSER

Community Systems Development, Durham, North Carolina

In addition to a basic building system, this organization proposes a very broad and comprehensive community development program. The stated program embodies all phases of community development including site selection; financing arrangements, cooperation and coordination; logistic, topographical and general contour planning; design of day care, preschool, community, and laundry centers; and testing for sociological and psychological needs of the complex.

The plan advances multifamily low-rise and high-rise volumetric modules. The housing shell for the module is factory-fabricated and shipped to site with roof and floor components and plywood panels. Major onsite activity is limited to joining of modules with floor and roof components. Interior elements are gypsum board finishes, ceramic or resilient tile, and oak flooring. Foundations are slab-on-the-ground but other construction can be utilized.

Appliances and appliance areas become a function of cost. Low-cost units have essential requirements, with the number of items included increasing as size of units increase. CATV or Attic Antenna are also provided. Many of the minor elements of completion, landscaping, and finishing can be accomplished by self-help with suggested developer-furnished materials.

Although the state-of-the-art relative to mass production of major units is well advanced, some proof-testing and development activity is necessary before the project can be fully launched.

SITE SYSTEM	
1 Site Situation	URBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	FLEXIBLE
6 Nonresidential Functions	DAY CARE; PRESCHOOL; COMMUNITY & LAUNDRY FACILITIES
7 Circulation	CUL-DE-SACS; COLLECTOR STREETS SURROUNDING SITE WITH MINOR STREETS
8 Site Planning Services	BY PROPOSER
9 Community Involvement	TESTING OF SOCIOLOGICAL & PSYCHOLOGICAL NEEDS
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1, 2, 3, 4 BEDROOMS
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULES WITH ROOF & FLOOR COMPONENTS
17 Exterior Elements	PLYWOOD PANELS
18 Interior Elements	GYPSUM BOARD FINISHES; CERAMIC OR RESILIENT TILE; OAK FLOORING
19 Foundations	SLAB-ON-GROUND
20 Comfort Systems	FACTORY-FABRICATED UNITS
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	MODULES, ROOF, FLOOR & WALL COMPONENTS
26 Onsite Construction and Erection	JOINING OF MODULES WITH FLOOR & ROOF COMPONENTS
29 Community Involvement	SELF-HELP
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF BUILDING SYSTEM & COMMUNITY DEVELOPMENT PROGRAM

Computer Planning Corporation

ECONOMICS	
30 **Construction Costs**	COMPUTERIZED MANAGEMENT INFORMATION SYSTEM APPLICABLE TO SUCH FUNCTIONS AS PAYROLL, COST ACCOUNTING, LAND ACCOUNTING & PROJECT SCHEDULING
31 **Financing Methods**	

MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEVELOPMENT OF COMPUTERIZED MANAGEMENT INFORMATION SYSTEM

PROPOSER

Computer Planning Corporation, Silver Spring, Maryland

The magnitude of overall construction implicit in Operation Breakthrough requires the support of a total management information system capable of satisfying a variety of user requirements. A first step toward development of such a system is proposed through use of a proprietary computer software concept. This concept offers a highly flexible software capability to support a number of functions such as payroll, cost accounting, land accounting, and project scheduling—all of which contribute to a total management system.

The proposed software concept interfaces with the computer's operating system, without change to that system, and thus continues to be a usable tool, regardless of equipment modifications or the release of new operating systems. The concept has been successfully implemented for other major computer applications.

Computer Usage Company

SITE SYSTEM	
5 **Planning Concepts**	COMPUTERIZED REAL ESTATE DATA BASE TO FACILITATE SITE FEASIBILITY DETERMINATION
ECONOMICS	
30 **Construction Costs**	RESEARCH & DEVELOPMENT OF COMPUTER MODEL TO FACILITATE PROCESSING OF APPLICATIONS FOR FHA PROGRAMS; COST BENEFIT ANALYSIS OF PROJECTED PROCESSING TIME SAVINGS TO BE PERFORMED
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	DESIGN OF SYSTEM TO EXPEDITE FHA MULTIFAMILY PROCESSING; ESTABLISH COMPUTERIZED REAL ESTATE DATA BASE; SHORTEN FHA FEASIBILITY & PROCESSING STAGES
36 **Market Area**	REAL ESTATE DATA BASE TO BE NATIONWIDE
38 **Consumer Protection**	ALMOST IMMEDIATE RESPONSE TO FHA QUERIES OF THE FEASIBILITY OF AN APPLICATION

PROPOSER CONSORTIUM

Computer Usage Company, Inc., Bethesda, Maryland
Karp, Nestler & Company, Housing Consultants, Washington, D. C.

A research and development effort, involving a computer model to hasten the processing of applications for Federal Housing Administration multifamily projects, is proposed for handling the increased demand expected over the next 10 years. Such an effort is expected to result in the following benefits: (1) A more accurate, economical, and efficient system for processing FHA applications with capacity to handle increasing volumes over the decade ahead. (2) Establishment and maintenance of an up-to-date base for required real estate information. (3) A reduction in the overall FHA processing cycle by elimination of much of the waiting period in the feasibility and processing stages, resulting in almost immediate response to FHA queries of the feasibility of the application.

Objectives would be to research, design and develop an automated model for processing the applications, to determine shortcuts in specific areas of the processing cycle, and to measure benefits by implementing a small scale model and by testing its applicability to each stage of processing. Further objectives are to provide full documentation or descriptions, operations, costs, test results, and evaluation activities, to determine feasibility and cost of such a system on a national scale, and to improve FHA organizational procedures for expediting mortgage loans.

This model would be capable of evaluating, or allowing FHA analysts to evaluate, each application on the exact criteria used currently in manual evaluation.

Concepts & Directions, Inc.

PROPOSER

Concepts & Directions, Inc., Oyster Bay, New York

Providing management with incentives for greater utilization of occupant equity participation in housing construction is the goal set for the study being proposed. Given such incentives, management should be able to achieve a program of almost total self-help, and aim at a desirable target of 25 to 30 percent in equity to be earned by the prospective low-income family.

Among the incentives that might be considered as aiding any self-help program is permitting an extension of the work period, thus giving the participants a longer time to accrue credits. Other incentives might be providing centralized management services that would assist the builder through money-saving procedures, and assisting in raising seed money for new projects.

The study would extend to a search for the systems most adaptable to self-help programs, with the most probable answer to be found in wood-framed construction of individual houses, because conventional materials like wood tend to be relatively low in cost and call for a relatively substantial amount of labor. Since labor is the prospective owner's principal asset, a wood-framed home therefore offers him the greatest opportunity to accrue equity. The same would hold true for any system that utilizes small building units, such as concrete block, or standard precast concrete component where a repetitive process is employed.

As part of the proposed study, a pilot program for a specific site would be detailed as a model which could be utilized nationally. Throughout the study, emphasis would be on employment of self-help at the very earliest possible phase of the construction process, beginning in the assembly plant, and continuing through finishing operations onsite.

Under the concept to be studied, prospective owners would not be paid wages, but would receive credits toward their equity at rates lower than skilled union scale, but higher than their normal pay. Basic to the entire concept is the overall reduction in borrowing requirements resulting in qualifying many more families as borrowers.

BUILDING SYSTEMS	
11 Housing Types	STUDY OF HOUSING TYPES TO DETERMINE MOST APPROPRIATE FOR SELF-HELP
14 State of Development	PROPOSED STUDY
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	STUDY OF BUILDING SYSTEMS MOST ADAPTABLE TO SELF-HELP PARTICIPATION
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection 27 Labor	STUDY TO PROVIDE MANAGEMENT INCENTIVES FOR ADOPTION OF SELF-HELP EQUITY PARTICIPATION PROGRAMS; EVALUATION OF PROCESSES MOST ADAPTABLE TO SELF-HELP; DEVELOPMENT OF PILOT PROGRAM TO ACT AS NATIONAL MODEL FOR DETERMINING MOST APPROPRIATE PRODUCTION & CONSTRUCTION PROCESSES FOR SELF-HELP
28 Labor Training Programs	INSTRUCTOR SUPERVISION TO DEVELOP MANUAL SKILLS
29 Community Involvement	LOCAL LABOR TO BE EMPLOYED; SELF-HELP EQUITY PARTICIPATION
ECONOMICS	
30 Construction Costs 31 Financing Methods	POSSIBLE MANAGEMENT INCENTIVES: PROVISION FOR CENTRAL MANAGEMENT SERVICES TO ASSIST IN COST-REDUCING PROCEDURES; ASSISTANCE IN RAISING SEED MONEY; EQUITY PARTICIPATION TO REDUCE FINANCING COST; 20% TO 30% EQUITY TARGET; OTHER CONVENTIONAL FINANCING; COOPERATIVES; CONDOMINIUM
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	STUDY MANAGEMENT INCENTIVES TO ADOPTION OF SELF-HELP EQUITY PARTICIPATION PROGRAMS
GENERAL	
39 Major Innovative Concepts	MANAGEMENT INCENTIVES TO INSTITUTE SELF-HELP EQUITY PARTICIPATION

Concepts & Directions, Inc.

PROPOSERS

Concepts & Directions, Inc., Oyster Bay, New York
Applied Marketing Technology, Inc., Marblehead, Massachusetts

This proposal contemplates the conduct of comprehensive market research in 12 major cities in a four-phase program. The complete market research will involve psychological in-depth personal interviewing, panel studies, programed questionnaries, and complete analysis of existing related information. A total of 5,000 would be interviewed, questioned, and tested for reactions to Breakthrough housing.

Phase I of the program will investigate all previous research on markets and cover interviewing of selected family formation groups. Questionnaires will be answered by low-income families to test the earlier research. Phase II will correlate and reference all information and program it for computer use in referencing Breakthrough projects. Phase III involves a complete analysis of motivation, needs, and desires of future owners/tenants for use by HUD in evaluating market requirements. Phase IV involves the preparation of a questionnaire to be used at the prototype locations to evaluate and qualify reactions to the housing models.

SITE SYSTEM	
9 **Community Involvement**	MARKET RESEARCH STUDY TO DETERMINE USER NEEDS & DESIRES THROUGH INTERVIEWS, QUESTIONNAIRES, PANELS STUDIES, AND OTHER MEANS.
BUILDING SYSTEMS	
14 **State of Development**	MARKET STUDY IN CONCEPTUAL STAGE
15 **Community Involvement**	INTERVIEW, QUESTIONING & TESTING OF REACTIONS TO HOUSING MODELS
MANAGEMENT	
33 **Proposer Organization**	JOINT VENTURE
34 **Internal Functions**	CONDUCT OF MARKET STUDY TO EVALUATE & QUALIFY USER REACTIONS TO BREAKTHROUGH HOUSING MODELS
36 **Market Area**	TWELVE MAJOR CITIES REPRESENTING A NATIONWIDE CROSS-SECTION

Concrete Fabricators

PROPOSER

Concrete Fabricators Company, Inc., Denver, Colorado

Research, development, design, and prototype construction of a housing system consisting of floor- or wall-sized modular components of reinforced adobe clay is proposed. The modular sections are cast on or adjacent to the site and may be erected by unskilled workers, under the supervision of a foreman assisted by a crane operator.

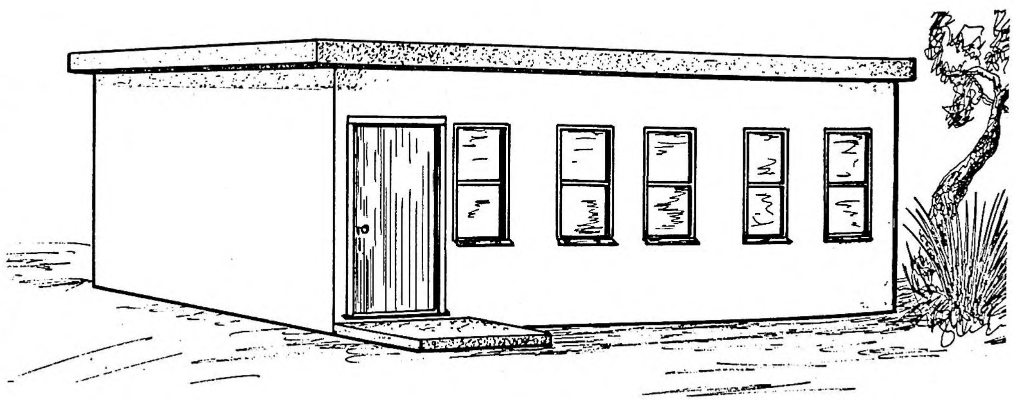
Basic to the proposal is the unitized, continuous-casting machine. The machine is adjustable for width and thickness of panel, with the length being controlled by shearing as panels come from the continuous bed. A typical wall panel may be 8 in. thick, 20 ft. wide or high, in a 25-ft. length. A special feature of the machine keeps the reinforcement at the precise design position within the adobe mix, the resultant slab acting to prestress the steel reinforcing, whether bars, strand, or welded wire fabric.

Floor and roof panels, exterior walls, party walls, partitions, stair treads, and landings are all cast in the site-located machine, with plastic or copper piping and conduit wiring being cast integrally into the panels where required. Flexible connectors assure rapid connection of utilities as the modular components are assembled.

Weatherproof jointing of the panels is accomplished by caulking of grooves, machine-cast continuously into the edges of components, plus a continuous spline of noncorrosive metal or plastic. No exterior finishing is required, the clay being integrally colored. Wood joists, 14 in. high, tie exterior bearing walls together (10 ft. on center vertically—that is, at each story height), support the second and the third floors, and enable the roof to withstand snow loads.

Extensive self-help potential is claimed for the adobe panel system, and its ease of disassembly and removal to another site for reuse at low cost is cited as a further advantage.

SITE SYSTEM	
2 Density Range	33 DWELLING UNITS PER ACRE
4 Climate	ADPATABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
13 Design Selection	FROM STANDARD PLANS
14 State of Development	BUILDING SYSTEM & PRODUCTION PLANT REQUIRING RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure	REINFORCED ADOBE CLAY MODULAR FLOOR, WALL & ROOF COMPONENTS
18 Interior Elements	REINFORCED ADOBE CLAY PARTITIONS; STAIR TREADS & LANDINGS
19 Foundations	CONTINUOUS FULL PERIMETER FOOTINGS
20 Comfort Systems	GAS-FIRED FORCED AIR HEATING
21 Plumbing	COPPER OR PLASTIC PIPING INTEGRAL IN UNITS; FLEXIBLE CONNECTIONS; VENT STACK
22 Electrical	CONDUIT WIRING CAST IN WALLS; FLEXIBLE CONNECTIONS; CENTRAL CEILING LIGHTS
PRODUCTION	
25 Onsite Production	CASTING OF EXTERIOR WALL, FLOOR & ROOF COMPONENTS; PARTITIONS; STAIRS; LANDINGS
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF COMPONENTS; FINISHES; UTILITIES HOOK-UPS
27 Labor	PRIMARILY UNSKILLED; SKILLED CASTING-DRYING-CURING ENGINEER & OTHER CRAFTSMEN
29 Community Involvement	EXTENSIVE SELF-HELP POSSIBLE
ECONOMICS	
30 Construction Costs	$10,000 TO $13,500 PER UNIT, 1000 UNITS PER YEAR
32 Useful Life	STRUCTURAL SYSTEM—50 TO 100 YEARS; ROOF—20 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN; PRODUCTION; CONSTRUCTION
36 Market Area	NATIONWIDE
37 Delivery Rate	FOUR UNITS PER DAY
GENERAL	
40 Codes	DOES NOT CONFORM TO ALL CODE REQUIREMENTS



Consultants Network

PROPOSER

Consultants Network, Inc., Santa Ana, California

Five programs, one having applicability to the building field in general, the others pertaining to definitive building concepts or proprietary systems more specifically, are proposed by this group of consultants. The program of general applicability concerns development of an information system which would operate to evaluate and disseminate to all concerned a broad spectrum of the data and current knowledge required in all phases of the building process.

Four tasks would be required: (1) Identification of information requirements and criteria; (2) Determination of a structural concept for the system and subsequent design of an information base; (3) Determination of information inflow and design of an access and update system; and (4) Design of user methodologies. The proposed information system possibly might be a foundation for establishing a national building systems institute.

The group's second proposal would set up a training program to teach American Indian workers how to build simple living structures, using a proprietary system of concrete construction. This system comprises essentially space-frame panels of welded wire fabric and trussed web rods, the cores of which are filled onsite with sprayed insulating concrete; the interior and exterior surfaces similarly are sprayed in place. During the 8-week training program, two single-family, one-story dwelling units would be constructed by self-help labor, with the workers being guided by previously selected and trained Indian supervisors.

A third proposal is for evaluation of fire-sensing and extinguishing systems for high-rise apartment structures, with an objective being to implement the use of a proprietary aluminum space-frame system in multi-story construction. Five tasks would be undertaken in this study: (1) Evaluation of the state of the art for

Subproposal No. 1

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF AN INFORMATION SYSTEM SUPPLIED BY & DISSEMINATED
35 External Functions	TO BUILDERS, DEVELOPERS, PROFESSIONALS & SUPPLIERS
36 Market Area	NATIONAL INFORMATION SYSTEM

Subproposal No. 2

SITE SYSTEM	
1 Site Situation	RURAL
4 Climate	ESPECIALLY SUITABLE FOR SOUTHWEST
BUILDING SUBSYSTEMS	
16 Structure	SPACE-FRAME PANELS OF WELDED WIRE FABRIC & TRUSSED WEB RODS, THE CORES OF WHICH ARE SPRAYED WITH CONCRETE
17 Exterior Elements	INTERIOR & EXTERIOR SURFACES ARE SPRAYED IN PLACE
18 Interior Elements	
PRODUCTION	
26 Onsite Construction and Erection	FOUNDATIONS; SPRAYING OF CONCRETE ON PANELS
27 Labor	UNSKILLED; TRAINED INDIAN SUPERVISORS
28 Labor Training Programs	8 WEEK PROGRAM TO TEACH AMERICAN INDIANS TO BUILD SIMPLE STRUCTURES
29 Community Involvement	SELF-HELP LABOR
MANAGEMENT	
34 Internal Functions	SYSTEM DESIGN; CONSULTANT SERVICES; SUPERVISION OF CONSTRUCTION OF 2 UNITS

Subproposal No. 3

BUILDING SYSTEMS	
11 Housing Types	STUDY OF SYSTEMS FOR MULTIFAMILY HIGH-RISE
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure	EVALUATION OF FIRE SENSING & EXTINGUISHING SYSTEMS TO MAKE POSSIBLE USE OF ALUMINUM STRUCTURAL MEMBERS IN MULTI-STORY CONSTRUCTION
17 Exterior Elements	EVALUATION OF NEW BUILDING MATERIALS WHICH COULD EMPLOY SELF-EXTINGUISHING METHODS

Consultants Network (continued)

temperature sensing devices; (2) Evaluation of current extinguishing devices; (3) Evaluation of proposed extinguishing devices; (4) Exploration of new building materials for use in self-extinguishing methods; and (5) Bench tests of alternate solutions, using an aluminum space-frame.

The fourth proposal is for study of the technical and economic feasibility of machine-produced, filament-wound plastic modules in high-rise construction. Emphasis would be placed upon the particular advantages claimed for this proprietary concept—lightweight, high strength, and fire resistance. The study would also investigate the employment of relocatable filament winding machines, so that the modules could be produced near or adjacent to both site and mobile home manufacturing plants, which would finish the interiors of the units for subsequent crane-placement in the structure.

The final, and fifth, proposal is for study of the feasibility of factory-produced, filament-wound elevator towers for use with a proprietary system of filament-wound dwelling modules. The elevator tower, thought to be capable of supporting a pressure-driven passenger cage up to a height of seven stories, would be essentially a glass-reinforced, plastic tube. The study would investigate various methods of propulsion and develop a preliminary set of specifications for a seven-story tower.

Subproposal No. 4

BUILDING SUBSYSTEMS	
16 Structure	STUDY OF USE OF A LIGHTWEIGHT, HIGH STRENGTH FILAMENT-WOUND PLASTIC STRUCTURAL SHELL FOR MODULAR UNITS
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES; FINISHING OF INTERIOR
26 Onsite Construction and Erection	PLACING OF VOLUMETRIC MODULES BY CRANE
MANAGEMENT	
34 Internal Functions **35 External Functions**	TESTING OF MATERIALS; MARKET STUDY OF AVAILABLE FIRE RESISTANT RESINS & REINFORCING MATERIALS

Subproposal No. 5

BUILDING SUBSYSTEMS	
16 Structure	STUDY OF FILAMENT-WOUND PLASTICS STRENGTH ELEVATOR TOWER TO WITHSTAND REQUIRED PRESSURE TO OPERATE PASSENGER CAGE TO SEVEN STORIES
22 Electrical	STUDY OF ELEVATOR LIFT TECHNIQUES FROM STANDPOINT OF ELECTRICAL, MECHANICAL, PNEUMATICS, HYDRAULICS
PRODUCTION	
24 Offsite Production	STUDY OF FEASIBILITY OF FACTORY PRODUCTION OF COMPLETE ELEVATOR TOWER POWERED BY A PRESSURE SYSTEM
MANAGEMENT	
34 Internal Functions **35 External Functions**	RESEARCH; TESTING; REPORTING
38 Consumer Protection	MECHANICAL LOCKING & OTHER SAFETY DEVICES

Consyst, Inc.

PROPOSER

Consyst, Inc., Tallmadge, Ohio

AFFILIATES

Pennsylvania Engineering Corporation, Press Design; H. B. Zachry Company, Construction; Harris & Sutherland, Systems Analysis; Thomas J. Dillon & Co.; Dalton-Dalton-Little, Architectural Engineering; Urban Research & Planning; Crane Company, Bath Module; Tappan Company, Kitchen Module.

A two-phase proposal for investigation of methods of casting pressure-treated concrete panels onsite and preparing construction drawings with the aid of a computer program is advanced by this proposer.

The pressure casting technique has been developed over a period of years in Great Britain, and consists of casting completely reinforced panels of 24 ft. x 12 ft. x 6-in. to 12-in. depth, in a giant press. The press is capable of exerting pressures of more than 400 pounds per sq. in. over the surface of the panel for a period of 1 to 2 min. The result is a panel sufficiently strong to be lifted from the mold by vacuum lifting devices as soon as the form is released.

It is contemplated that such a machine, set up onsite, could quickly produce structural concrete panels, which could then be erected quickly—with little need for transport arrangements—to form the frame and weather envelope of the building. Preassembled bathroom and kitchen elements would also be manufactured to be lifted into place as the building progresses.

Also proposed is a computer program, already partially demonstrated, for production of drawings necessary for construction work. The idea is practical, in that most of the drawings necessary contain numerous repetitive details for each floor or section of a building, and use of a computer could eliminate literally thousands of manhours devoted to preparing the drawings.

The resulting building system would be adaptable to almost all types of housing.

BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF CASTING METHOD FOR CONCRETE ELEMENTS; COMPUTER PROGRAM FOR PREPARATION OF CONSTRUCTION DRAWINGS
21 Plumbing	KITCHEN & BATH MODULES INSTALLED ONSITE ALONG WITH CONCRETE PANELS
PRODUCTION	
25 Onsite Production	DEVELOPMENT OF METHOD OF CASTING CONCRETE ELEMENTS
26 Onsite Construction and Erection	PANELS DEVELOPED TO BE SITE ERECTED
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF CONCRETE CASTING METHOD & COMPUTER PROGRAM FOR PREPARATION OF CONSTRUCTION DRAWINGS
37 Delivery Rate	15 CONCRETE ELEMENTS PER HOUR USING HIGH-SPEED CASTING MACHINE

Continental Homes

PROPOSER

Continental Homes, Inc., Los Angeles, Calif.

AFFILIATES

Strobel and Rongved, Engineering; Win Hoffman, AIA, Architect; H. E. Walshe, Architect; A. J. Sarett & Associates, Advertising; G. H. Schiff, Attorney; Egon Dumler, Attorney; W. J. Mattauch & Company, CPA; Dr. Herman J.A.C. Arens; J. Boneparth & Associates; John J. McFadden; Richard Shelly, AIA, Architect; Ron Brukoff, Interior Design; Autocade, Inc., Building Codes; Karl R. Rohrer & Associates, Environmental Engineering; Munters Environment Control, Heating/Air Conditioning

Wall elements formed by bonding hardboard sheets to a kraftpaper honeycomb core are proposed for use in volume construction of single-family and multi-family low-rise housing. The stressed-skin panel subsystem allows close tolerance production controls at the plant and provides load-bearing components adaptable to wall, ceiling, and floor construction where concrete slabs are not dictated by local conditions. A useful life of 100 years is claimed for this construction method. A volume production for the panel system is projected at 1,000 to 3,000 units per year.

An innovative feature of this proposal is the use of adhesives instead of nails or other conventional fasteners. The 5-ft. or 6-ft. wide hardboard substrates are bonded to the honeycombs with thermosetting adhesives. The kraft fiber cellular form, with nested hexagonal-shaped voids, is impregnated with phenolic resin for strength and wearability. By switching from conventional 4-ft. widths of the sandwich layers to larger dimension, the manufacturer can save up to 20 percent on labor costs at the plant. Even wider elements are planned, with wall section lengths running to as much as 14 ft. in 1-ft. increments.

Door and window openings are actually "non-panels" with filler material forming transoms and sills. The flexibility of this system, with its varied panel sizes, permits a wide variety of architectural treatments ranging from custom to standardized appearance. Exterior finish can be paint or plant-applied acrylic or fluoride films. All interiors will be either factory-primed and field-painted, or completely factory-finished by priming and painting, roll film laminated with vinyl finishes, tile-board or paneling. Acoustical ceiling tile is prescribed where applicable; trim is to be standard wood or plastic on metal.

Preplumbed trees will be dropped into place where this is feasible, or conventional plumbing is specified. Power supply and distribution will be underground with factory-installed conduits placed within walls for conventional wiring runs. Foundations can be of slab, perimeter or pier type.

Summary Information

SITE SYSTEM	
1 Site Situation	SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION
10 Utilities	UNDERGROUND WIRING
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	EFFICIENCY; 1 TO 3 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM DEVELOPED BUT NOT BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure	STRESSED-SKIN WALL & FLOOR PANELS (FIBERBOARD SURFACED, KRAFTPAPER HONEYCOMB CORE)
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	PREFINISHED PANELS; GYPSUM BOARD & PLASTIC FILM-FINISHED FIBREBOARD
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	GAS OR ELECTRIC HEATING SYSTEM FOR INDIVIDUAL UNITS;
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
PRODUCTION	
24 Offsite Production	WALL, FLOOR, CEILING PANELS; SERVICE MODULES
25 Onsite Production	
26 Onsite Construction	FOUNDATIONS; ERECTION OF PANELS; UTILITY HOOK-UPS
29 Community Involvement	SELF-HELP; COMMUNITY INVOLVEMENT TEAM TO BE DEVELOPED IN FUTURE
ECONOMICS	
30 Construction Costs	$7,887 PER UNIT ($8.23 PER SQ. FT.); 1,000 UNITS PER YEAR
31 Financing Methods	CONVENTIONAL
32 Useful Life	STRUCTURE—100 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; MANUFACTURING
35 External Functions	ENGINEERING; ARCHITECTURAL DESIGN; ACCOUNTING; FINANCING
36 Market Area	500 MILE RADIUS OF FACTORY
37 Delivery Rate	1,000 UNITS MINIMUM; 3,000 UNITS MAXIMUM
GENERAL	
39 Major Innovative Concepts	ADHESIVE CONSTRUCTION OF PANEL FABRICATION
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Coverbond

PROPOSER

Coverbond Corporation, Washington, D. C.

AFFILIATES

National Brick and Supply Company; Petro Plastics, Supplier; Design Consultant; John H. Hampshire, Inc., Management, Training, Production, Financing; Grant Stetter, Construction Consultant; Gayle S. Mann and Associates, Training and Production

Further development is proposed of a system of concrete-block construction that utilizes smooth-ground block (at top and bottom) and injection of mortar into the joints of prestacked block.

The system of construction lends itself to use of unskilled labor for stacking of the block but calls for skilled men for injecting the mortar. Conventional plumbing and mechanical systems and electrical wiring can be carried through the voids in the block for conventional installations in single-story or multistory structures.

Floors are conventional reinforced-concrete slab, strengthened slightly at bearing points. Interior partitions would also be built of concrete block; ceilings would receive sprayed on acoustical treatment. The injected mortar includes waterproofing and pigmentation if desired, and when completed gives the wall the appearance of a sand-plaster coating for the wall, since it constitutes also the final treatment of the wall element. The system is said to be readily adaptable to expansion of basic living units.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	3 TO 22 UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
14 State of Development	BUILDING SYSTEM PARTIALLY DEVELOPED & TESTED FOR SINGLE-FAMILY UNITS
BUILDING SUBSYSTEMS	
16 Structure	PRESTACKED CONCRETE BLOCK MASONRY TO WHICH MORTAR IS PNEUMATICALLY APPLIED
18 Interior Elements	CONCRETE BLOCK MASONRY TO WHICH MORTAR IS PNEUMATICALLY APPLIED
19 Foundations	CONVENTIONAL SLAB THICKENED UNDER BEARING PARTITIONS
PRODUCTION	
24 Offsite Production	CONCRETE BLOCKS
26 Onsite Construction and Erection	FOUNDATION; STACKING OF BLOCKS; PNEUMATIC APPLICATION OF MORTAR; ROOF CONSTRUCTION
27 Labor	UNSKILLED FOR ERECTION; SKILLED FOR MORTAR APPLICATION, PLUMBING & ELECTRICAL
28 Labor Training Programs	ON-THE-JOB TRAINING
29 Community Involvement	SELF-HELP ERECTION FEASIBLE
ECONOMICS	
30 Construction Costs	WALL SECTIONS $0.75 PER SQ. FT.; APPROXIMATELY $8,000 TO $11,000 PER UNIT
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN & IMPLEMENTATION OF CONSTRUCTION METHOD
35 External Functions	CONSULTANT WORK IN FIELDS RELATING TO METHOD
36 Market Area	NATIONAL FRANCHISES; 50 MILE RADIUS OF BLOCK PLANTS
37 Delivery Rate	28 PLANTS PRODUCE MATERIALS FOR 56 UNITS PER DAY
GENERAL	
39 Major Innovative Concepts	PNEUMATIC MORTAR INJECTION METHOD FOR PRESTACKED CONCRETE BLOCKS
40 Codes	CONSTRUCTION METHOD MEETS ALL CODES

Weld Coxe

PROPOSER

Weld Coxe, Management Consultant, Philadelphia, Pennsylvania

Development of improved communications techniques and presentation concepts which can be used in support of innovative housing programs, and thus hasten their public acceptance and implementation, is the goal of this proposal.

A three-stage effort is outlined as an approach to the stated goal. Stage 1, designated as experience analysis, would consist of case studies to be made in each of 10 to 15 metropolitan areas. Surveying and assessment would be made of instances in which community approval was sought relating to proposed changes in neighborhood environments. Onsite interviews and a review of records of the various communication processes used in these situations would be subjected to intensive analysis, seeking the reasons for success or failure. (The areas to be studied might be selected in consultation with both HUD and private sources, in order to identify representative situations which might conceivably arise subsequently in connection with Operation Breakthrough applications.)

Stage 2 concerns process development and testing. The results of Stage 1 would be combined with inputs from consultants on the proposer's staff in order to arrive at recommended communications processes. These processes might then be tested in situations typically encountered in community relations problems in any one of three optional procedures: (1) The recommendations could be handed over to Operation Breakthrough Type A contractors for use at their discretion, with the proposer's consultants to evaluate results; (2) the consultants could train the contractor's community relations staff and, again, monitor and evaluate results; or (3) the consultants could accept full responsibility for community relations and put the communications recommendations into operation as a subcontract of a Type A contract.

Finally, in Stage 3, recommendations and guideline development would complete the study, with final output being recommended communications procedures for use in most typical situations which might arise in connection with solving the nation's housing problems.

SITE SYSTEM	
1 Site Situation 2 Density Range 3 Topography 4 Climate 5 Planning Concepts 6 Nonresidential Functions 7 Circulation 8 Site Planning Services 9 Community Involvement	FORMULATION OF COMMUNITY RELATIONS COMMUNICATIONS PROCEDURES TO IMPLEMENT ACCEPTANCE OF NEW PLANNING CONCEPTS AT COMMUNITY & NEIGHBORHOOD LEVELS; STUDIES IN 10 TO 15 METROPOLITAN AREAS; TESTING IN REPRESENTATIVE PROJECTS; ACTION GUIDELINES FOR FUTURE SITES INVOLVING NEW ENVIRONMENTAL CONCEPTS (BALANCED HOUSING, PUD, CLUSTERS, HIGHER DENSITIES, ETC.); CASE STUDIES TO INVOLVE ONSITE INTERVIEWS & REVIEW OF AVAILABLE RECORDS (TRANSCRIPTS, LEGAL BRIEFS, PUBLICITY, CLIPPING, ETC.)
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	SUPERVISION; RESEARCH; TESTING; PREPARATION OF GUIDELINES & RECOMMENDATIONS; OPTIONAL CONSULTING ARRANGEMENTS FOR EVALUATION, TRAINING, OR APPLICATION
35 External Functions	HUD TO SELECT STUDY SITES; TYPE A CONTRACTORS TO PARTICIPATE IN TESTING RECOMMENDATIONS & APPLYING GUIDELINES
36 Market Area	BREAKTHROUGH SITES OR OTHERS WHERE COMMUNITY RELATIONS ARE INVOLVED
GENERAL	
39 Major Innovative Concepts 40	APPLICATION OF SUCCESSFUL COMMUNICATION TECHNOLOGY FOR COMMUNITY SUPPORT
40 Codes	MAY REQUIRE CHANGES, VARIANCES, & DEPARTURES FROM ZONING & LAND USE PRACTICES

Craftsman's Guild

PROPOSER

Craftsmen's Guild, Elkhart, Indiana

A survey of the industrialized building industry to determine the state of the art is proposed by this association of consultants. The survey of presently existing and operating facilities would be on a state-by-state basis and would cover manufacturers of modular sectionalized housing and systems. A second phase of the survey would pertain to organizations actively planning to venture into the field in the near future (prior to December 1971) and would identify the types of products to be introduced.

The summary reports expected to emerge from the study would be in four categories: (1) A comprehensive summary of specific structural, electrical and mechanical standards now being achieved in industrialized housing production; (2) a comparison of the state-of-the-art construction standards of plants now making modular of sectionalized housing in accordance with existing building codes in 10 selected metropolitan areas in order to reveal variances and constraints; (3) a similar comparison with model codes to reveal variances; and (4) association of the survey's overall results with a recommendation that a future program be developed for inspection to be carried out by independent standards certification organizations.

BUILDING SUBSYSTEMS	
16 **Structure**	SURVEY & IDENTIFICATION OF TYPES OF SECTIONAL AND/OR MODULAR BUILDING SYSTEMS IN USE OR PROPOSED
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	IDENTIFICATION OF PRESENT STANDARDS IN INDUSTRIALIZED HOUSING SYSTEMS
PRODUCTION	
24 **Offsite Production** 25 **Onsite Production**	SURVEY OF INDUSTRIALIZED HOUSING MANUFACTURERS; DETERMINATION OF STATE OF THE ART; RECOMMENDATION FOR DEVELOPMENT OF IN-PLANT INSPECTION PROGRAM BY INDEPENDENT STANDARD CERTIFICATION ORGANIZATIONS
MANAGEMENT	
33 **Proposer Organization**	NONPROFIT CORPORATION
34 **Internal Functions**	CONDUCT SURVEY OF EXISTING INDUSTRIALIZED HOUSING PLANTS GEOGRAPHICALLY; INVESTIGATE; MAKE RECOMMENDATIONS REGARDING INDUSTRIALIZED SYSTEMS STANDARDS
GENERAL	
40 **Codes**	STUDY OF VARIANCES & CONSTRAINTS OF SECTIONAL AND/OR MODULAR SYSTEMS

Crumlish, Sporleder & Associates

PROPOSER

Crumlish, Sporleder & Associates, Architects & Urban Designers, Mishawaka, Indiana

This group of planning consultants proposes development of a land-use concept which would implement environmental changes within a neighborhood, and which would encourage operating efficiencies in local administrative units and quality design and planning of the site. Motivating the proposal are the national urban problems of site density and the need for accommodating increases in site density.

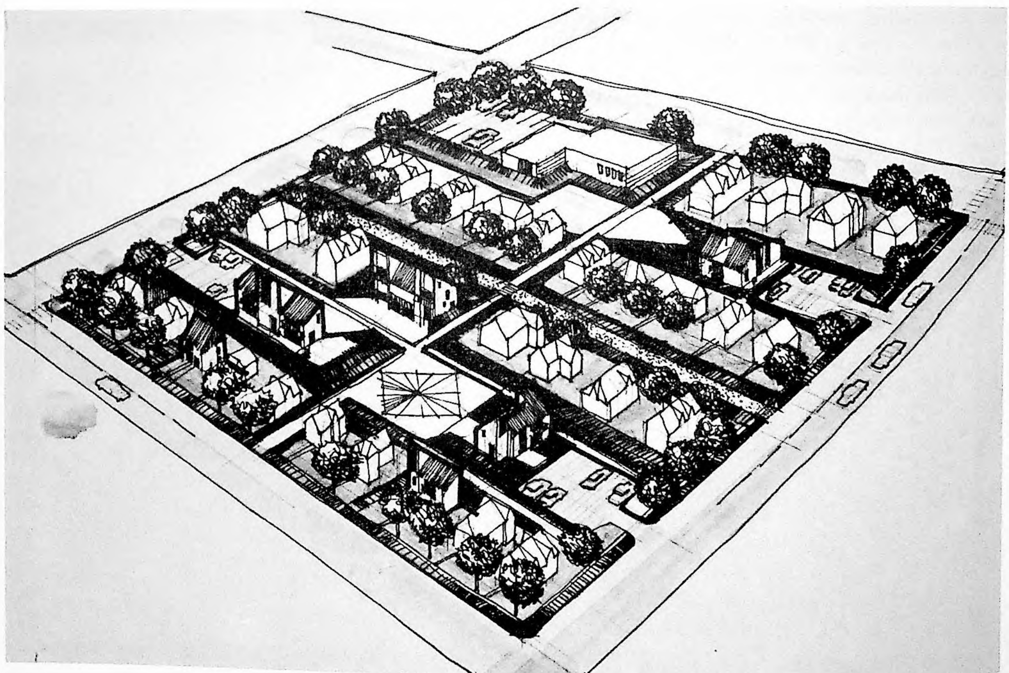
Maintaining the single-family character of the neighborhood, while increasing the density, is basic to the proposed land-use program. The study would consider existing single-family housing situations with a density of about 10 dwelling units per acre and search for means of increasing this density to 15. Some of the concepts put forward as partial solutions for study include: Conversion of streets between collector streets into open space; development of car parks at entrances to former alleys, which would become part of a strip of common open space running through the back yard area of existing lots; covered parking areas with platform structures upon which would be built one-level, four-unit ranch style homes; rehabilitation of existing structures; construction of new single-family semi-detached housing; additions to existing homes; and development of an efficient utility system, combining service feeder systems on the housing site.

Further, the need is recognized for development of a delivery system of planning and design concepts and coordinated government activities, in which the residents themselves express interest and which they accept.

SITE SYSTEM	
1 Site Situation	DEVELOPMENT OF LAND-USE CONCEPT DIRECTED TOWARD URBAN ENVIRONMENTAL CHANGE WITH NEIGHBORHOOD ACCEPTANCE; EMPHASIS ON SINGLE-FAMILY
2 Density Range	HIGH DENSITY HOUSING; 10-15 DWELLING UNITS PER ACRE
5 Planning Concepts	EXPLORATION OF MEANS OF MAINTAINING SINGLE-FAMILY CHARACTER WHILE INCREASING DENSITY; INCREASED OPEN SPACE
8 Site Planning Services	DEVELOPMENT OF SYSTEM OF PLANNING & DESIGN CONCEPTS COORDINATED WITH GOVERNMENT ACTIVITIES & RESIDENT INTEREST
9 Community Involvement	MAINTAINING NEIGHBORHOOD CONTINUITY BY PROMOTING ACCEPTANCE OF CHANGE; SELF-HELP; TENANT INVOLVEMENT IN MAINTENANCE.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
14 State of Development	CONCEPT DEVELOPED

MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	DEVELOPMENT OF PLANNING & DESIGN SYSTEM TO ASCERTAIN ENVIRONMENTAL CHANGE & NEIGHBORHOOD ACCEPTANCE
35 External Functions	CONSULTANTS TO BE DETERMINED



DMJM

PROPOSER

Daniel-Mann-Johnson-Mendenhall, Architects-Engineers, Los Angeles, California

The feasibility of developing hillside properties in urban areas, most often by-passed for economic reasons, would be explored in a study proposed by this architectural-engineering firm. Initial work in this area already has produced a concept known as contour-rise, in which the amenities of urban living and the housing to accommodate an expanding population are combined in a harmonious relationship with natural surroundings, with the texture of the existing topography being preserved.

Further exploration in this direction would include the necessary disciplines needed to establish a vocabulary for evaluating potential hilly and steeply sloping sites and to provide developers with technical data needed for construction considerations. The design approach which should emerge from the study would include means of making a cost analysis of any proposed solution, from which design recommendations might be made.

The concept, as presently viewed, places a concentration of urban activities such as shops, supermarkets, theatres, restaurants, medical facilities, hotels and parking areas on top of the natural rise. Stepping down from that mass, on both sides of the hill and faithfully following its contours, are concrete pads upon which are erected dwelling units not more than two or three stories high, so that no building casts its shadow over another, and occupants have an unimpeded view of the valley's natural beauty below.

The only vehicular access to this urban concentration would be by roadways which feed in along the natural ridge line of the hilly site and adjacent hills. Access to the living units, staged down along the hillsides, would be by passenger-controlled, self-propelled inclined elevator cars, the occupant walking to this elevator from his car, stored in the multilevel garage on top, or by riding a moving sidewalk or escalator.

The entire complex is designed so that the pace of living changes from top to bottom: at the top, a concentration of urban activity, fast rhythm, sophistication, down the sides of the hill, through quiet housing, and arriving at the bottom to nature, rocks, lake, winding path and solitude.

Structurally, the interrelated mass of construction would be supported by reinforced concrete anchor ties against the grade, holding in place major features; these ties being suspended from a diaphragm system across the top of the hilly site and counterbalanced by similar ties on the opposite side. Localized static loads would be supported on reinforced concrete spread footings. The low-rise diaphragm-supported structure would minimize seismic problems, overcome any tendency of the earth or structure to slide downhill, and would be open-ended in that, while complete at any one stage, it might evolve into further expansion and natural growth.

SITE SYSTEM	
1 Site Situation 2 Density Range 3 Topography 4 Climate	DEVELOPMENT OF CONTOUR-RISE SYSTEM AS INNOVATIVE CONCEPT FOR DEVELOPING HILLSIDE PROPERTIES; FEASIBILITY STUDIES & DESIGN APPROACH FOR SPECIFIC SITES AND/OR BASIC RESEARCH & DESIGN CRITERIA FOR SITE EVALUATION; TECHNICAL DATA FOR CONSTRUCTION CONSIDERATIONS; ANALYSIS OF SITE PHYSICAL ASPECTS
5 Planning Concepts 6 Nonresidential Functions	PRESERVATION OF NATURAL CONTOUR & PARKLAND; URBAN CORE WITH RECREATIONAL, SOCIAL, CULTURAL & COMMERCIAL FACILITIES AT TOP OF HILL
7 Circulation	ANALYSIS OF STATE OF THE ART FOR CONVEYING PEOPLE & FREIGHT ON VARIOUS SLOPES & DISTANCES
8 Site Planning Services 9 Community Involvement	ANALYSIS OF USER NEEDS
10 Utilities	ANALYSIS OF UTILITIES & DRAINAGE ASPECTS
BUILDING SYSTEMS	
11 Housing Types 12 Unit Variations 13 Design Selection 14 State of Development 15 Community Involvement	DESIGN OF SCHEMATIC UNIT LAYOUTS; ARCHITECTURAL VISUAL ASPECTS OF DEVELOPMENT & COORDINATION WITH ENGINEERING CONCEPTS
BUILDING SUBSYSTEMS	
16 Structure	ANALYSIS OF MODULAR SYSTEMS & MATERIAL FOR STRUCTURE; CONSTRUCTION TECHNIQUES COMPATIBLE TO LOCALE & SITE
19 Foundations	ANALYSIS OF SYSTEMS RELATED TO FOUNDATION REQUIREMENTS
20 Comfort Systems 21 Plumbing 22 Electrical	ANALYSIS OF CENTRAL HEATING PLANT POTENTIAL, & REQUIREMENTS OF DISTRIBUTION SYSTEMS FOR SLOPES
ECONOMICS	
30 Construction Costs	ESTABLISH COSTING METHOD FOR ANALYZING ALTERNATE METHODS OF CONSTRUCTION & HARDWARE PROPOSED IN STUDY
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	PROGRAM & USER NEEDS; SITE ANALYSES; PLANNING; ARCHITECTURAL; STRUCTURAL; MECHANICAL; ELECTRICAL; TRANSPORTATION; CONSTRUCTION COSTS
GENERAL	
39 Major Innovative Concepts	CONTOUR-RISE SITE & BUILDING SYSTEMS FOR SLOPING & HILLY SITES
40 Codes	PLANNING ANALYSIS TO INCLUDE ZONING, LAND USE, EASEMENTS, & PLANNING COMMISSION REQUIREMENTS

DMJM

PROPOSER CONSORTIUM

Daniel-Mann-Johnson-Mendenhall, Architecture & Engineering, Los Angeles, California
American Cement Corporation, Los Angeles, California

The potential use of aerated concrete would be investigated under the terms of this proposal. The objective is to establish the feasibility of manufacturing and using aerated concrete to build housing units on a large scale.

A proposed study would survey and compile information on the long-term experiences with this technology in Europe, Canada, Mexico and Japan. This would be considered in an overall systems approach to United States conditions involving markets, codes, and labor. Very little of the material has been produced in this country to date.

This material is a lightweight concrete containing quantities of small, closed air cells, uniformily distributed. The solid matrix separating the cells is a fine-grained silicate material composed of finely ground sand or other siliceous material, cement, lime, and water. The cells are introduced before the mixture hardens through the addition of small quantities of aluminum powder. This reacts with the lime to form gas bubbles. The product can be reinforced to form bearing walls, floors, roofs, and lintels. After shaping in semicured form the castings are moved into large autoclaves where curing occurs in high-temperature steam. The result is a strong, rigid, solid mass, its weight one-fifth to one-third that of ordinary dense concrete.

The properties cited that make aerated concrete a desirable building material include: strength, stiffness, low weight, good thermal insulation, workability, dimensional uniformity, fire resistance and frost resistance. The product can be easily reinforced by conventional means and can readily be sawn, planed, routed, and drilled in the same manner that timber is worked. A good insulating quality is provided by the myriad unconnected air cells. The manufacturing process, conducted in highly automated factories, is closely controlled and close tolerances, held to as little as 1/16 in., result.

The proposed study calls for detailing four major areas: (1) literature-compiling of all published works; (2) evaluation of experience outside the United States, concentrating on technology, economics, and user needs including design applications and development of pricing data for manufacture, distribution, and erection; (3) evaluation of constraints in the United States involving marketability, acceptability, labor considerations, raw material supplies, codes, comparative economics, regional variations, transportation, and financing, and (4) design adaptability for United States mass housing.

BUILDING SYSTEMS	
14 State of Development	DEVELOPMENT AND USE OF AERATED CONCRETE IN EUROPE SINCE 1930; CONCEPTUAL STAGE FOR LARGE-SCALE U.S. USE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	RESEARCH TO DETERMINE USE OF AERATED CONCRETE FOR VARIOUS CONCRETE LOAD-BEARING MODULES OR MODULAR STRUCTURES, SUCH AS BEARING WALLS; ROOFS; LINTELS; PARTITIONS; FLOORS
PRODUCTION	
24 Offsite Production	RESEARCH STUDY OF PRECAST AERATED CONCRETE AND POSSIBLE PRODUCTION FOR VARIOUS APPLICATIONS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	ANALYSIS OF EUROPEAN AERATED CONCRETE TECHNOLOGY AND ADAPTABILITY TO U.S. USE
36 Market Area	NATIONAL AND INTERNATIONAL
GENERAL	
39 Major Innovative Concepts	RESEARCH STUDY ON LARGE-SCALE USE OF AERATED CONCRETE IN U.S.

Data Transformation Corporation

PROPOSER

Data Transformation Corporation, New York, New York.

A computer program utilizing model simulation is proposed to offer housing planners solutions to problems on both new and rehabilitation projects.

Input for the proposed system would include a data bank consisting of (1) pertinent information on the costs of construction due to delays in starting a project and on other delays to which no cost can be assigned; (2) time dependent costs as a function of building costs; and (3) design considerations in terms of materials and labor. For each project being studied input would consist of the objectives sought for the particular project, data on the site (dimensions, costs, existing housing), and specific planning constraints expected to be encountered. The specific project input would be gathered from community groups and other interested local sources.

The system would edit the input data and create necessary files; simulate housing production projects; compile cost and completion estimates; and formulate optimum strategies from which the planners may choose.

SITE SYSTEM	
5 **Planning Concepts**	STUDY TO DEVELOP POSSIBLE CONFIGURATIONS FOR A GIVEN LOT
8 **Site Planning Services**	STUDY TO FORMULATE OPTIMUM STRATEGIES TO SATISFY OBJECTIVES BY PLANNER
9 **Community Involvement**	COMMUNITY GROUPS TO PROVIDE INPUT ON USER NEEDS
ECONOMICS	
30 **Construction Costs**	COMPLETE STUDY TO DETERMINE COST CONSTRAINTS RELATED TO DESIGN & CONSTRUCTION PROCESSES
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	COMPUTERIZED SYSTEM WITH MODEL SIMULATION OF PLANNING & CONSTRUCTION ACTIVITIES

Denver Research Institute

PROPOSER

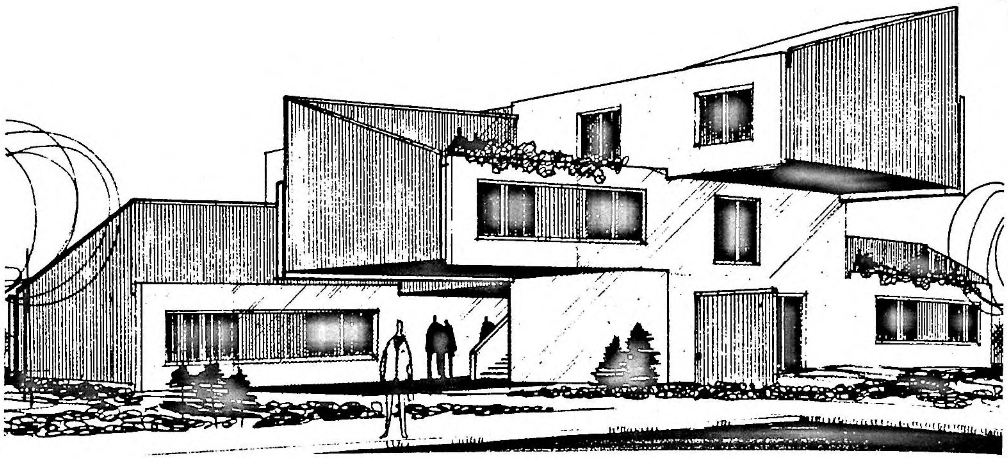
Denver Research Institute, University of Denver, Denver, Colorado.

Further study of a housing concept—aimed at multifamily low-rise structures—incorporating factory-cast concrete modules combined with steel and concrete beam supports, is proposed.

The concept contemplates prefabricated components (such as closets and bathrooms) assembled into modules and transported to a site for final assembly. Totally assembled, these modules would result in housing units each 24 ft. wide x 36 ft. or 48 ft. long, generally to be stacked three stories high, rotated 90 to 180 degrees horizontally about a core area, to give variety in appearance and exposure. Outer walls of the modules would be of reinforced concrete sandwich construction, to provide suitable insulation, and the modules would be nearly completely finished on the interior.

Central to the system is a 24-ft. x 24-ft. core section, which would provide the main structural support, and would be the only section bearing directly on the foundation. This unit would usually contain entranceways and wet areas such as kitchens and bathrooms. Living modules would then be cantilevered from this core unit, supported on reinforced concrete beams, with transverse steel open-web joists to take floor loads. Similar joists would support the roof structure. The core structures would thus provide a central stack area, where duplicating mechanical and electrical systems of upper-floor areas could be run in a straight line, despite the orientation of the living units.

Standard, commercially available components are planned, to make possible installation by workers of lower skill levels.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	18 TO 36 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE
12 Unit Variations	EFFICIENCY; 1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE MODULES, FLOOR SLABS & BEAMS; OPEN-WEB STEEL FLOOR & ROOF JOISTS
17 Exterior Elements	BALCONIES; METAL WALL PANELS
18 Interior Elements	METAL STUD, PANEL WALL
19 Foundations	CONVENTIONAL; SLAB-ON-GROUND OR FOUNDATION BEARING WALLS WITH PERIMETER FOOTINGS
20 Comfort Systems	
21 Plumbing	
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM
PRODUCTION	
24 Offsite Production	CONCRETE MODULES & BEAMS; STEEL JOISTS; CLOSETS & BATHS; WALL PANELS
26 Onsite Construction and Erection	FOUNDATIONS; PLACING MODULES; FRAMING; UTILITY HOOK-UPS
27 Labor	SEMISKILLED ONSITE & IN FACTORY
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY (RESEARCH INSTITUTE)
34 Internal Functions	CENTRAL CONTROL; RESEARCH
GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM, MODULES ROTATED ON CORE 90 TO 180 DEGREES
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Development Research Associates

PROPOSER

Development Research Associates, Washington, D.C.

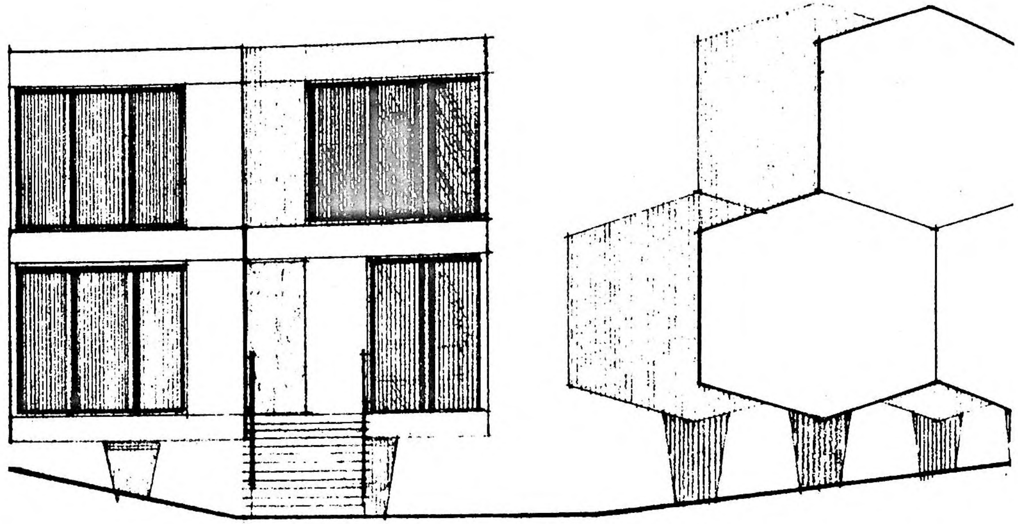
Proposed here is a delivery system for Operation Breakthrough housing that can be applied at regional and local levels. It would assist state and local governments in effectively performing their market aggregation responsibilities. The system would estimate gross housing demand by using a computer model storing demographic and economic characteristics. Constraints to Operation Breakthrough implementation would be evaluated after identification in each local market area, and recommendations would be submitted for their elimination.

One of the features of this proposal is establishment of a sound distribution system for moving housing units from factory to site. The delivery system could be used by HUD to demonstrate to state and local governments how to successfully aggregate demand on regional and local levels. Another element of this proposal is establishment of an effective site acquisition program geared to market demand and product characteristics. Merchandising and financing programs for Operation Breakthrough housing units also would be structured.

To assure that the delivery system developed meets user needs adequately, the proposer would establish a monitoring program to receive continuing feed-back from owners and tenants. Consumer response would be monitored and compared with the response of those who looked at Operation Breakthrough units but did not buy or lease.

SITE SYSTEM	
1 **Site Situation** 2 **Density Range**	DEVELOPMENT OF METHODS FOR DETERMINING SITE SELECTION & ESTIMATION OF GROSS HOUSING DEMAND IN EACH LOCAL MARKET AREA
8 **Site Planning Services**	DEVELOPMENT OF SITE ACQUISITION PROGRAM GEARED TO MARKET DEMAND
9 **Community Involvement**	DEVELOPMENT OF FEEDBACK SYSTEM FROM TENANTS OF OPERATION BREAKTHROUGH HOUSING
BUILDING SYSTEMS	
15 **Community Involvement**	DEVELOPMENT OF FEEDBACK SYSTEM FROM TENANTS OF OPERATION BREAKTHROUGH HOUSING
ECONOMICS	
31 **Financing Methods**	ESTABLISHMENT OF FINANCING PROGRAM FOR SALE/LEASE OF UNITS
MANAGEMENT	
33 **Proposer Organization**	ASSOCIATION
34 **Internal Functions**	STUDY & DEVELOPMENT OF DELIVERY SYSTEM FOR OPERATION BREAKTHROUGH HOUSING
36 **Market Area** 37 **Delivery Rate**	DEVELOPMENT OF A DELIVERY SYSTEM TO MOVE HOUSING UNITS FROM FACTORY TO ULTIMATE CONSUMER; MARKET AGGREGATION & MERCHANDISING PROGRAM; IDENTIFICATION OF CONSTRAINTS INFLUENCING DELIVERY OF UNITS & METHODS OF OVERCOMING RESTRAINTS
GENERAL	
39 **Major Innovative Concepts**	TECHNIQUE FOR EFFECTIVE MARKET AGGREGATION

Dingman-Fauteux & Partners



ELEVATIONS

PROPOSER

Dingman-Fauteux & Partners, Architects, Worcester, Massachusetts

AFFILIATES

A. Shairman & Associates, Mechanical Design; Ramon Housepian, Structural Design.

This proposal is centered on an architectural design concept which does not offer a finished structural product at this stage. The designer offers a modular system of 13-ft. x 13-ft. modules for erection of multi-family and single-family dwellings, vacation homes and other structures. An infinite number of configurations and plan combinations is possible.

Design requirements accommodate light, strong weatherable materials facilitating transportation and erection at comparatively low cost. Although the module wall structures are suitable for both internal and external exposures, the concept is slanted toward a maximum of self-help application concerning interior finishes and arrangements. Roof and floor unit design calls for preinstalled mechanical services so that only interconnection will be required onsite.

The concept visualizes a basic mechanical core unit providing sanitary, cooking, heating, and storage facilities. The designer is fashioning a mechanical module to heating, cooling, ventilating and plumbing facilities. Electrical systems are provided in prewired wall and ceiling panels which reduce onsite labor to making of connections between panels.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULES—RESEARCH TO DETERMINE MATERIAL
21 Plumbing 22 Electrical	MECHANICAL MODULE CONTAINING SANITARY, HEATING AND COOKING FACILITIES, FACTORY FABRICATED; SERVICE DISTRIBUTION LINES INTEGRATED IN WALL, FLOOR & ROOF ELEMENTS
PRODUCTION	
24 Offsite Production	MODULES
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF VOLUMETRIC MODULES; UTILITY HOOK-UPS; FINISHING
29 Community Involvement	SELF-HELP
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ARCHITECTURAL DESIGN; MANAGEMENT
35 External Functions	MECHANICAL & STRUCTURAL DESIGN
DESIGN	
40 Codes	ADAPTABLE TO BUILDING OFFICIALS CONFERENCE OF AMERICA CODE

Dow Chemical

PROPOSER

Dow Chemical Company, Midland, Michigan

A 50-week development program would be undertaken looking toward eventual factory production of a lightweight, load-bearing concrete module. The research would lead to the optimum combination of materials for casting modules weighing approximately half as much as the lightest produced or projected to date. The objective would be a 12-ft. x 24-ft. x 8-ft. unit weighing 16,000 to 18,000 lb. The research proposed would overcome weight impediments which to date have required special lifting equipment and limited transportation of finished modules. The combination of thermosetting-type resins with good low-density aggregates is one possibility under consideration for creating a new, low-cost building material, using raw materials already widely available.

The new construction system would be applied to single-family units and multifamily low-rise units by module stacking. High-rise buildings (over three stories) would require reinforced concrete space frames. Design criteria is to be established for a three-dimensional prototype (already designed) measuring 12-ft. x 24-ft. x 8-ft. The research would be directed toward developing a lightweight castable material meeting normal building criteria as to fire resistance, thermal insulation, and sound attenuation.

The problem posed is selecting the optimum combination of materials from existing lightweight aggregates and binders by investigating both familiar and unfamiliar possibilities. Six combinations of castable lightweight ingredients will be examined in detail. The product to be developed should be sufficiently fast-setting to enable one set of molds to produce one module every 4 hours. Three types of bonding systems will be explored: (1) latex-modified portland cement, (2) plastic resins, and (3) inorganic silicates—all in combination with many light-weight aggregates.

The economic objective is to produce such a module with a square foot cost competitive with present methods, yet holding the advantage of lightweight construction.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	DESIGN STAGE; RESEARCH & DEVELOPMENT REQUIRED
BUILDING SUBSYSTEMS	
16 Structures	DEVELOPMENT OF LIGHTWEIGHT LOAD-BEARING CONCRETE VOLUMETRIC MODULE (TECHNICAL DETAILS UNRELEASED)
PRODUCTION	
24 Offsite Production	DEVELOPMENT OF LIGHTWEIGHT CONCRETE MODULES EMPLOYING THERMOSETTING RESINS & LOW-DENSITY AGGREGATES
ECONOMICS	
30 Construction Costs	(UNRELEASED)
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	SELECTION OF OPTIMUM LIGHTWEIGHT AGGREGATES & BINDERS FOR LIGHTWEIGHT CONCRETE
35 External Functions	CONSULTANTS IN BUILDING CODES, FIRE REGULATIONS, ACCOUSTICAL MATERIALS, AGGREGATES, BONDING, CONCRETE
GENERAL	
39 Major Innovative Concepts	DEVELOPMENT OF LIGHTWEIGHT CONCRETE UTILIZING OPTIMUM SELECTION OF AGGREGATES & BINDERS
40 Codes	CODE COMPLIANCE WILL BE STUDIED

Norman Drummond

PROPOSER

Norman Drummond Planning, Waukegan, Illinois

This proposer offers studies planned to develop compatible housing systems for medium-density urban or suburban development areas, combining various housing types.

It is proposed that the studies will result in development of two basic housing systems that would (1) include single-family, duplex and row houses, and (2) multifamily units, both of which could be fitted into almost any environmental situation. The single-family systems would be based on components and subsystems such as prebuilt or premanufactured housing, containing a core structure for utility components, indoor recreation, off-street parking and storage. The multifamily system would also use manufactured housing components, as well as components that lend themselves to owner-building.

Accompanying the systems would be plans for site development that provide for the desired densities, and for a variety in visual appearances.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; NEW TOWNS
2 Density Range	10 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTERS; OPEN SPACES
6 Nonresidential Functions	RECREATION, LAUNDRY & STORAGE FACILITIES
8 Site Planning Services	SITE DEVELOPMENT PLANS FOR DESIRED DENSITIES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	DEVELOPMENT OF MANUFACTURED HOUSING COMPONENTS (MULTIFAMILY); DEVELOPMENT OF PREBUILT MANUFACTURED HOUSING COMPONENTS OR MOBILE HOMES (SINGLE FAMILY)
20 Comfort Systems 21 Plumbing 22 Electrical	MECHANICAL CORE
PRODUCTION	
25 Onsite Production	CORE & HOUSING COMPONENTS OR MODULES
26 Onsite Construction and Erection	CONVENTIONAL CONSTRUCTION
29 Community Involvement	SELF-HELP
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DEVELOPMENT OF SYSTEMS

Dunlap & Associates

PROPOSER

Dunlap & Associates, Inc., Darien, Connecticut

A study is proposed of how the effect of the physical design of housing affects the individuality of the user, and of how design can be suited to the needs, habits, and life-style of user families. The proposer assumes that conventional design for housing may not express or even permit the type of life-style to which low- and middle-income families are accustomed.

It is proposed that the study follow the course of development of either one or several selected Type A developments through all stages until such time as an adequate occupancy experience has been obtained. The dwellings would be assessed for their value as habitations by questionnaires, interviews, and other means, and the results and conclusions would be translated into design guidance terms for future use. For example, it is pointed out, that some families and subcultures call for a family to eat all meals together—hence a large kitchen or dining area is a requirement; while other families may not consider this an important feature.

SITE SYSTEM	
5 **Planning Concepts**	STUDY OF AFFECT OF PUBLIC SPACES ON USER
9 **Community Involvement**	INTERVIEWS WITH PROSPECTIVE TENANTS TO DETERMINE BEST DESIGN FOR USER NEEDS
BUILDING SYSTEMS	
14 **State of Development**	CONCEPTUAL STAGE
15 **Community Involvement**	STUDY TO DETERMINE HOW DESIGN PROMOTES OR INHIBITS INDIVIDUALITY OF USER; DESIGN OF HOUSING UNIT TO EXPRESS VARYING LIVING PATTERNS
PRODUCTION	
29 **Community Involvement**	INTRODUCTION OF FORMAL CONTROLLED FEEDBACK MECHANISM INTO BUILDING PROCESS
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	DEVELOPMENT OF DESIGN-RELATED USER STUDY

East Central Citizens Organizations

PROPOSER

East Central Citizens Organization, Columbus, Ohio.

Manufacture and site assembly of room-sized modules for high-volume, low-income housing is proposed by this ghetto-based, neighborhood corporation of citizens. Through innovative use of modern chemical materials, the proposer projects selling prices one-third less than that of conventionally built homes of comparable size.

Advantages cited for the use of the proposed modular system are that they are structurally stronger, offer better insulation characteristics and are more maintenance-free than units of conventional construction. The modules would be shipped to the site fully carpeted, wired, plumbed, and equipped with air conditioning.

Community benefits expected to result from implementation of the system in a typical urban, ghetto area include creation of jobs for the unskilled, managerial opportunities for minority residents, upgrading of housing and neighborhood, and stimulation of the economic development of the area.

SITE SYSTEM	
1 Site Situation	URBAN, SUBURBAN
5 Planning Concepts	CLUSTER
9 Community Involvement	PROPOSER ORGANIZATION
BUILDING SYSTEMS	
12 Unit Variations	1 TO 4 BEDROOMS
14 State of Development	BUILDING SYSTEM AND PRODUCTION FACILITIES REQUIRE FURTHER RESEARCH FOR DESIGN AND CONSTRUCTION
15 Community Involvement	PROPOSER ORGANIZATION
BUILDING SUBSYSTEMS	
16 Structure	ROOM-SIZED VOLUMETRIC MODULES
18 Interior Elements	CARPETING
20 Comfort Systems 21 Plumbing 22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
PRODUCTION	
25 Onsite Production	PRODUCTION OF VOLUMETRIC MODULES; DEVELOPMENT OF NEW PRODUCTION TECHNIQUES
26 Onsite Construction and Erection	PLACING OF MODULES TO FORM DWELLING UNIT
27 Labor	PROJECT WILL CREATE JOBS FOR 300 LOW-INCOME RESIDENTS, MANY UNSKILLED LABORERS
28 Labor Training Programs	MANAGERIAL TRAINING FOR MINORITY RESIDENTS
29 Community Involvement	EMPLOYMENT OF LOCAL LABOR AND SUBCONTRACTORS
ECONOMICS	
30 Construction Costs	$12,000 PER DWELLING UNIT
31 Financing Methods	STOCK PARTICIPATION BY RESIDENTS FOR DWELLING UNITS; OFFICE OF ECONOMIC OPPORTUNITY FOR PLANT
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	ARCHITECTURAL DESIGN; MANAGEMENT
35 External Functions	PRODUCTION

East Oakland Fruitvale Planning Center

PROPOSER

East Oakland Fruitvale Planning Center, Inc., Oakland, California.

AFFILIATES

Self-Help Enterprises, Inc.; Silco, Inc., Developers; Trans-Bay Engineers and Builders, Inc.; Technical Assistance and Management Company (TAMCO).

Proposed for single-family, one-story homes, with a substantial portion of the onsite erection work being done by self-help labor, is the utilization of a system of factory-assembled, wood-framed wall panels and trusses, along with other prefabricated components. Purpose of the proposal is to enable families in very small communities to participate in self-help housing programs, to provide training and employment opportunities for farm workers, and to permit a vastly expanded program of self-help. A plant for production of the components is in operation and typical homes have been produced under the self-help provisions proposed.

Innovations claimed for the system which are expected to help achieve these goals include: (1) Reduction of construction time through use of readily assembled, prefinished components, including prewired, preinsulated panels; and a consequent reduction in construction costs, because technical assistance costs, mainly incurred during actual construction, can be cut proportionately. (2) Use of self-help to reduce construction costs; typically, families will contribute up to 1,500 hours of labor. (3) Use of self-help, even in highly unionized areas, without union intervention, because owners will be constructing their own homes. (4) Reduction of overall costs to a figure at least $4,000 less than that of comparable construction, so that more low-income families can qualify for home purchase.

SITE SYSTEM	
1 Site Situation	RURAL; SUBURBAN; URBAN
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY
14 State of Development	PRODUCTION FACILITY OPERATIONAL; BUILDING SYSTEM DEVELOPED
BUILDING SUBSYSTEMS	
16 Structure	PREFABRICATED WOOD-FRAME WALL PANELS AND ROOF TRUSSES
21 Plumbing	PLUMBING CORE
PRODUCTION	
24 Offsite Production	WALL PANELS, ROOF TRUSSES & OTHER COMPONENTS
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF MODULAR COMPONENTS
27 Labor	MUTUAL HELP GROUP; FACTORY LABOR & ONSITE SELF-HELP
28 Labor Training Programs	CLASSES IN SELF-HELP METHOD & PROPERTY MAINTENANCE
29 Community Involvement	SELF-HELP ONSITE CONSTRUCTION
ECONOMICS	
30 Construction Costs	$4,505 PER 3-BEDROOM UNIT ($4.07 PER SQ. FT.) EXCLUSIVE OF LAND & SEPTIC SYSTEM
31 Financing Methods	1,500 HOURS OF LABOR PER FAMILY APPLIED TOWARD COST OF DWELLING
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; PLANNING; ADMINISTRATION
35 External Functions	PRODUCTION; CONSTRUCTION; TECHNICAL MANAGEMENT ASSISTANCE
36 Market Area	OAKLAND, CALIFORNIA

Eastern Kentucky Housing Development Corporation

PROPOSER

Eastern Kentucky Housing Development Corporation, Whitesburg, Kentucky

AFFILIATES

Moore-Turnbull, Architects; Associated Engineering Engineers; John L. Altieri, Mechanical Engineer; Humbert V. Sacco, Jr., Site Engineer; Gideon Yachin, Engineer; Robert Prestrige, Consultant

This is a proposal for research and design which addresses the hard-core problems of housing and the critical conditions in rural mountain construction. Specifically, the program deals with the eastern Kentucky and Appalachia areas. Investigation is proposed of critical conditions to provide solutions based on the following major considerations: land use, topographic conditions, research methods, utility systems, foundations, building materials, and related criteria.

The program, scheduled for approximately one year, would be directed toward methods for using varying topographies and foundations adaptable to the terrain, development of indigenous materials and manufacturing methods and associated systems. Complete mockups and working models of resultant designs would be provided, and cost analyses in all aspects would determine feasibility at varying levels of production.

The ultimate benefit, aside from the provision of low-cost housing, would be the stimulation of regional economy by making full use of local resources, materials, and labor in the project.

SITE SYSTEM	
1 Site Situation	RURAL
3 Topography	STUDY TO DETERMINE USE OF MOUNTAINOUS TOPOGRAPHIES
8 Site Planning Services	STUDY OF LAND USE
10 Utilities	STUDY OF UTILITY SYSTEMS
BUILDING SUBSYSTEMS	
16 Structure	STUDY OF BUILDING MATERIALS
19 Foundations	STUDY OF FOUNDATIONS FOR MOUNTAINOUS SITES
PRODUCTION	
24 Offsite Production	RESEARCH & DEVELOPMENT OF MANUFACTURING PROCESSES
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions 35 External Functions	PROVISION OF LOW-COST HOUSING, STIMULATION OF REGIONAL ECONOMY BY MAKING FULL USE OF RESOURCES, MATERIALS & LABOR IN THE EASTERN KENTUCKY & APPALACHIA AREAS

Echo Module Systems, Inc.

PROPOSER

Echo Module Systems, Inc., Project Management, Quincy, Massachusetts.

AFFILIATES

AVCO Computer Service, Logistic System.

The proposed system consists of plate and beam structure which forms three dimensional modules, spanned by floor plates and combinable into a structural unit. Design and construction are adaptable to any environment. This concept bridges the gap between two-dimensional systems and sterile monolithic cubes. Substantial advantage occurs in use of off-site construction and closely controlled specifications.

The module is an assembly of precast concrete plates forming a rigid and integral structure. Both low- and high-rise structures are possible with this principle of construction. Floor plates are of precast, prestressed concrete planks, plate columns are thin plates spaced to conform to the modular layout. Shear wass plates act as deep cantilever beams. Floor plates receive lateral loads and transmit them to the shear wall plates. Plate columns pick up vertical loading and also support nonbearing facade panels. The shear wall plates become the main members for all transverse lateral loads.

A connection system—consisting of post-tensioning, stud shear connectors, tie rods and dowels—assures that the plate system will act as an integral unit. Tension rods on the floor plate set up compression in the plate plane, assuring that transverse joints remain closed. Post-tensioning of shear walls prevents tensile stresses from high bending moments. Inherent in the connective system is high resistance to seismic loads.

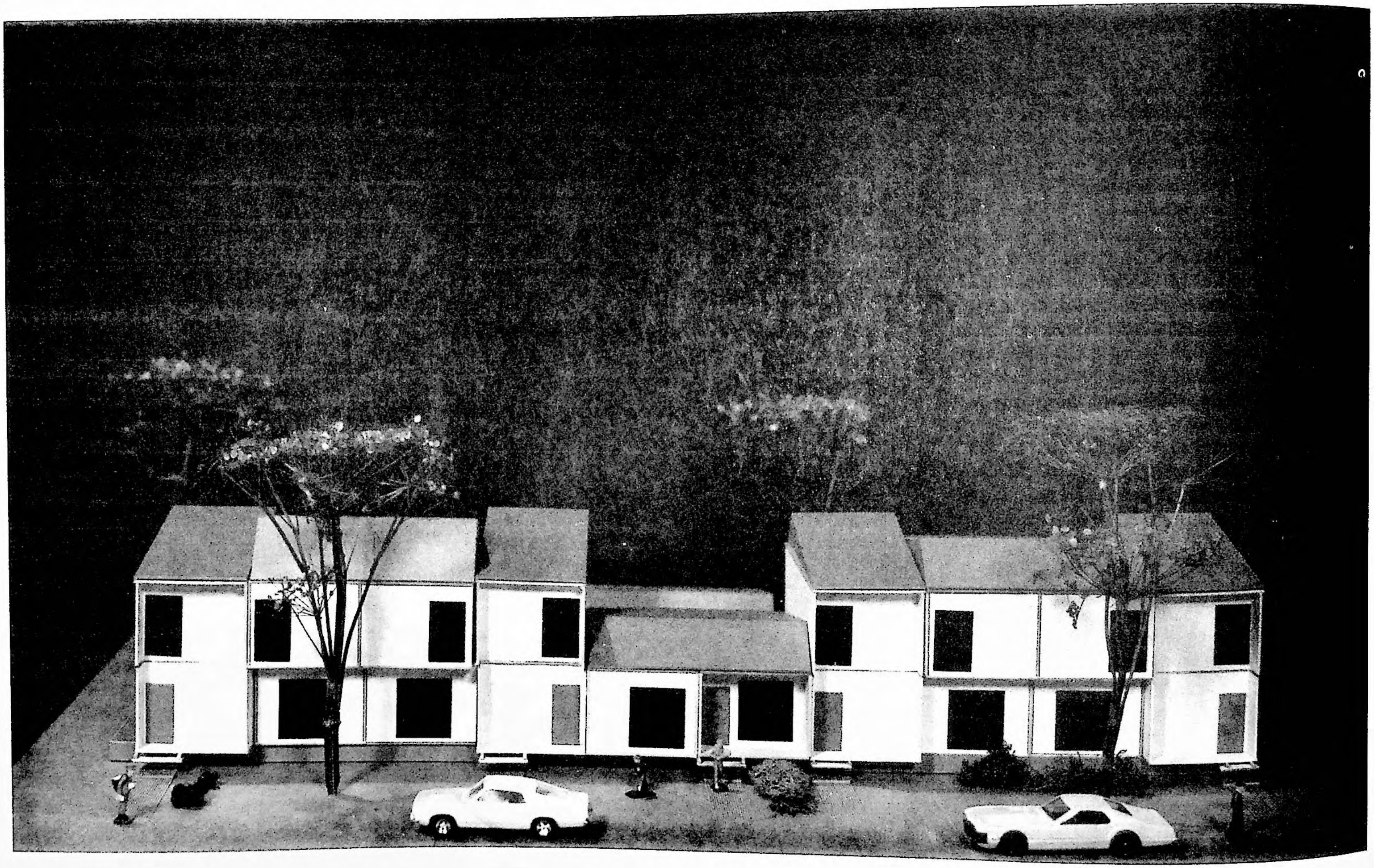
SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NORMAL CLIMATES
6 Nonresidential Functions	NURSING HOMES; OFFICES; MOTELS; SCHOOLS; HOSPITALS
8 Site Planning Services	COMMUNITY ENGINEERS & ARCHITECTS
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 3 BEDROOMS
13 Design Selection	OPEN PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM BEING MARKETED; PROTOTYPE CONSTRUCTED
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE WALL & FLOOR PANELS, COLUMNS & BEAMS; POST TENSIONING JOINING
17 Exterior Elements	PRECAST CONCRETE PANELS OR OTHER CURTAIN WALL SYSTEMS
18 Interior Elements	PARTITIONS; FACADE PANELS KITCHEN/BATH; MECHANICAL, CORRIDOR, & ELEVATOR MODULES
19 Foundations	CONVENTIONAL SLAB ON GROUND WITH PERIMETER FOOTINGS
20 Comfort Systems	CONVENTIONAL; INTEGRATED IN MODULE AT FACTORY
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	PRODUCTION OF FLOOR & SHEAR WALL PANELS & COLUMNS; MODULES
26 Onsite Construction and Erection	FOUNDATIONS; UTILTY HOOK-UPS; ASSEMBLY & ERECTION OF COMPONENTS & MODULES
27 Labor	UNSKILLED & SEMISKILLED OFFSITE; SKILLED ONSITE
28 Labor Training Programs	AT FACTORY
29 Community Involvement	SELF-HELP INSTALLATION OF PARTITIONS
ECONOMICS	
30 Construction Costs	20% TO 30% REDUCTION OVER CONVENTIONAL
31 Financing Methods	CONVENTIONAL
32 Useful Life	50 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	PROJECT MANAGEMENT
35 External Functions	COMPUTER SYSTEM; LOGISTIC SYSTEM
36 Market Area	NATIONAL
GENERAL	
39 Major Innovative Concepts	BUILDING COMPONENT JOINING SYSTEM
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Echo Module Systems (continued)

Shear resistance is provided by use of grout and threaded studs bolted into inserts in the module units. Rods in the floor plate tie the building laterally by resisting tensile stresses of wind suction or the effect of longitudinal post-tensioning. The innovative connecting method assures that all prestress is transferred into the entire floor plate unit.

All types of curtain wall systems are applicable. Window and sliding door units are integral to exterior walls and arrive as part of the facade component. Kitchen, bath and mechanical subsystems are incorporated in a factory-fabricated module delivered complete to the site.

Where vertical circulation is needed, a prepackaged elevator system, in subsections including cab and penthouse modules, is delivered for onsite assembly and erection. Other than site preparation and placing of ground floor slab and spread footings, onsite operations prior to building erection are minimal.



Heikki K. Elo

PROPOSER

Heikki K. Elo, Structural and Civil Engineering Consultation; Easton, Pennsylvania.

Development of basically simple machinery to mass-produce structural concrete building enclosure elements is proposed. The resultant structure could be put in place for about $0.68 per sq. ft. (including cost of production), and would lend itself to self-help operations by a homeowner.

Subject for study includes final development of machinery to produce a type of waffled concrete panel, 4 ft. x 16 ft. in plan dimension. Equipment required would include sideforms, a vibrator, and other components, and an inexpensive type of platform. It is contemplated that the machine could move from one platform to another in a fairly rapid sequence, so that the same equipment could produce the required number of panels in each working day. Time sequence for each casting operation is estimated at 10 minutes—thus in a normal production day, 36 panels, each 8 ft. x 16 ft., could be cast using 48 platforms, 12 sets of sideforms, and one waffle-pan vibrator unit.

The proposer points out that the panel-casting operation would fit easily into present operations of precast-concrete companies or block manufacturers; and the panels can be designed to accommodate any of several sizes of windows and door openings. As cast, the panels would include connecting devices. In all cases, the panels would constitute a complete structural system, with wall panels placed directly on footings. Hence, the system could be applied to almost any desired housing type.

BUILDING SYSTEMS	
14 **State of Development**	MACHINE PRODUCTION OF PROTOTYPE PANELS & PANEL TESTING COMPLETE; FURTHER DEVELOPMENT IN PROGRESS
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements**	DEVELOPMENT OF ASSEMBLY-LINE MACHINERY FOR PRODUCTION OF STRUCTURAL CONCRETE BUILDING ENCLOSURE ELEMENTS
19 **Foundations**	CONCRETE FOUNDATION WALL MAY BE USED
PRODUCTION	
24 **Offsite Production**	DEVELOPMENT OF CONCRETE PANEL ELEMENTS
26 **Onsite Construction and Erection**	SETTING OF CONCRETE ELEMENTS; USE OF CRANE
27 **Labor**	USE OF MASONS, IRON WORKERS, OR CARPENTERS FOR FIELD ERECTION
29 **Community Involvement**	SELF-HELP COMPLETION WITHIN THE CONCRETE SHELL
ECONOMICS	
30 **Construction Costs**	$0.68 PER SQ. FT. FOR CONCRETE ENCLOSURE IN-PLACE AS COMPARED WITH $1.50 PER SQ. FT. FOR CONVENTIONAL MASONRY
MANAGEMENT	
33 **Proposer Organization**	PROFESSIONAL
34 **Internal Functions**	RESEARCH, DEVELOPMENT & DESIGN OF MACHINERY TO ECONOMICALLY MASS PRODUCE CONCRETE WALL & FLOOR ELEMENTS
37 **Delivery Rate**	36 PANELS 8 FT. BY 16 FT. CAST PER 8-HOUR DAY, PER OPERATIONAL UNIT
GENERAL	
39 **Major Innovative Concepts**	MACHINERY TO MASS PRODUCE STRUCTURAL CONCRETE BUILDING ENVELOPE ELEMENTS
40 **Codes**	CONFORMS TO NATIONAL MODEL CODES

Emerson & Company

PROPOSER CONSORTIUM

Emerson & Company, Financial Advisors, San Antonio, Texas
Emco Developers, Inc., San Antonio, Texas
Russ Securities Corporation, San Antonio, Texas
Urban Systems Institute, Inc., College Station, Texas

AFFILIATE

Paul Garza & Associates, Urban Planning Consultants

The proposer cites that training and availability of labor and elimination of work involved in utilities and mechanical systems would do much to speed progress of housing construction, and keep costs in line. Therefore, studies looking toward creation of a prototype labor-training program and toward the development of new utility cores and electrical and mechanical systems are proposed.

In the matter of labor training, attention is called to the results of crash training programs of the armed forces and manufacturers during World War II, when thousands of both skilled and semiskilled workers were trained for wartime tasks in a relatively brief period of time. It is believed that using existing preassembled component parts, hard-core unemployed and non-skilled individuals could be trained at low cost and in a short time to erect living units, with no sacrifice in quality or quantity.

With regard to utility systems and components, it is suggested that further study could produce greater benefits in the development of subsystems that would include complete utility cores (comprising bathroom, kitchen, heating-cooling system, and hot water production) which could then be manufactured and shipped as preassembled units. Among other possibilities suggested are development of precast plumbing trees or preassembled plastic plumbing trees. In addition, the study would include a review of building codes, a study of safety and maintenance requirements and costs, and the design of a prototype core system.

BUILDING SUBSYSTEMS 20 Comfort Systems 21 Plumbing 22 Electrical	DEVELOPMENT OF INNOVATIVE PREASSEMBLED UTILITY CORES FOR ALL MECHANICAL & ELECTRICAL SYSTEMS; DEVELOPMENT WOULD INVOLVE PRIVATE UTILITY COMPANIES, MANUFACTURERS, & SUBCONTRACTORS; PREASSEMBLED UTILITIES WOULD FACILITATE TRAINING OF HARD CORE UNEMPLOYED
PRODUCTION 28 Labor Training Programs	PROPOSED CREATION OF A LABOR TRAINING PROGRAM TO TRAIN HARD-CORE UNEMPLOYED IN SKILLS NECESSARY TO BUILD A COMPLETE HOUSING UNIT
29 Community Involvement	LOCAL SAN ANTONIO HARD-CORE UNEMPLOYED FOR TRAINING PROGRAM
MANAGEMENT 33 Proposer Organization	CONSORTIUM
34 Internal Functions	CREATION OF TRAINING PROGRAM IN SAN ANTONIO "HARD CORE" AREA; DEVELOPMENT OF INNOVATIVE PREASSEMBLED UTILITY CORES
35 External Functions	URBAN PLANNING
GENERAL 40 Codes	PROPOSED STUDY OF CODES TO DETERMINE UTILITY SYSTEMS VARIANCES

Robert Engelbrecht

PROPOSER CONSORTIUM

Robert Martin Engelbrecht and Associates, Architects, Princeton, New Jersey
Simpson Timber Company, Environmental Control Products Division, Portland, Oregon

Proposed here is research and development into two new product subsystems which, if perfected, should contribute substantially to the true industrialization of residential construction. Study is proposed for a totally surface-mounted, trim-type electrical conduit system for all primary and secondary circuitry, and for a totally molded core wall which eliminates rough plumbing.

To eliminate the impediments which built-in wiring imposes on rationalized construction of factory-built panels or modules (with associated problems of interconnection onsite and field inspection), achievement of a surface mounted system is proposed by this five-part program: (1) Compilation of existing surface-mounted systems; (2) Evaluation of trim-molding requirements; (3) Development study for a residential surface-mounted system integrating the output of steps (1) and (2); (4) Integration of these requirements into a highly sophisticated extruded and molded system of components which doubles as trim and moldings; and (5) Report defining advantages, costs and criteria necessary to establish a prototype system.

Obviating the hindrances to industrialization offered by conventional plumbing requirements and current technology is the purpose of the second program of the proposed study. To be achieved is a molded cavity wall which would eliminate all vertical roughing now necessary to accommodate plumbing fixtures, with all connections being at the wall surface, there being no hidden fittings or connections. The proposed study would review existing attempts at unitized rough plumbing, determine a basic layout for fixtures, engineer the proper cavity circuitry within the wall thickness, and finally produce the criteria necessary to develop a prototype system.

BUILDING SUBSYSTEMS	
21 Plumbing	DEVELOP A TOTALLY MOLDED CORE WALL WHICH ELIMINATES ROUGH PLUMBING
22 Electrical	STUDY & DEVELOPMENT OF A TOTALLY SURFACE MOUNTED CONDUIT SYSTEM FOR ALL PRIMARY & SECONDARY CIRCUITRY; COMPILATION OF ELECTRICAL DISTRIBUTION TECHNOLOGY REQUIREMENTS
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction	EVALUATION OF EXISTING SYSTEMS: ELECTRICAL SYSTEMS: PROPOSE A SOPHISTICATED EXTRUDED & MOLDED SYSTEM OF PLASTIC COMPONENTS, WHICH DOUBLE AS TRIM, MOLDINGS, & JOINT DEVICES; PLUMBING SYSTEMS: DETERMINE A BASIC FIXTURE PLANNING LAYOUT; DESIGN A MOLDED CORE WALL.
27 Labor	ANTICIPATED REDUCTION OF SKILL REQUIREMENTS
ECONOMICS	
30 Construction Costs	ESTABLISH COST COMPARISONS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions 35 External Functions	CONDUCT STUDY; DEFINE ADVANTAGES, COST COMPARISONS, & ENGINEERING
GENERAL	
40 Codes	SURFACE-MOUNTED SYSTEM WOULD FACILITATE INSPECTIONS

Robert Engelbrecht

PROPOSER CONSORTIUM

Robert Martin Engelbrecht and Associates, Architects, Princeton, New Jersey
Simpson Timber Company, Environmental Control Products Division, Portland, Oregon

This proposal advances a two-pipe sanitary collector system providing for substantial amounts of water to be recycled for multiple use and couples the system with a closed incinerator-evaporator unit for disposal of all residential waste solids. Application is proposed for a single-family neighborhood complex or regional unit.

The proposer indicates the system will make substantial contributions to reduction in water usage, distribution system costs, sewage collection costs and environmental pollution results.

Theoretically, water wastes may be separated into two categories: namely, densely contaminated (5 to 15 percent of volume) and slightly contaminated (85 to 95 percent of volume). By inverting the associated water proportions the cost of waste water and resanitized water might well invert as well. A potential result is that the currently growing water resource problem and increasing municipal water resource costs could be reversed.

The primary unit in the system is a closed-circuit, self-contained water purification technique with a 5 to 20 percent pure water additive. The secondary system in this two-pipe collector network is a closed-circuit, self-contained, dead-end system with solids collecting in a disposal facility. It is envisioned that the latter system will take all collectables in concentrate form and dispose of them through power energized processing. Moisture is evaporated and waste is reduced to 5 to 20 percent of existing norms.

The designer states that the proposed multispecies waste system could revolutionize house plumbing, equipment, site, community and water resource facilities design.

SITE SYSTEM	
6 **Nonresidential Functions**	REDUCE ENVIRONMENTAL POLLUTION
10 **Utilities**	DEVELOPMENT OF NEW WASTES DISPOSAL CRITERIA TO REDUCE MUNICIPAL PROVISIONS FOR WATER SUPPLY & FOR WASTE DISPOSAL
BUILDING SYSTEMS	
14 **State of Development**	FURTHER RESEARCH, DESIGN, DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING REQUIRED OF SYSTEM
BUILDING SUBSYSTEMS	
21 **Plumbing**	DEVELOPMENT OF SYSTEM TO COLLECT, SANITIZE, & RECYCLE WASTE WATER; COLLECT SANITARY WASTE SOLIDS; NEW PIPING SYSTEM
ECONOMICS	
30 **Construction Costs**	ESTIMATED REDUCED COSTS OF WATER DISTRIBUTION & SEWAGE COLLECTION SYSTEMS & THEREFORE THE TOTAL COST OF A LIVING UNIT
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	RESEARCH, FEASIBILITY ANALYSIS, ENGINEERING DEVELOPMENT, SYSTEMS DESIGN, REPORTS
GENERAL	
39 **Major Innovative Concepts**	TWO-PIPE SANITARY COLLECTOR SYSTEM; CLOSED SYSTEM INCINERATOR-EVAPORATOR DISPOSER

Robert Engelbrecht

PROPOSERS

Robert Martin Engelbrecht and Associates, Building Products-Research-And-Design, Princeton, New Jersey
McClean-Anderson Inc., Research and Development Unit, Milwaukee, Wisconsin

The proposer advances a system for a totally functioning, filament-wound module for multiwidth, multiheight, multiunit installations of low-cost housing. The filament winding technique offers high-producibility potential for large structural units of component nature, which will lend themselves quite readily to airlift site assembly.

The proposer recognizes the need for further investigation and determination of basic requirements. The engineering of the structure's electrical and mechanical systems as single, self-contained, self-functioning units needs further study. The supporting structural system and inter-connect units need to be further developed and defined for specific installations. Finalization of all details, computations, and production specifications for the actual production of winding equipment and accessory assemblies necessary to prototype modules would be the end product of the proposer's project.

BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY; MULTIFAMILY LOW-RISE & HIGH-RISE
BUILDING SUBSYSTEMS	
16 **Structure**	DEVELOPMENT OF FILAMENT-WOUND VOLUMETRIC MODULE & SUPPORTING STRUCTURAL SYSTEM FOR INTER-CONNECTING MODULAR UNITS
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	DEVELOPMENT OF A MECHANICAL & ELECTRICAL SYSTEM ENGINEERED AS A SINGLE, SELF-CONTAINED, SELF-FUNCTIONING MODULAR UNIT.
PRODUCTION	
26 **Onsite Construction and Erection**	PROBABLE DELIVERY OF LARGE COMPONENTS TO SITE BY AIRLIFT
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	DEVELOPMENT OF A TOTALLY FUNCTIONING FILAMENT WOUND MODULE SYSTEM FOR MULTIWIDTH, MULTIHEIGHT INSTALLATIONS
GENERAL	
39 **Major Innovative Concepts**	MULTIWIDE, MULTIHIGH FILAMENT-WOUND MODULES & SELF-CONTAINED MECHANICAL & ELECTRICAL SUBSYSTEMS

Ensculptic, Inc.

PROPOSER

Ensculptic, Inc., Maple Plain, Minnesota

A concept of an almost free-form, all plastic house—sprayed and cast in place initially on cables suspended from a central mast—is proposed for further study. The basic structure in a prototype already erected is a central mast which also serves as a chimney. Nylon cables are extended from the mast to anchors in the surrounding earth, burlap is placed between the cables to form a base for spraying of polyurethane foam to a thickness of 3 in. When set, this material is further covered with a sprayed coating of fiberglass.

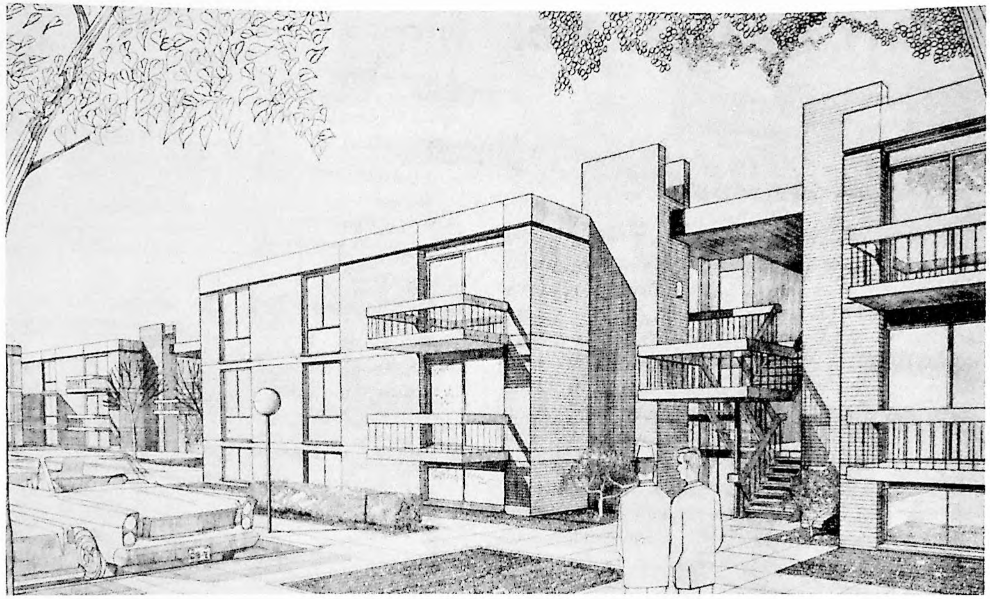
No footings or other foundations are required: The floor consists of the ground itself, leveled to specifications, then sprayed with fiberglass and polyurethane of various densities. Even some furniture can be sprayed in place onsite, later contoured to proper form.

Interior walls are simply room dividers, propped between grade and ceiling, and consist of 2-in. x 2-in. wood slats with a wire mesh cover, over which plastic is sprayed. Onsite work, other than leveling, includes installation of plumbing and electrical services in the ground, prior to spraying of the floor. Heating ducts are to consist of a shaped burlap-type material, also sprayed with urethane. Doors, windows and skylights can be cut through the material at any point to suit the desires of the architect or tenant.

Study is proposed of consumer acceptance of design characteristics of windows, doors and other openings, heating-cooling systems, performance under rapid changes of temperature, and other site conditions.

BUILDING SYSTEMS	
14 State of Development	PROTOTYPE CONSTRUCTED; FURTHER RESEARCH REQUIRED
15 Community Involvement	STUDY OF CONSUMER ACCEPTANCE, DESIGN CHARACTERISTICS OF DOORS, WINDOWS, & COMFORT SYSTEM
BUILDING SUBSYSTEMS	
16 Structure	FREE-FORM, ALL-PLASTIC HOUSE SPRAYED IN PLACE
17 Exterior Elements 18 Interior Elements	FLOORS SPRAYED WITH FIBERGLASS & POLYURETHANE; INTERIOR DIVIDER WALLS
19 Foundations	NO FOOTINGS OR OTHER FOUNDATIONS REQUIRED
20 Comfort Systems	DUCT SYSTEM SPRAYED WITH URETHANE
21 Plumbing	INTEGRATED INTO FLOOR SYSTEM
22 Electrical	INTEGRATED INTO FLOOR SYSTEM
23 Furnishings	SPRAYED IN PLACE
PRODUCTION	
26 Onsite Construction and Erection	IN PLACE FORMING OF SYSTEM COMPONENTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF FREE-FORM PLASTIC HOUSING SYSTEM
GENERAL	
39 Major Innovative Concepts	FREE FORM SPRAYED IN PLACE ALL-PLASTIC SYSTEM

Esten Associates



PROPOSER

Esten Associates, Architects, Silver Spring, Maryland

AFFILIATES

Carl C. Hansen, Structural Engineers; Scullen and Marchigiani, Structural Engineers; Kluckhuhn, McDavid Co., Mechanical Engineers; Silver Schwartz and Associates, Mechanical Engineers; Arthur E. Previll, Mechanical Engineers

Proposed is the design for a fully prefabricated housing system with a steel-skeleton frame as its central element. The frame is so designed that factory-produced 12-ft. x 24-ft. modules can be stacked up to heights of eight stories. All units are prewired and pre-plumbed before delivery to the site. Walls and floors are factory finished and open ends of units are sealed with supported plastic film before shipment. The temporary exterior of the module is sprayed with polyurethane foam.

Benefits cited for this type of construction include factory finishing of interiors and site erection time saved through rapid and economical erection processes. Connection of frame members is by bolting through access panels; if connecting points are not accessible, an explosive design is proposed as an alternative. Sound transmission is reduced by isolating ceiling construction from the floor.

Included as part of the proposal is a system of alternate units stacked in checkerboard fashion, with prefinished flat panels where required.

SITE SYSTEM	
8 Site Planning Services	PROPOSE TO ASSOCIATE WITH EXPERIENCED DEVELOPERS
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE UP TO 8 STORIES
12 Unit Variations	2 BEDROOMS
14 State of Development	BUILDING SYSTEM REQUIRES FURTHER RESEARCH FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure	STEEL-FRAME MODULES OR PANELS; STEEL-SKELETON FRAME; BOLTED CONNECTORS
17 Exterior Elements	BALCONIES; STEEL STAIR UNITS; CONVENTIONAL FINISHES
18 Interior Elements	GYPSUM BOARD PARTITIONS & CEILINGS; STEEL STAIR UNITS
19 Foundations	BEARING WALLS WITH PERIMETER FOOTINGS
20 Comfort Systems	INDIVIDUAL HEATING PER DWELLING UNIT; INTEGRATED COOLING
21 Plumbing	PIPING INTEGRATED WITH BUILDING SYSTEM
22 Electrical	WIRING INTEGRATED WITH BUILDING SYSTEM
PRODUCTION	
24 Offsite Production	FRAME COMPONENTS; VOLUMETRIC MODULES; PANELS
26 Onsite Construction and Erection	FOUNDATIONS; FRAME & MODULE OR PANEL ERECTION; UTILITY HOOK-UPS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & DEVELOP BUILDING SYSTEM
35 External Functions	ENGINEERING; SITE DESIGN & DEVELOPMENT; PRODUCTION; CONSTRUCTION

F. C. H. Services, Inc.

PROPOSER

F.C.H. Services, Inc., Washington, D. C.

AFFILIATE

Krooth & Altman, Counsel, Washington, D. C.

The plan here proposed would make mass marketing techniques available through advisory services to each Operation Breakthrough prime contractor. A relatively small amount of money would be necessary for use as a catalyst to foster prototype projects in the field of cooperative housing with additional assistance coming from regular FHA, GNMA and FNMA sources. Objectives of the sponsor, character of site, and available housing types would be related by the proposer. At the same time, preliminary cost projections would be developed, marketing considerations would be reviewed for each site, and assessments made of general feasibility. The proposer would enter into arrangements with prospective sponsors and developers to get cooperative housing projects underway.

The proposer presently is engaged in marketing activities involving suburban multifamily housing, innercity renewal, rural cooperative housing, elderly housing, low-income home-ownership using rental supplement financing, and housing for Indians and Mexican-Americans. Elements of the plan suggested are: (1) Consultations including explanation of basic cooperative housing concepts and techniques; (2) Technical meetings providing preliminary site analysis and site planning services to relate space and housing location within cooperative communities; (3) Sample projects and cost analysis; (4) Specific project analysis covering market conditions, site inspection and development of preliminary site plans; (5) Regional applications.

SITE SYSTEM	APPLICABLE TO URBAN, URBAN RENEWAL, SUBURBAN & RURAL HOUSING
1 Site Situation	MINIMUM OF 200 DWELLING UNITS PREFERRED
2 Density Range	COMPLETE RESIDENTIAL COMMUNITIES
5 Planning Concepts	
8 Site Planning Services	ANALYSIS & PLANNING SERVICES PROVIDED TO BUILDERS & GROUPS INTERESTED IN COOPERATIVE HOUSING
BUILDING SYSTEMS	MULTIFAMILY HOUSING COOPERATIVES; MIXED DENSITIES
11 Housing Types	ADVISORY SERVICES AVAILABLE
14 State of Development	THROUGH COOPERATIVE HOUSING
15 Community Involvement	
ECONOMICS	
31 Financing Methods	ADVICE TO BE PROVIDED ON DEVELOPING FHA-INSURED COOPERATIVE PROJECTS UNDER SECTIONS 213, 221(d)(3), AND 236
MANAGEMENT	NONPROFIT CORPORATION
33 Proposer Organization	
34 Internal Functions	TECHNICAL & ORGANIZATIONAL SERVICES TO AGGREGATE MARKET FOR COOPERATIVE HOUSING FOR LOWER & MODERATE INCOME FAMILIES.
35 External Functions	COUNSEL

Fillmore Community Development Association, Inc.

PROPOSER

Fillmore Community Development Association, Inc., San Francisco, California

AFFILIATES

Whisler-Patri Associates, Architects; Kennard & Silvers, Architects; Bruce, Erts & Associates, Systems; Infometrics, Inc., Systems; San Francisco State College, Systems Institute; International Business Machines.

Creation of an urban development system to enable a community to be developed with the needs and resources of residents in mind, is proposed. Extensive use of computer techniques is planned, with the objective of producing a kind of textbook that will permit a developer or project manager to communicate his knowledge to persons within his organization, or in other areas. First phase of the program would be a study and investigation of the use of network diagramming and computerized scheduling techniques for project management to implement all phases of development, engineering, construction, and operation of residential, industrial, and commercial complexes planned. The textbook would cover all phases, from initial acquisition of land or assembly of a site through construction and operation.

When fully developed, it is contemplated that the proposed system will be capable of accepting inputs on physical structures from manufacturers or contractors and marketing these structures to consumers, while at the same time providing necessary services to residents. The marketing function, for example, would include: A real estate analysis to determine best use of the land; Collection and analysis of consumer needs, and relaying these needs to the housing producer; Selection and placement of tenants or owners; and, The management of the unit throughout its useful life. Services to be provided to tenants would include provisions for job development, small business assistance, tenant orientation, counselling, and education.

SITE SYSTEM	
8 **Site Planning Services**	CREATION OF AN URBAN DEVELOPMENT SYSTEM INCLUDING A TEXTBOOK TO COVER ACQUISITION OF LAND, SITE, ASSEMBLY, CONSTRUCTION, & MANAGEMENT OPERATIONS
9 **Community Involvement**	ANALYSIS OF CONSUMER NEEDS
BUILDING SYSTEMS	
14 **State of Development**	CONCEPTUAL STAGE
15 **Community Development**	ANALYSIS OF CONSUMER NEEDS
PRODUCTION	
28 **Labor Training Programs**	URBAN MANAGEMENT & URBAN DEVELOPMENT TRAINING PROGRAMS
29 **Community Involvement**	URBAN DEVELOPMENT SYSTEM TO ENABLE A COMMUNITY TO BE DEVELOPED BY & FOR RESIDENTS. PROVISIONS FOR JOB DEVELOPMENT, SMALL BUSINESS ASSISTANCE, TENANT ORIENTATION, COUNSELING, & EDUCATION
ECONOMICS	
30 **Construction Costs**	15 to 25% COST REDUCTIONS DUE TO 20 TO 30% REDUCTION IN CONSTRUCTION TIME; $26,000,000 SAVINGS OVER 6 YEARS
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	REFINE URBAN DEVELOPMENT SYSTEM TO ENABLE COMMUNITY DEVELOPMENT WITH NEEDS & RESOURCES OF RESIDENTS IN MIND
36 **Market Area**	SAN FRANCISCO

Fisher-Jackson

PROPOSER CONSORTIUM

Fisher-Jackson Associates, Architects/Urban Designers, Berkeley, California
T. Y. Lin, Kulka, Yang & Associates, Structural Engineers, New York, New York
Belden & Wistort, Mechanical-Electrical Engineers
Rohm & Haas Company, Manufacturer, Philadelphia, Pennsylvania
National Housing Industries, Inc., Developer-Contractor-Manufacturer.

Proposed for further design and development is an optimized and economical three-dimensional, nonredundant, completely prefinished modular system that is entirely flexible for single-family to multifamily high-rise structures and usable for varying apartment sizes and apartment types across the nation.

Six different basic volumetric modular systems are shown. It is proposed that further study be made into the six systems all of which eliminate double floors and walls to determine which might be best produced. The six have different attributes, some using one shape, some using two shapes. The basic constraint is a 12' wide trucking limitation. Concrete was proposed for the study, however the systems are suitable for any plastic material.

The study would also include an assessment of suitable infill materials, either to form walls for the open spaces created by staggering, or for interior partitioning, with emphasis on the use of plastic materials wherever possible to aid in conserving natural resources.

It is suggested that the modules might be connected by post-tensioning devices, to provide a rigid final structure, and additions of rooms or space would be easily accomplished.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
5 Planning Concepts	CLUSTERS
6 Nonresidential Functions	COMMON OPEN SPACES; COMMERCIAL & PROFESSIONAL OFFICES
7 Circulation	CUL-DE-SACS
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements	STUDY TO DEVELOP A COMPLETELY FACTORY-FINISHED CONCRETE MODULE BUILDING BLOCK SYSTEM (OTHER PLASTIC MATERIALS POSSIBLE)
20 Comfort Systems	CENTRAL HYDRONIC HEATING & COOLING, PLASTIC PIPING; OR UNITIZED FORCED WARM AIR HEATER
21 Plumbing	PREFABRICATED PLUMBING TREES; FIXTURES STACKED IN FACTORY; PLASTIC PIPING CONSIDERED
22 Electrical	WIRING PASSED IN PLASTIC TUBING IN WALLS, PROTECTED BY BLOCKOUTS; SPLICES AT JUNCTION BOX
PRODUCTION	
24 Offsite Production	VOLUMETRIC STRUCTURAL MODULES
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF MODULES; INSTALLATION OF SUBSYSTEMS
27 Labor	MINORITY GROUPS; PRIMARILY UNSKILLED
28 Labor Training Programs	ON-THE-JOB TRAINING
ECONOMICS	
30 Construction Costs	\$8.50 PER SQ. FT.; ESTIMATED \$2.00 PER SQ. FT. SAVINGS OVER CONVENTIONAL METHODS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN & DEVELOPMENT OF ECONOMICAL PREFINISHED VOLUMETRIC MODULE SYSTEM
36 Market Area	NATIONWIDE; WITHIN ONE-DAY'S TRAVEL OF PLANT
GENERAL	
39 Major Innovative Concepts	NONREDUNDANT BUILDING BLOCK MODULE SYSTEM

Thomas B. Fitzgerald

PROPOSER

Thomas B. Fitzgerald, Glenview, Illinois.

Study of a housing concept based on a simple space frame, and on total planning of a community so that individual homes conform to community needs and desires, is proposed. The same system would be applicable to high-density apartment construction. The proposer also would view the housing complex in which the homes may be built as a total entity, in order to achieve a proper environment.

The dwellings themselves would be supported by a space frame that can be supported on only four drilled-in concrete piers, thus reducing to a minimum any required disturbance of the natural conditions at the site. The supporting piers need not even be at the same level, since a metal supporting frame could be detailed to adapt to such variations by use of differing sizes of beams. Thus, a hillside location could result in a multilevel structure, providing additional space below for carport, recreation area or other function.

The frame would define a rectangular cube, roughly 60 ft. x 30 ft. in dimension, within which the dwelling would be built. The dwelling would be made up of nonbearing panel elements serving as outside wall and interior partitions, floor and roof. It is contemplated that the panels and all interior appurtenances would be premanufactured to permit easy assembly onsite. Some would be of glass, some of other materials, some would contain doors and openings, so that a complete unit could be assembled from the standard sections. Accommodations could be expanded easily within the space frame by the simple addition of further framing members and additional paneling.

SITE SYSTEM	
2 Density Range	HIGH DENSITY
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
5 Planning Concepts	TOTAL COMMUNITY PLANNING
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY & MULTIFAMILY
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure	STUDY OF HOUSING CONCEPT BASED ON SPACE FRAME SUPPORTED ON 4 DRILLED-IN CONCRETE PIERS
17 Exterior Elements	NONBEARING WALL, FLOOR & ROOF PANELS
18 Interior Elements	PARTITIONS, GLASS & OTHER MATERIALS
MANAGEMENT	
33 Proposer Organization	INDIVIDUAL
35 External Functions	DESIGN

Five Points Housing Consortium

PROPOSER CONSORTIUM

Five Points Housing Consortium, San Diego, California
A. J. Blaylock & Associates, Engineers
Kenneth E. Anderson, A.I.A., Architect
Nielsen Construction Company
Hazard Incorporated, Sales & Development
Commercial Facilities, Inc.

Lightweight concrete bearing walls and floor slabs comprise the principal components of this proposal. These components could be cast onsite or in remote yards. Design calculations would be straightforward with a minimum of complicated connection devices. The system proposed lends itself to the thread-line method of joining masonry building units using epoxy plastics. To employ this method, the precast elements would have to be cast in specially designed molds to provide accurate spacers to accomodate plastic cements. Unskilled labor could be used for the most part. The concept permits wide flexibility for architectural layouts.

The proposer would rely on computerized calculations in designing mechanical subsystems, adjusting for all climatic conditions and for use of various fuel types. New plumbing systems and materials would be investigated if they offer promise of economy. Trade practice problems, penalty costs and code difficulties are anticipated in these areas.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL BUT EXTREMELY STEEP TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL CLIMATE
5 Planning Concepts	GREENBELTS; PARK LAND; ELIMINATION OF "RIBBON DEVELOPMENT"
6 Nonresidential Functions	LAUNDRY; GAME ROOM; NURSERY; OTHER COMMUNAL FACILITIES
9 Community Involvement	RESEARCH INTO COMMUNITY ACCEPTANCE OF SITE SYSTEM
BUILDING SYSTEM	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH & DEVELOPMENT
15 Community Involvement	RESEARCH INTO COMMUNITY ACCEPTANCE OF BUILDING SYSTEMS
BUILDING SUBSYSTEMS	
16 Structure	LIGHTWEIGHT CONCRETE BEARING WALLS & FLOOR SLABS JOINED BY EPOXY CEMENT
20 Comfort Systems	CENTRAL TOTAL ENERGY HEATING-AIR CONDITIONING-HOT WATER SYSTEM
21 Plumbing	NEW PLUMBING SYSTEMS TO BE STUDIED
22 Electrical	PROBABLE USE OF PLASTIC MOLDINGS FOR RACEWAYS & CAST-IN DISTRIBUTION SYSTEMS
23 Furnishings	EVALUATION OF PREFABRICATED FURNISHINGS
PRODUCTION	
24 Offsite Production	PRECAST CONCRETE SLABS & WALLS
25 Onsite Production	PRECAST CONCRETE SLABS & WALLS (OPTIONAL)
27 Labor	PRIMARILY UNSKILLED
29 Community Involvement	SELF-HELP POSSIBILITIES TO BE STUDIED
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN, DEVELOPMENT, & IMPLEMENTATION OF BUILDING SYSTEM
36 Market Area	NATIONWIDE; CALIFORNIA PREFERRED
GENERAL	
39 Major Innovative Concepts	PRECAST STRUCTURAL ELEMENTS JOINED BY EPOXY CEMENTS
40 Codes	INVESTIGATIONS INTO CODE PROBLEMS WITH PLUMBING & MECHANICAL SYSTEMS

Formica Corporation

PROPOSER

Formica Corporation, Subsidiary of American Cyanamid, Cincinnati, Ohio

AFFILIATES

R. W. Van Battum, Government Contract Finance

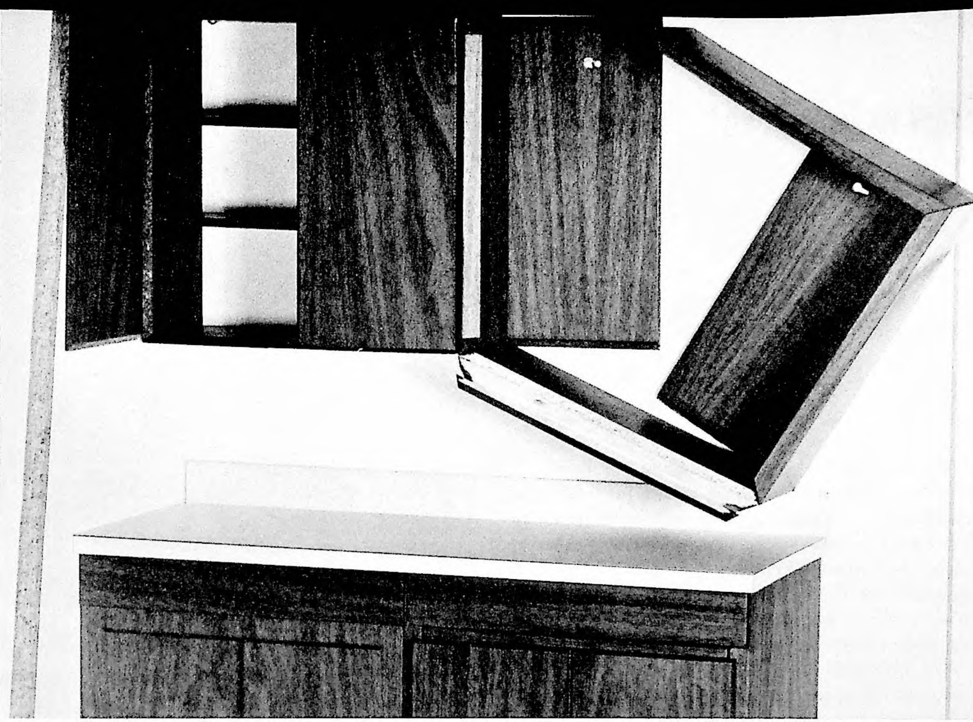
This proposal advances a line of high-producibility cabinet modules with wide application to new housing or remodeled dwellings.

The concept, although currently pointed to kitchen and bathroom cabinets, is expandable to bedroom, recreation areas, storage rooms, dens, and other areas where space is premium.

The product is prefabricated in a central production facility and is flat-shipped to the site. Since the design utilizes a novel folding concept, unskilled labor may be employed to assemble the cabinets onsite and semiskilled labor can readily accomplish final installation. No additional finishes or processing are required after installation.

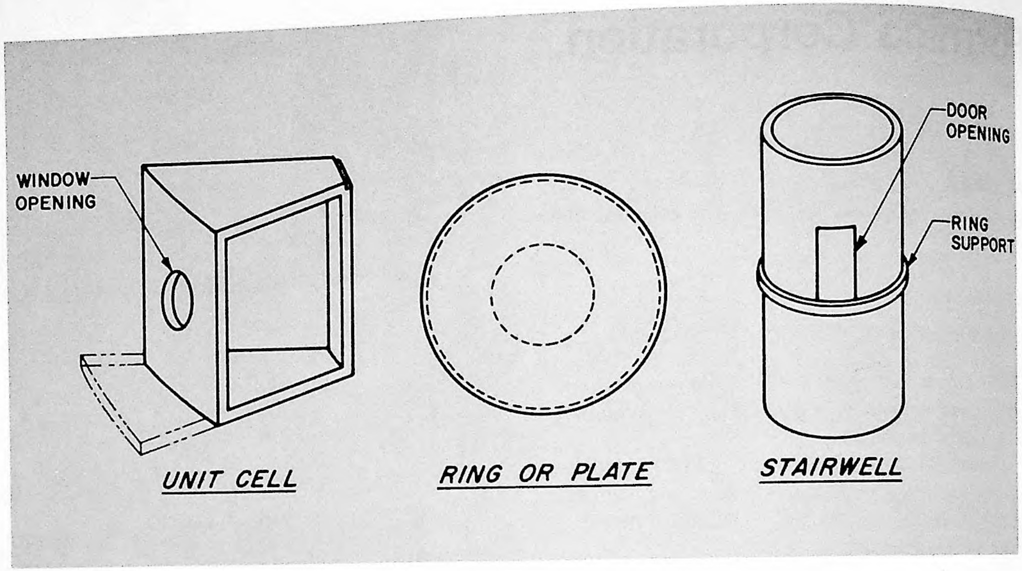
The product line will include vanities, pullman units, medicine cabinets, kitchen cabinets, floor and wall mounted storage units (fully enclosed) with drawers and/or shelves. The manufacturer visualizes a wide variety of popular finishes and styles with standardization of size and configuration. The base product utilizes an exterior skin of flexible, abrasion-resistant, crosslinked polyester surface supported on decorative print paper or plastic which is supported by a woven fiberglass or cloth. The composite is then bonded to a core. The blanks are properly scored and grooved to provide for minimal physical effort during installation.

Research and development activity has progressed to the point that feasibility of the design is quite apparent and marketable status could be attained in a relatively short time. The product is readily adaptable to a small business, dealer network through which basic forms could be shipped to dealers for local stocking and distribution on an individual or volume sale basis.



BUILDING SUBSYSTEMS	
23 Furnishings	FABRICATION RESEARCH & DEVELOPMENT, MATERIALS, & DESIGN OF NOVEL FOLDABLE ENCLOSURES; KITCHEN & VANITY CABINETS, FLOOR & WALL MOUNTED STORAGE UNITS & FURNISHINGS
PRODUCTION	
24 Offsite Production	COMPLETE FOLDABLE ITEMS FACTORY PRODUCED
26 Onsite Construction and Erection	EASY INSTALLATION; ASSEMBLY & ERECTION TIME 20 MIN
27 Labor	UNSKILLED FOR ASSEMBLY; SEMISKILLED FOR INSTALLATION
29 Community Involvement	NETWORK OF FABRICATOR-APPLICATOR BUSINESSES OWNED & STAFFED BY DISADVANTAGED PERSONS
ECONOMICS	
30 Construction Costs	$25.00 PER FOOT (INCLUDES WALL, BASE CABINETS AND COUNTERTOP); 30% LESS THAN SIMILAR WOOD CABINETS; 35% LESS THAN PLASTIC
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	FABRICATION RESEARCH & DEVELOPMENT, MATERIALS, & DESIGN OF FURNISHING
35 External Functions	CONSUMER SALE
36 Market Area	NATIONWIDE
GENERAL	
39 Major Innovative Concepts	NOVEL FOLDING DESIGN OF CABINETRY & FURNISHING

Franklin Institute



PROPOSER

The Franklin Institute Research Laboratories, Mechanical and Nuclear Engineering Department, Philadelphia, Pennsylvania
Applied Mechanics Laboratory, Philadelphia, Pennsylvania

This proposal focuses on housing for hurricane, tornado and earthquake areas, calling for a study of construction in cylindrical form to provide greater resistance to natural forces. The structural system involves reinforced lightweight concrete as the basic material. The finished structure consists of individual sector cells set around a central stairwell core, wedge-shaped and with curved exterior surface.

The proposed study would establish net diameters of cylindrical structures for single-family dwellings and multifamily low-rise and high-rise apartments. A structural analysis of these units would be prepared to determine thickness of walls and slabs and amount of reinforcing or prestressing required. Tornado, hurricane and earthquake forces would be considered. The study would also encompass adaptability of mechanical and electrical systems to the structures, techniques and problems in actual construction, and cost estimates.

A feature of this proposal is the method of stabilizing the structure. Circular holes in the vertical direction in the cell walls, equally spaced, would contain large-diameter steel bars, threaded from the top story down to the foundation. Spaces around these bars would be filled with cement grout. This would reduce lifting weight of the cells and anchor the structure to the foundation, tieing together the stories in the low-rise and high-rise structures. In high-rise construction, prestressing tendons might be substituted for the large-diameter steel bars. Where circumferential prestressing is required, concentrated ring wire-winding through the top and bottom of window or door openings would be used.

SITE SYSTEM	
4 Climate	DESIGNED FOR HURRICANES, EARTHQUAKE & OTHER NATURAL HAZARD AREAS
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	2 TO 4 BEDROOMS
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE CYLINDRICAL SHELL STRUCTURE STABILIZED BY STEEL BARS OR PRESTRESSING TENDONS
20 Comfort Systems 21 Plumbing 22 Electrical	STUDY ADAPTABILITY OF MECHANICAL & ELECTRICAL SYSTEMS TO CYLINDRICAL STRUCTURAL SYSTEM
PRODUCTION	
26 Onsite Construction and Erection	CONDUCT STUDY OF TRANSPORTATION & ERECTION REQUIREMENTS
ECONOMICS	
30 Construction Costs	COST ESTIMATES INCLUDED IN STUDY
MANAGEMENT	
33 Proposer Organization	NONPROFIT CORPORATION
34 Internal Functions	DEVELOPMENT OF CYLINDRICAL, THIN-SHELLED CONCRETE STRUCTURES RESISTANT TO NATURAL HAZARDS SUCH AS HURRICANE & EARTHQUAKE
GENERAL	
39 Major Innovative Concepts	DEVELOPMENT OF HURRICANE & EARTHQUAKE-RESISTANT CYLINDRICAL CONCRETE RESIDENTIAL STRUCTURES

The cells would be joined in the horizontal direction by anchoring steel angles and plates along the edges and welding or bolting these to the cell surface. In multistory structures the vertical joints between stories would be staggered for added stability.

One plan calls for the elevator shaft and the stairwell to be located outside the apartment structure with walkways at each floor connecting the two cylindrical buildings. This would give families more privacy than locating the stairwell as a central core of the building.

Franklin Institute

PROPOSER

Franklin Institute Research Laboratories, The Chemistry Department, Colloids and Polymers Laboratory, Philadelphia, Pennsylvania

Research into the possibilities of using low-cost or waste bituminous coal washing fines in order to produce improved waterproof concretes and other building materials is proposed.

The proposal points out that use of concrete materials in below-grade construction requires that steps be taken to waterproof the finished product by either incorporation of sealants or by the use of cement-rich mixes, or by covering the concrete with paint, asphalt, or suitable coating. The coating materials have a tendency to separate from the concrete, and the fillers and rich mixes add appreciably to costs. Similar water-conducting tendencies in concrete used above grade are also common, thus concrete used for roofing and siding must often be protected from moisture intrusion.

The proposer suggests — on the basis of tests already conducted — that substitution of coal washing fines of minus 100 mesh particle size to replace part of the sand in a cement mortar can substantially increase resistance to water penetration, as well as transmission after penetration. However, substitution of the coal fines has also indicated some loss in compressive strength and slightly more deflection under loads in beam tests.

The proposer points out that as well as gaining production of water-resistant concrete structures, availability of such fines in depressed mining areas should keep prices low and might contribute to local economy.

BUILDING SYSTEMS	
14 State of Development	RESEARCH STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	RESEARCH & DEVELOPMENT TO IMPROVE LOW-COST WATERPROOF CONCRETE THROUGH USE OF LOW-COST OR WASTE BITUMINOUS COAL WASHING FINES WHICH IN CEMENT MORTAR CAN SUBSTANTIALLY INCREASE RESISTANCE TO WATER PENETRATION. USE OF COAL WASHING FINES WOULD REDUCE THE COSTS OF SEALING & WATERPROOFING CONCRETE, ALTHOUGH THERE IS SOME LOSS OF COMPRESSIVE STRENGTH.
MANAGEMENT	
33 Proposer Organization	RESEARCH INSTITUTE
34 Internal Functions	RESEARCH & DEVELOPMENT OF WATERPROOF CONCRETE USING COAL WASHING FINES

Christian Frey

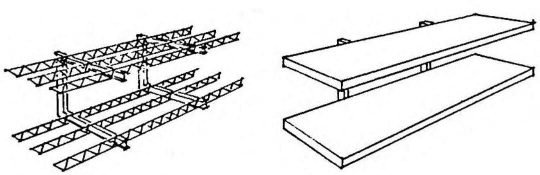
PROPOSER

Christian Frey, AIA, Architect, San Francisco, California

The basis of the system proposed is a patented, three-dimensional, open-ended, economic, lightweight, load-bearing building component. Designated as a universal building rib, the component is a cantilever, palleted-floor, beam-type unit which utilizes vertical columns, beam arms, and rake-column legs to provide a basic structure. It can be organized vertically as well as horizontally with other like components in chosen mathematical configurations. The system is flexible to the extent that it can provide almost limitless volumetrics, offset levels, and overhangs in a wide variety of architectural configurations. The system is adaptable to and practical for single-family and multifamily low-rise and mid-rise structures. Base materials, beyond the metals used for cantilever beam structure, can be concrete, steel, and aluminum, and gypsum products.

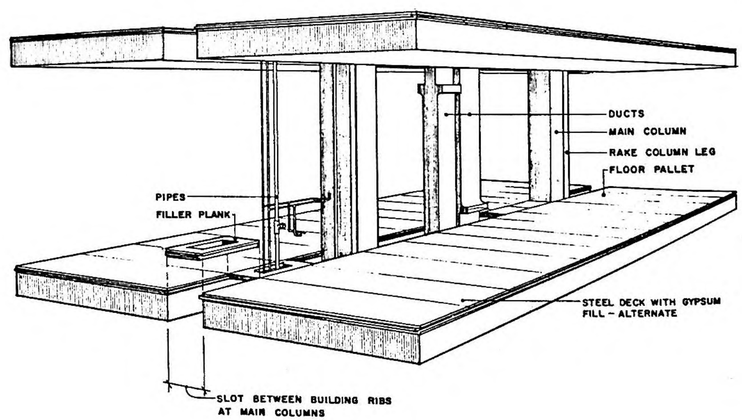
The proposer classifies the total group of primary components in the system in three categories: (1) universal building rib; (2) exterior wall panels (solid, window, and door); and (3) interior wall panels (solid and door). Secondary components include: plumbing, heating and air conditioning, and cabinets and closets. All units lend themselves readily to mass production.

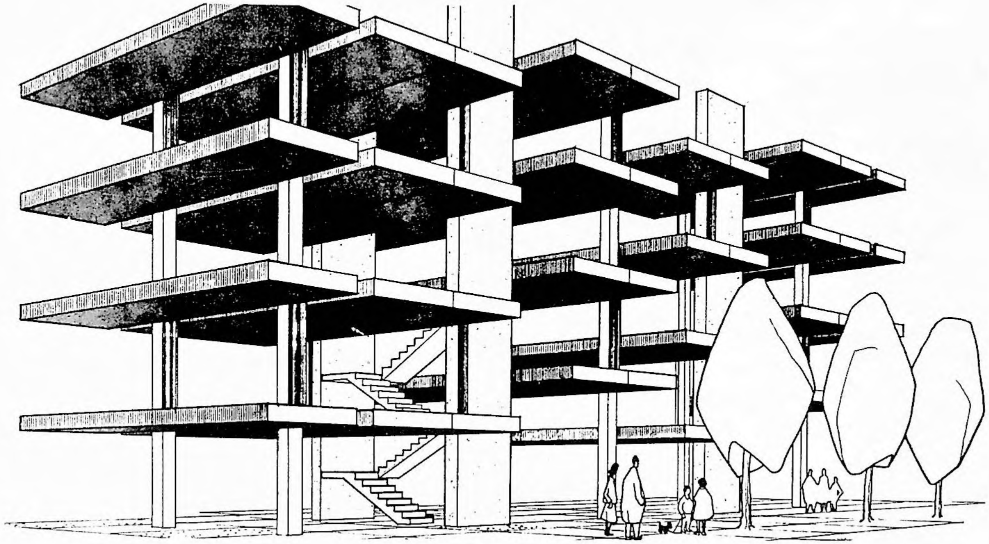
The system is considered to be reduced to practice since similar cantilever structures and secondary applications are almost classic in the construction field, and it is adaptable to central factory or site production.

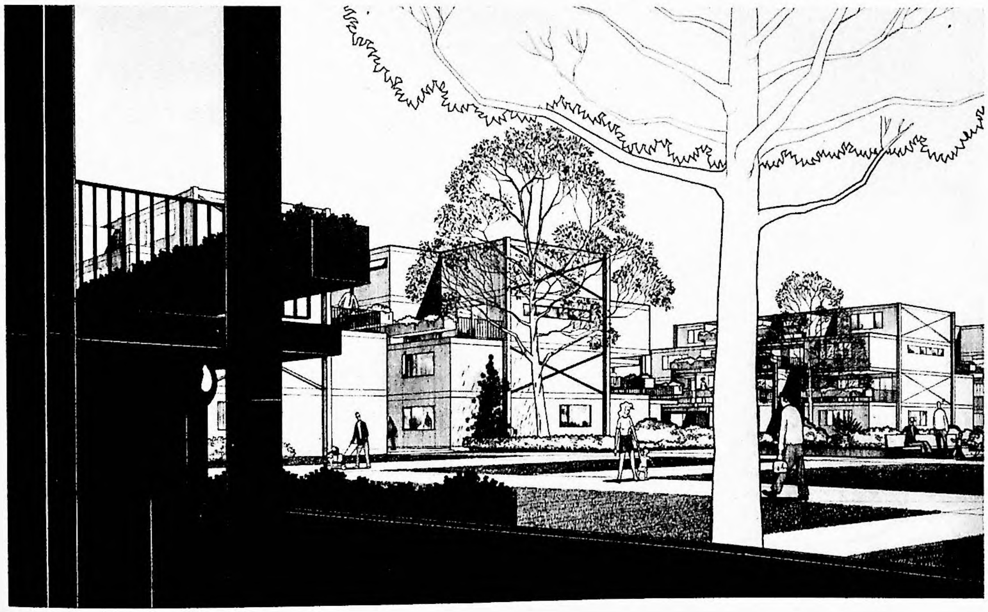


UNIVERSAL BUILDING RIB

SITE SYSTEM	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE & MID-RISE
12 Unit Variations	1 TO 6 BEDROOMS
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	UNIVERSAL BUILDING RIB: A THREE-DIMENSIONAL, OPEN-ENDED, ECONOMIC, LIGHTWEIGHT, LOAD-BEARING BUILDING COMPONENT. THE "UBR" IS A CANTILEVER, PALLETED-FLOOR, BEAM-TYPE UNIT WHICH UTILIZES VERTICAL COLUMNS, BEAM ARMS & RAKE-COLUMN LEGS TO PROVIDE A BASIC STRUCTURE; MATERIAL CAN BE CONCRETE, STEEL, ALUMINUM, OR GYPSUM PRODUCTS; INTERIOR & EXTERIOR WALL PANELS
20 Comfort Systems	CENTRAL HEATING & AIR CONDITIONING
21 Plumbing	PLUMBING CORE UNIT; UNITIZED KITCHEN & BATHROOM
PRODUCTION	
24 Offsite Production	UNIVERSAL BUILDING RIBS, WALL PANELS
27 Labor	UNSKILLED & SEMISKILLED LABOR
ECONOMICS	
30 Construction Costs	COSTS BELOW AVERAGE FOR COMPARABLE CONSTRUCTION
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN HOUSING SYSTEM UTILIZING THE UNIVERSAL BUILDING RIB CONCEPT
GENERAL	
39 Major Innovative Concepts	UNIVERSAL BUILDING RIB COMPONENT
40 Codes	NO OBSTACLES FORESEEN







Gas Development Corporation

PROPOSER

Gas Development Corporation, Chicago, Illinois

This proposal comprises design, manufacture, installation, operation, and evaluation of 40 environmental control units at eight housing sites.

The system under consideration is a patented gas-fired device that heats, cools, humidifies, dehumidifies, filters air, and provides fresh air ventilation for a variety of housing units. The six capabilities are not now available in a compact, integrated package at competitive prices; though performance has been demonstrated in experimental model status, and analyses indicate the feasibility of manufacture at a competitive price.

Advantages of the system include single-unit control, low operating cost, quiet operation and competitive initial cost. Basic design of the system employs a double chamber arrangement with intake and return capabilities. Within the unit, a series of subunits utilizes the basic heat exchange, evaporation, saturation, and drying process principle to activate the three major modes of the system cooling, heating and humidification, and dehumidification.

BUILDING SYSTEMS	
14 State of Development	COMPLETELY DESIGNED, NOT BEING MANUFACTURED
BUILDING SUBSYSTEMS	
20 Comfort Systems	DEVELOPMENT OF GAS FIRED ENVIRONMENTAL CONTROL SYSTEM INCLUDING A DEVICE WHICH HEATS, COOLS, HUMIDIFIES, FILTERS, & VENTILATES
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANUFACTURE OF ENVIRONMENTAL CONTROL SYSTEM
GENERAL	
39 Major Innovative Concepts	SINGLE ENVIRONMENTAL CONTROL SYSTEMS, GAS-FIRED

General American Transportation

PROPOSER

General American Transportation Corporation, General American Research Division, Niles, Illinois.

This proposer offers the services of its thermal engineering and computer analysis disciplines to develop analyses of heating and cooling loads of a prototype building. The tasks would include: thermal modeling on a computer; simulation of thermal response of the prototype building and air conditioning systems to one year of hourly weather data; summarization of all hourly energy requirements; and a report of analysis results.

The proposed program is based on recently completed development of a computer program which calculates dynamic heat transfer characteristics of buildings. Simulation of thermal responses as a function of weather history, including hourly values of temperature, humidity, barometric pressure, wind velocity, wind direction, cloud type, cloud amount, and solar radiation permits automatic scanning of heating and cooling loads and selection of maximums in order to define the capacities required to heat and cool a given building.

The aforementioned, coupled with simulation of other distribution systems, permits instantaneous load determinations and an accurate estimate of instantaneous energy requirements over a given period of time. Consequently, application of capital and maintenance costs and rate structures afford a facile method for computer determination of an overall installation requirement, cost, and feasibility.

BUILDING SUBSYSTEMS	
20 Comfort Systems	COMPUTER ANALYSES OF DYNAMIC HEAT TRANSFER CHARACTERISTICS OF BUILDINGS; SERVICES AVAILABLE TO BREAKTHROUGH
ECONOMICS	
30 Construction Costs	COMPUTER ANALYSES WILL AVOID EXPENSIVE OVERDESIGN OF AIR CONDITIONING SYSTEMS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CONDUCT TERMINAL ENGINEERING & COMPUTER ANALYSES OF HEATING & COOLING LOADS

General American Transportation

PROPOSER

General American Transportation Corporation, Niles, Illinois

Based on the philosophy that a water piping system should be adequate to supply peak demands in any particular building, and any design which exceeds these requirements is unnecessarily wasteful and expensive, a two-stage program is proposed. Phase I would analyze the statistical approach to systems design and conduct preliminary tests to determine peak water demands and frequency of use. Phase II would embrace a full-scale test on a group of apartment units in a prototype building. The proposer states that the savings potential possible through the study could amount to as much as $450 million a year on a nationwide basis.

Preliminary tests would be conducted on an existing five-story, 140-unit apartment structure which has many spool pieces installed in the pipes for meters. This device would present proper physical location, building type and occupancy. The entire system would then be instrumented to obtain statistical data. The results of these tests would then be used as the basis for designing tests on a prototype building to establish more rational and realistic plumbing design procedures.

SITE SYSTEM	
10 Utilities	DATA COLLECTION TO DETERMINE CHARACTERISTICS OF OCCUPANTS RELEVANT TO DEMANDS ON PLUMBING SYSTEMS
BUILDING SYSTEMS	
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
21 Plumbing	RESEARCH PROGRAM TO COLLECT DATA ON ACTUAL DEMANDS PLACED ON PLUMBING SYSTEM: DEVELOPMENT OF A DESIGN TO PROVIDE ADEQUATE WATER SUPPLY AND ELIMINATE WASTEFULNESS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF AN ADEQUATE, BUT NOT WASTEFUL PLUMBING SYSTEM

Genova Products

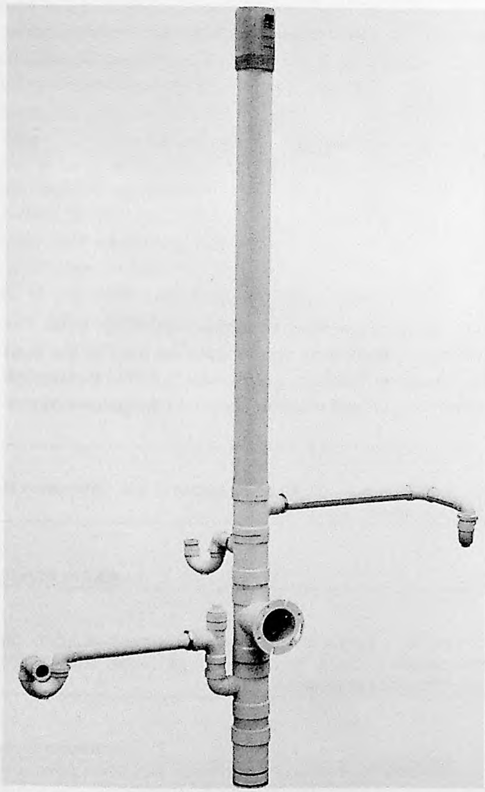
PROPOSER

Genova Products, Davison, Michigan

Further development and eventual supply is proposed for single-stack plumbing trees of rigid vinyl materials and water distribution systems of chlorinated PVC pipe. Advantages which are expected to accrue from the two systems include lower materials and installation costs and longer useful life, in comparison with conventional systems of equivalent performance.

The single-stack concept, following European designs, has had extensive testing in Great Britain and is currently in use in the Lancaster, Pennsylvania, area. It is a performance-engineered design consisting essentially of a rigid plastic assembly, one branch in height, with branches to receive discharge from one complete bathroom and one complete kitchen, and also incorporating provision for laundry waste. Through use of special fittings, the tree can be 'stabbed' directly into previously installed ground work and can be stacked for multistory construction. Cost reductions of as much as 40 percent are claimed for the concept, depending upon building height and the number of fixtures to be served.

Basic to the costs savings for use of rigid vinyl material in both systems is the fact that the plastic product can be readily worked, with a hand saw being one of the few tools required. A single training session prepares an average worker to produce a successful plumbing job. A further advantage is the fact that no open flame for soldering torches and lead pots is required. This is of particular importance in rehabilitation projects where the tinder-dry conditions of old frame construction constitutes a major fire hazard.



BUILDING SYSTEMS	
14 State of Development	DEVELOPED & CURRENTLY BEING MARKETED; FURTHER REFINEMENT REQUIRED
BUILDING SUBSYSTEMS	
21 Plumbing	SINGLE STACK PLUMBING TREE & WATER DISTRIBUTION OF RIGID VINYL PLASTIC PIPING; FACTORY FABRICATED
PRODUCTION	
24 Offsite Production	PLUMBING TREE; POTENTIAL KITCHEN/BATH MODULES
26 Onsite Construction and Erection	INSTALLATION OF PLUMBING TREE (NO OPEN FLAME NECESSARY)
28 Labor Training Programs	TRAINING PROGRAM FOR SELF-HELP
29 Community Involvement	SELF-HELP
ECONOMICS	
30 Construction Costs	LOWER MATERIAL & INSTALLATION COSTS
32 Useful Life	LONGER USEFUL LIFE THAN CONVENTIONAL SYSTEMS
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	MANAGEMENT; MANUFACTURING; MARKETING
GENERAL	
39 Major Innovative Concepts	RIGID VINYL PLASTIC SINGLE-STACK PLUMBING TREE & WATER DISTRIBUTION SYSTEM

Geonetics, Inc.

PROPOSER

Geonetics, Inc., Portland, Oregon

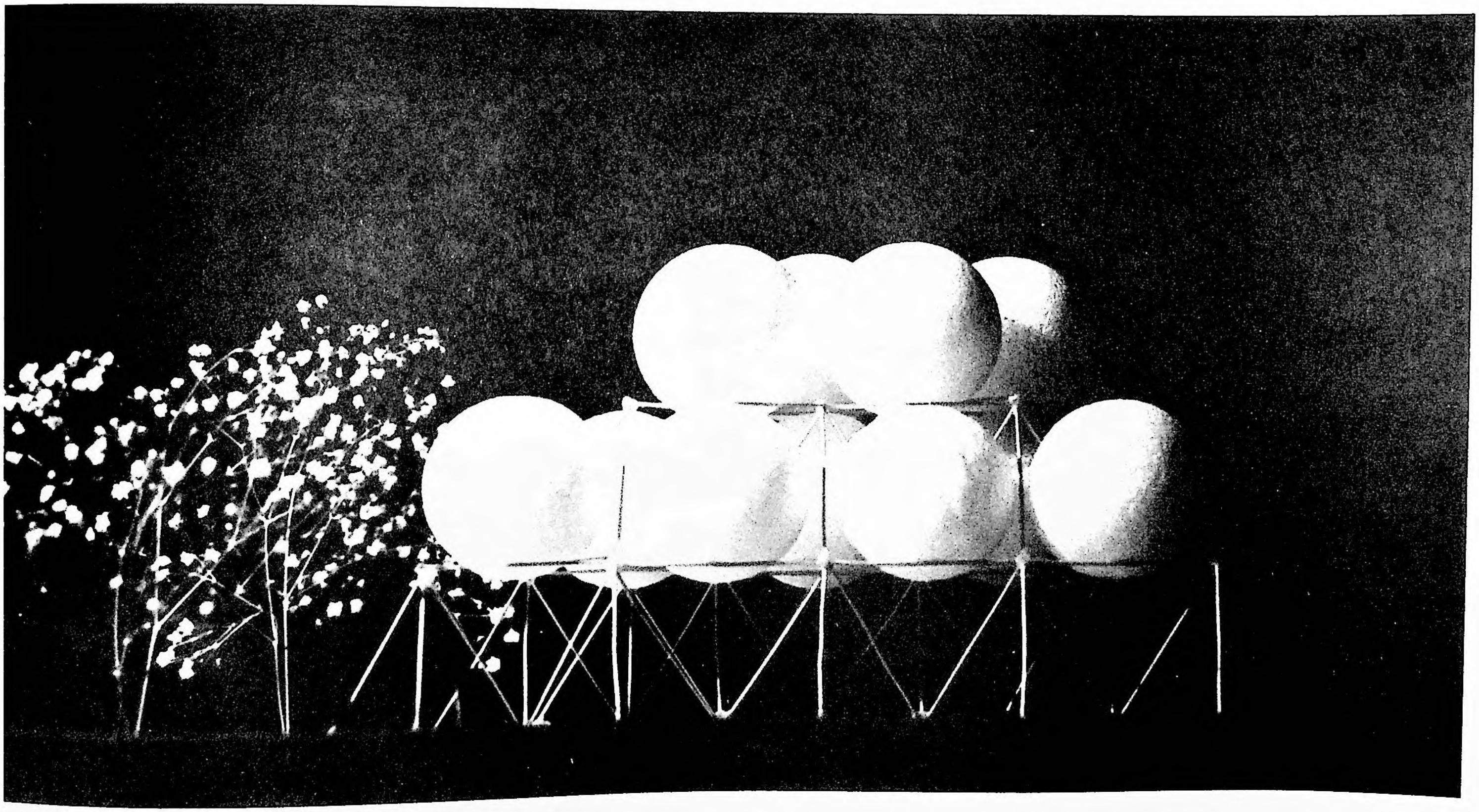
AFFILIATES

Skidmore, Owings and Merrill, Architects; The Boeing Company (Aerospace Group), Environmental Control, Manufacturing, Waste Disposal, Technology Development, Programs Organization; Sandwell International, Inc., Site Services, Materials, Manufacturing

Departing almost totally from even extrapolation on conventional housing and building construction, this proposal offers a housing system in which living space is enclosed in room-sized plastic spheres or cells, with these bubbles joined to form dwelling units within a tetrahedral steel space the resultant structure looking like a vast honeycomb.

This departure, taken by the proposer after extensive evaluation revealed that existing building systems retained little potential for significantly lowering costs and thus meeting expanding housing demands, is a result of a design methodology based on existing technological capabilities and currently advanced production techniques.

The spherical cell, or module, 16 1/2 ft. in diameter at its waist, 14 1/2 ft. in diameter at the floor line, is made of fiberglass-reinforced plastic, with an inner skin of urethane and thin fiberglass affording insulation. The double shell configuration of the module develops maximum stiffness, allowing the outer-skin thickness to be as little as 1/16 in. The spherical enclosures are made in upper and lower sections, with vertical joints through the half-sections to the apex, permitting the flexible shells to be rolled in on themselves to reduce diameters for shipping purposes. Onsite, the lower section is anchored in place within the lattice work of a



Geonetics, Inc. (continued)

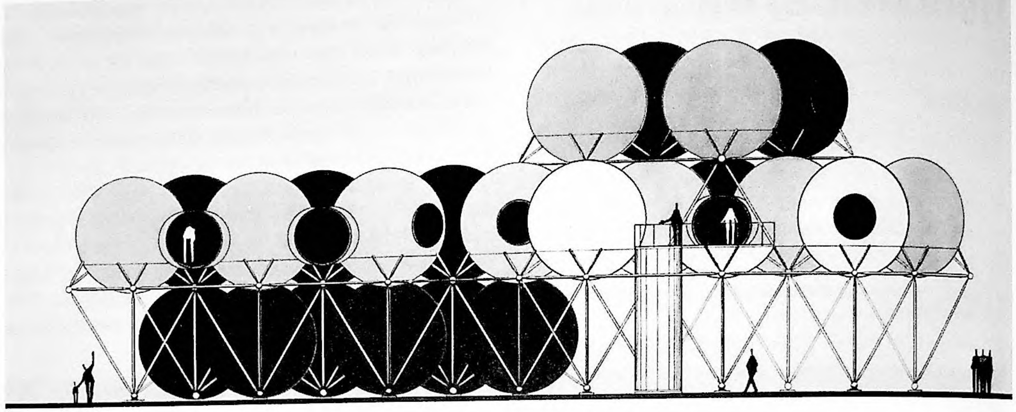
steel subframe, the top section is restored to complete the hemispheric shape, and all joints are sealed. The entire structure—modules and space frame—assumes a structural entity by integral bonding.

The lattice framework is presently designed to be made of 4-in. steel tubing with bolted connections, although the feasibility of high-strength concrete tubes will be investigated. Plastic connectors, 8 ft. in diameter, join the modules to each other, three modules typically making up a single dwelling unit. Vertical circulation will be by means of elevators and stairwells sited in hexagonal cores which will penetrate the tetrahedral framework between modules at several locations within a multifamily assembly. Horizontal circulation between dwelling units will be by open or closed walkways within the framework, as dictated by climate.

Interiors of the modules will be textured fiberglass-reinforced plastic, with polypropelene carpeting covering the composite board subflooring. Each module is expected to serve as a single facility; hence, there will be no partitions within cells, the only vertical elements being free-standing service units. Both bathroom and kitchen facilities will be modular in concept and manufacture, with the completely self-contained units being installed during placement and assembly of the plastic space enclosures. All mechanical services, including electric heating and an independent central cooling system will be in or under the floor, with no utility lines contained in the shell walls.

Windows and skylights, in a variety of diameters, will pierce the walls of the module (sealed by rubber gasket) without restriction, limited only by architectural or esthetic considerations. Doors will be of fiberglass skin over foamed plastic cores, with interior doors consisting of a diaphragm buttoned over the ends of the connector tubes, and access being made by pushing through a slit in the skin.

Codes were not considered in design of the sphere-and-lattice system, because they were recognized as being too restrictive for the concept, although all criteria for safety, sanitation, and structural soundness were observed in its development. Present cost of a dwelling unit in a 10-module configuration is stated to be comparable to that of a moderately priced, conventionally constructed house.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	RECREATIONAL AREA
BUILDING SYSTEMS	
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
16 Structure	TETRAHEDRAL STEEL SPACE FRAME; FIBERGLASS-REINFORCED PLASTIC SPHERICAL MODULES FORMED BY INTEGRAL BONDING OF HALF SPHERES
18 Interior Elements	BATH/KITCHEN MODULES; FIBERGLASS & FOAMED PLASTIC; COMPOSITE BOARD SUBFLOOR WITH POLYPROPELENE CARPETING
20 Comfort Systems	ELECTRIC HEATING SYSTEM; SEPARATE COOLING SYSTEM; DISTRIBUTION IN OR UNDER FLOORS
21 Plumbing	CONVENTIONAL IN KITCHEN/BATH MODULES, DISTRIBUTION IN OR UNDER FLOOR CONSTRUCTION
22 Electrical	CONVENTIONAL; INTEGRATED WITH FLOOR CONSTRUCTION
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES; KITCHEN/BATH MODULES
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF STEEL FRAME; PLACING OF MODULES; UTILITY HOOKUPS
ECONOMICS	
30 Construction Costs	COMPARABLE TO MODERATELY PRICED, CONVENTIONALLY CONSTRUCTED HOUSE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; MARKETING
35 External Functions	ARCHITECTURAL DESIGN; MANUFACTURING
GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM—TETRAHEDRAL STEEL SPACE FRAME, PLASTIC SPHERICAL MODULES

George Washington University

PROPOSER

George Washington University, Program of Policy Studies in Science and Technology, Washington, D. C.

This proposal combines two legal concepts pertaining to land use: ground rent and chattel real, for the property improvement. In doing this, it adapts to modern shelter acquisition needs and brings into play all current government housing and other government-assisted programs. Basically it involves a title-holding and management corporation, vesting in it the fee simple title to the land. This Home Owners Title Registration Corporation (TRC) can be structured as a private nonprofit, quasi-public or, with some modification, a private profit, or public entity. Civic groups, local government authorities, or mass producers of industrialized housing could originate TRC's.

Such corporations would identify land, prepare master plans, and obtain financing necessary for purchase on the open market or from an authority which has exercised eminent domain. Financing would be through a long-term (preferably 99-year) loan from an institution which would also provide land development money. Such loans would be government guaranteed. Development and operation of any commercial segments could be placed with private contractors.

With the land ready for occupancy, the TRC would offer a lease-hold interest in single parcels to homeowners or in parcel combinations to builders who would construct for sale. Important to the plan is the fact that each original lease would be granted for the entire 99-year term, carrying assignment privileges under the TRC charter terms. The initial lease establishes the base rent, fixed for the entire lease period. Property taxes, subject to annual adjustment, are added to rent charges on a monthly pro rata basis, and property taxes are assessed against the use, not against the fee.

Lessees receive registration certificates of use which comprise the title document on which land holding rights are predicted. These can be transferred through the TRC. Construction and permanent financing loans would be made in the conventional manner. FHA-type guarantees would secure mortgage financing for the residential structures. The rate would be determined when the TRC is formed and computed as the average prevailing in the locality over the preceding 20 years or other selected period. Rates would be supplemented by federal government payments to attract funds, such rates based on the prime interest rate existing in any quarter. The subsidy payments would cover the difference between the prime rate and the established TRC rate with the government taking liens on the TRC developments to secure its advances. This flexible government interest subsidy is considered a critical factor of the proposal.

Cited as advantages of the concept are:

Mortgage funds would be independent of market fluctuations; interest rates would stabilize; no down payments for land occupancy; and payment for land would be separate from payment for structure; reduced closing and related costs; quick and easy transfers;

Reduced real estate brokerage fees; stabilized land values; less speculative appreciation on the structure; in moving residence, land ownership would not be a consideration; government subsidies would be investments with some recuperation assured;

No change required in present mortgage market or present home-ownership benefits; provisions offered for reconsideration of land use with community changes at specific points in time; community benefits of land appreciation, avoiding speculation and windfall profits;

Occupants would not be exposed to the risk of loss of accumulated equity in the land payment, nor homes exposed to the same degree of risk, because of the stabilizing aspect of the land-lease system.

Two years will be required to conduct the necessary studies for development of system details. Present ground rent and lease-hold arrangements will be researched thoroughly, as will legal aspects of all the proposal's points.

BUILDING SYSTEMS	
14 **State of Development**	CONCEPT DEVELOPED, BUT NOT IMPLEMENTED; TWO YEARS RESEARCH REQUIRED
ECONOMICS	
30 **Construction Costs** 31 **Financing Methods**	DEVELOPMENT CONCEPT TO REDUCE COST OF LAND ACQUISITION BY: FACILITATING TRANSFER OF REAL PROPERTY; ATTRACTING MORTGAGE FUNDS FROM CONTRACT THRIFT INSTITUTIONS; PROVIDING LEASING OF REAL PROPERTY & MAINTAINING FEE OWNERSHIP IN A NEIGHBORHOOD OR COMMUNITY RATHER THAN THE TRADITIONAL PRIVATE OWNERSHIP OF LAND
MANAGEMENT	
33 **Proposer Organization**	EDUCATIONAL FACILITY
34 **Internal Functions**	IMPLEMENTATION & FURTHER DEVELOPMENT OF CONCEPT TO REDUCE COST OF LAND ACQUISITION
GENERAL	
39 **Major Innovative Concepts**	LAND-LEASE-CHATTEL REAL SYSTEM OF LAND USE STRUCTURED ON HOME-OWNERS TITLE REGISTRATION CORPORATION

Bernard S. Gild

BUILDING SYSTEMS	
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	DEVELOPMENT OF URETHANE PANEL REINFORCED WITH COMMON SWAMP REEDS; SUITABLE FOR INTERIOR & EXTERIOR WALLS
PRODUCTION	
24 Offsite Production	FACTORY FABRICATION OF 4-FT. x 8-FT. PANELS, 1/2 IN. TO 4 IN. THICK
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL ATTORNEY
34 Internal Functions	CENTRAL CONTROL

PROPOSER

Bernard S. Gild, Attorney at Law, Annandale, Virginia

Proposed for use in preengineered modular wall construction is a patented building panel produced from urethane, reinforced with common swamp reeds. Although the product, as presently planned would be fabricated in 1/2-in. to 4-in. thick, 4-ft. x 8-ft. panels, suitable for paneling applications, instead of sheathing lumber of plywood, its evolution into structural wall panels is envisioned.

At that state of development, the reinforced urethane product, as a single entity, would replace siding, sheathing, studding, insulation, and plaster or gypsum board. Advantages claimed for the concept are that it is rot-proof, vermin-proof, waterproof, fire retardant, and possesses high insulative and soundproofing characteristics.

Gleeson Industrialized Building

PROPOSER

Gleeson Industrialized Building, Ltd., North Cheam, Surrey, England

Licensing to an American firm of this site-factory method of housing production is proposed by its British originator. Advantages claimed for the system are that it combines the stability of in-place concrete construction with the flexibility of precast construction. The system is fully developed, is being marketed, and 1000 units have been erected, mainly in the London area.

Basically, the three- to six-story structures are formed by site-cast concrete load-bearing party walls, usually 20 ft. on center; cast-in-place, 9-in. thick, reinforced concrete floor-ceiling slabs; and prefabricated wood-framed infill panels to close the unit to the weather. Gabled roof for the low-rise structure is formed from factory-made wood trusses and other elements. Also precast in the site-factory facilities are concrete gabled end walls which close each end of the building under the roof peak.

Floor-to-floor height of the dwelling units formed by the system is 8 ft. 4 in., with the depth of the space being variable, depending on the number of rooms desired in the apartment layouts. Interior partitions for the units are prefabricated of framed hollow-core, gypsum board construction.

SITE SYSTEM	
8 Site Planning Services	CONSULTANTS WILL PROVIDE SITE LAYOUT & TOWN PLANNING
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE WALLS; CAST-IN-PLACE FLOOR SLABS; WOOD ROOF TRUSSES
17 Exterior Elements	WOOD-FRAME INFILL PANELS; CONCRETE GABLE-END WALLS
18 Interior Elements	GYPSUM BOARD PARTITIONS
PRODUCTION	
25 Onsite Production	CONCRETE WALLS; WOOD FRAME TRUSSES & INFILL PANELS
26 Onsite Construction and Erection	FLOOR SLABS; ERECTION OF COMPONENTS
MANAGEMENT	
33 Proposer Organization	CORPORATION (LTD.)
34 Internal Functions	PROPOSER WOULD ENTER INTO AN AGREEMENT WITH AN AMERICAN COMPANY
35 External Functions	FOR LICENSING OF SYSTEM

Goldsworthy Engineering

PROPOSER CONSORTIUM

Goldsworthy Engineering, Inc., Torrance, California
Mobile/Modules, Inc., Croton-on-Hudson, New York, New York

Fiber-reinforced plastic mobile modules, supported on a continuous tube structure and adaptable to use of mobile-home park utilities, are proposed for study.

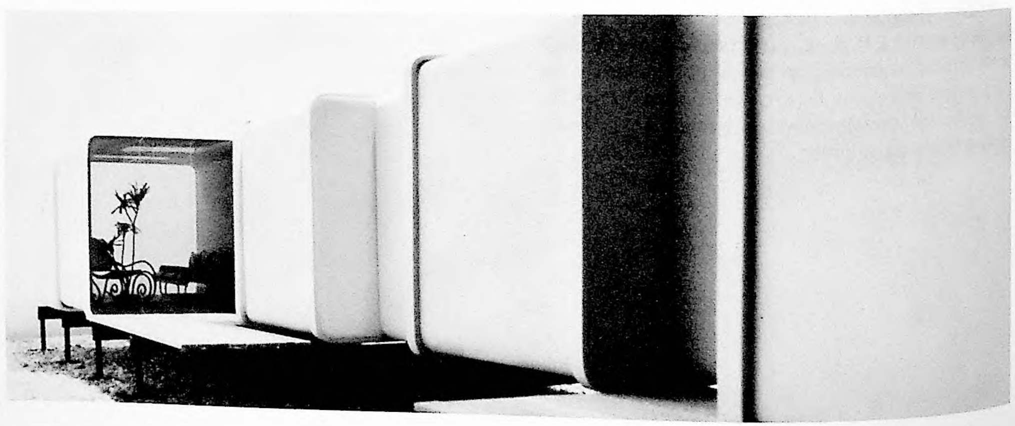
Basic components would be prefabricated, room-sized modules, connected in a series to form a housing unit, the number of room modules used being variable and to be determined by the owner. Space can be provided for sleeping, dining, and social needs, with kitchen and bathroom modules also prefabricated and positioned selectively within the series of modules as assembled.

Configuration of the module series can be reshaped to fit changing needs—adjacent rooms would slide against each other axially to form a variety of arrangements; exposed openings would be closed with quick-release, snap-in panels, or translucent or solid doors, windows or blank wall panels.

Structure of each module as designed is continuous tubing that comprises floor, walls, and roof, and would be delivered complete including self-contained furniture and all components. The furniture units clip into place on horizontal support tracks built into the module walls. These tracks also provide continuous electrical strips for interior rearrangement if desired.

Transverse girders packed under each module are pulled out at the site, vertical ground-conforming stanchions fold down, and once the delivery truck is pulled away, the entire home is lowered as a unit to the desired level by jacks. The result is instant site adaptability.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
3 Topography	TO BE ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS; "INSTANT" SITE ADAPTABILITY
4 Climate	TO BE ADAPTABLE TO ALL CLIMATES INCLUDING EXTREMES
9 Community Involvement	USER TO BE ABLE TO MODIFY HOME TO FIT SITE; RELOCATABLE
10 Utilities	SELF-CONTAINED EXCEPT FOR WATER; ADAPTABLE TO USE OF MOBILE HOME PARK UTILITIES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
13 Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14 State of Development	CONCEPT IS COMPLETE; DESIGN DETAILS REQUIRE TESTING
15 Community Involvement	USER TO BE ABLE TO MODIFY DWELLING UNIT AFTER COMPLETION
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC FIBER-REINFORCED PLASTIC MOBILE MODULES; CONTINUOUS TUBE STRUCTURE
19 Foundations	VERTICAL GROUND-CONFORMING STANCHIONS FOLD DOWN; UNIT LOWERED TO DESIRED LEVEL
21 Plumbing	KITCHEN & BATHROOM CORE UNITS
22 Electrical	ELECTRIC CHASE PROVIDED IN HORIZONTAL SUPPORT TRACKS
23 Furnishings	FURNITURE UNITS CLIP-ATTACHED TO SUPPORT TRACKS IN MODULE WALLS
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES
26 Onsite Construction and Erection	PLACING & JOINING OF MODULES; UTILITY HOOKUPS
ECONOMICS	
30 Construction Costs	SUITED TO BUYING POWER OF LOW & MEDIUM INCOME EARNERS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN, DEVELOPMENT & PRODUCTION OF SYSTEM
35 External Functions	LOCAL FRANCHISE OPERATIONS
36 Market Area	NATIONWIDE
GENERAL	
40 Codes	CODE RESTRICTIONS ON MOBILE HOMES LESS SEVERE THAN ON CONVENTIONAL



Gra-Tec

PROPOSER

GRA-TEC, INC., Manufacturer of Plumbing Elements, Campbell, California

A research and development program directed toward a new concept for water supply systems for large volume housing construction is the prime concern of this proposal. The program would yield plumbing elements characterized by space-saving, quick-disconnect fluid-flow elements, readily and rapidly installable by unskilled labor. Advantages of the system in serviceability and flexibility over contemporary systems would be demonstrated.

Plastic materials will be the basic experimental element in the program due to the indicated predominance of plastics in future water supply systems. Although the proposer's modular fitting system has had successful adaptation in industrial plumbing, it is noted that further development is required to adapt specific components such as the interconnection system, shut-off valves, check valves and vacuum breakers to residential systems. No major technical problems are anticipated since this is an extension of the proposer's experience and current capabilities into a specific problem area.

SITE SYSTEM	
10 **Utilities**	QUICK-DISCONNECT PLUMBING DESIGNED FOR INSTALLATION BY UNSKILLED LABOR
BUILDING SUBSYSTEMS	
21 **Plumbing**	RESEARCH INTO QUICK-DISCONNECT SYSTEMS WILL ADDRESS ITSELF TO PLASTICS; DESIGN OF INTERCONNECTION SYSTEM, SHUT-OFF VALVE, CHECK VALVE, & VACUUM BREAKER
PRODUCTION	
27 **Labor**	DEVELOPMENT OF PLUMBING SYSTEM WILL PERMIT ASSEMBLY BY RELATIVELY UNSKILLED LABOR
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH, DESIGN, & DEVELOPMENT OF WATER SUPPLY SYSTEMS FOR VOLUME CONSTRUCTION; PLUMBING ELEMENTS UTILIZING SPACE-SAVING QUICK-DISCONNECT FLUID FLOW SYSTEM

Griffolyn Company

PROPOSER

Griffolyn Company, Inc., Houston, Texas.

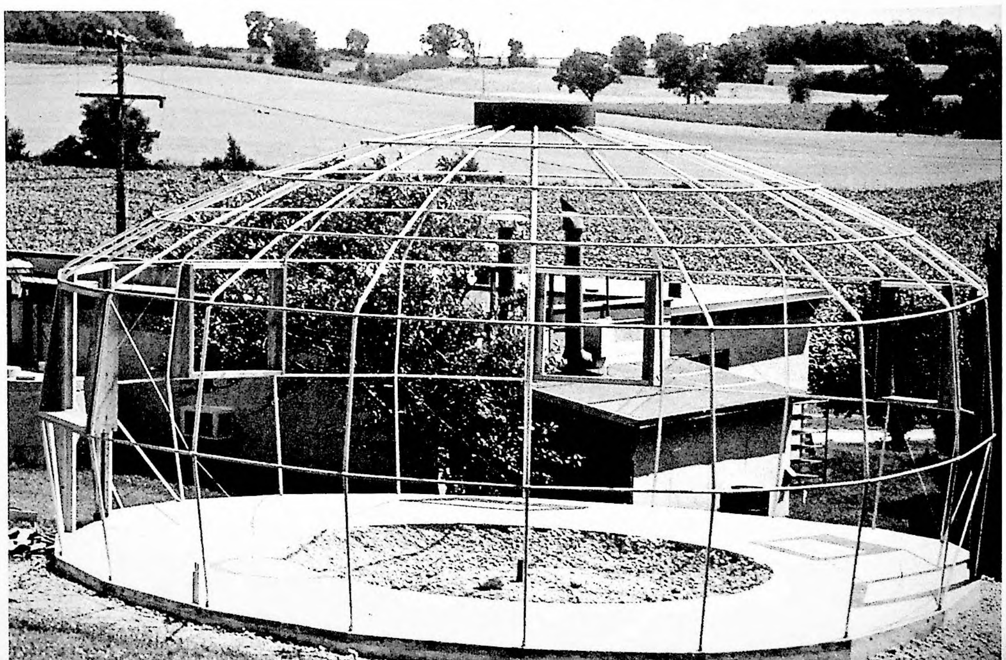
A plastic-enclosed structure is proposed, built around a structural framework of lightweight metal that would also contain electrical, water, and other utility services.

The resulting building, the proposer believes, will offer advantages of lightweightness, easy adjustment in either enlarging or contracting the available space, attractive appearance, and quick erection. The structure would be adaptable for single-family or multifamily dwellings. Structures built to a similar specification also would be easily adaptable to uses such as community centers, stores, and play facilities.

Foundations may be either cast-in-place concrete slabs or plastic materials that provide a tough, resilient floor. Reinforced plastics would be used for siding, roof, and other elements needed to complete the enclosure, and the structures can be built to withstand wind pressures of more than 75 mph.

Advantages, in addition to quick erection and lightweight construction, include easy portability of wall, floor, and roof components. It is suggested that less time will be consumed in erection and finishing of the structure, which will more than compensate for the greater amount of site work required than in many factory-built models, for plumbing, wiring, and mechanical hook-ups and installation.

SITE SYSTEM	
3 Topography	ADAPTABLE TO NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES; SUITABLE FOR HIGH WIND CONDITIONS
5 Planning Concepts	ARRANGEMENT OF BUILDING MODULES AROUND AN ENCLOSED CENTRAL SPACE
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY; MULTIFAMILY
13 Design Selection	FROM STANDARD PLANS
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure	LIGHTWEIGHT METAL FRAME; REINFORCED PLASTIC FLOOR, WALL & ROOF COMPONENTS
17 Exterior Elements	REINFORCED PLASTIC FINISHES
19 Foundations	CAST-IN-PLACE CONCRETE OR PLASTICS MATERIAL SLAB
21 Plumbing	WATER PIPES CONTAINED IN STRUCTURAL FRAME
22 Electrical	WIRING CONTAINED IN STRUCTURAL FRAME
PRODUCTION	
24 Offsite Production	METAL FRAME & PLASTIC FLOOR, WALL & ROOF ELEMENTS
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF FRAME & COMPONENTS; MECHANICAL INSTALLATIONS
29 Community Involvement	SELF-HELP POSSIBLE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN; DEVELOPMENT; PRODUCTION
GENERAL	
39 Major Innovative Concepts	ENCLOSED COMMUNAL CENTRAL SPACE WITH CLIMATE CONTROL



Grumman Aerospace

PROPOSER

Grumman Aerospace Corporation, Bethpage, New York

Proposed for development is the integration of all household services—including heating and cooling, water supply, sewage disposal, refuse disposal, food preparation and hygienic systems—into a single balanced system capable of significantly reducing both wastes and inputs, and thereby greatly lowering total household operating costs.

Premise of the proposal is realization and acceptance of the fact that the large numbers of houses which must be built in the coming years to meet the nation's needs will increase substantially potential environmental pollution and will severely tax public utilities, services and other dwindling life support resources—among them fresh air, water, refuse/garbage removal and sewage disposal. Reducing the impact of these problems through the single-system approach is a concept the proposer has borrowed from the spacecraft industry. The central thought is to use the waste products of one subsystem to generate useful products for the others.

A five-phase program is presented to achieve this goal: (1) Analysis of possible methods of integrating all applicable household operating systems and selection of the best combination or combinations. (2) Study of the combination(s) selected, and preparation of questionnaires for submission to state health and building code authorities and other bodies from whom comment and input is desired; and, based on the questionnaire results, selection of the best system. (3) Development of bench-type hardware for the subsystems. (4) Detail design of an integrated system which would demonstrate feasibility, including extraneous components needed to simulate loads such as house heating or cooling and human inputs. (5) Fabrication of a feasibility model system and test for successful operation of its subcomponents; then, construction of an engineering model which would be tested under service conditions in a mobile home, in which one or more families would live for stated periods of time.

BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE; RESEARCH FOR DESIGN AND CONSTRUCTION OF SYSTEM REQUIRED
BUILDING SUBSYSTEMS	
20 Comfort Systems 21 Plumbing 22 Electric	DEVELOPMENT OF INTEGRATED SERVICE OF SUBSYSTEMS TO FORM A BALANCED SYSTEM, INCLUDING HEATING, COOKING, HYGIENIC, COOLING, DISPOSAL, & WATER RECLAMATION; SEWAGE TREATMENT AND OTHER SERVICE SYSTEMS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL; RESEARCH, DESIGN & MODEL CONSTRUCTION

Gulf South Research Institute

PROPOSER

Gulf South Research Institute, Baton Rouge, Louisiana

A broad and comprehensive study of land development concepts is proposed to assist private and public, government and industry personnel to evaluate proposed land and housing development projects.

The proposer would survey and evaluate all existing literature relative to building codes, techniques, zoning and regulatory powers, as well as modern and innovative design and development techniques.

A compendium of results of the survey would be published in manual form with accompanying 35mm slide presentations suitable for incorporation into 16mm motion pictures. Purpose of this production would be to broaden knowledge of the subject, to dispel negative attitudes, and to motivate further investigation of innovative concepts through coordination of an educational program with local land planning groups.

SITE SYSTEM	
5 **Planning Concepts**	DEVELOPMENT OF GRAPHIC & NARRATIVE DESCRIPTIONS OF MODERN RESIDENTIAL LAND DEVELOPMENT CONCEPTS FOR EDUCATIONAL DISSEMINATION
8 **Site Planning Services**	STUDY WOULD CONSTITUTE A SITE PLANNING SERVICE FOR URBAN OFFICIALS & OTHERS
9 **Community Involvement**	USER NEEDS DETERMINED IN DEVELOPING LAND-USE CONCEPTS
ECONOMICS	
30 **Construction Costs**	ECONOMIC FEASIBILITY STUDIES (COST/BENEFIT) TO BE UNDERTAKEN ON INNOVATIVE LAND-USE CONCEPTS
MANAGEMENT	
33 **Proposer Organization**	PRIVATE COMPANY
34 **Internal Functions**	DATA COLLECTION; PLANNED UNIT DEVELOPMENT ANALYSIS; PREPARATION OF LAND-USE MANUAL; FILM PRESENTATIONS
GENERAL	
40 **Codes**	LAND-USE CONCEPTS REQUIRING CHANGES IN ZONING REGULATIONS & BUILDING CODES

H. F. Construction Company

PROPOSER

H. F. Construction Company, Inc., Dallas, Texas

AFFILIATE

Ed Nicholson Associates, Planners, Architects, Engineer, San Antonio, Texas

Design and development is proposed for a standardized system of concrete panels for use as floors, walls, roofs and ceilings in both single-family and multifamily housing projects. The panels, as envisioned now, would be 2-in. thick, precast, prestressed, load-bearing elements which would be fitted to form a monocoque-type structure. Insulation for these elements would be sprayed on, or preformed sections of rigid material.

The several basic components of the system, which would be manufactured on a mass production basis, would be adaptable to a variety of different configurations, with additional diversity being afforded through inclusion of courtyards, ironwork, shrubbery, and concrete fence elements. The principal materials of the system being concrete and metal, maintenance and upkeep of the proposed system is expected to be minimal.

The precast concrete elements are expected to be light enough in weight so that prospective and future owners or occupants of dwelling units can play a major self-help role in component assembly, and the proposer sets forth successful experience in recruiting and training unskilled persons for such work.

SITE SYSTEM	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
5 Planning Concepts	COURTYARDS, IRON WORK, SHRUBBERY TO ACHIEVE EXTERIOR DIVERSITY
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY; MULTIFAMILY
14 State of Development	CONCEPTUAL STAGE; DESIGN, DEVELOPMENT, TESTING & PRODUCTION REQUIRED
BUILDING SUBSYSTEMS	
16 Structure	STANDARDIZED, LOAD-BEARING, PRECAST, PRESTRESSED CONCRETE PANELS JOINED TO FORM A MONOCOQUE STRUCTURE
PRODUCTION	
24 Offsite Production	STANDARDIZED CONCRETE FLOOR, WALL, ROOF, CEILING PANELS; FENCES
26 Onsite Construction and Erection	FOUNDATION; JOINING OF CONCRETE PANELS
27 Labor	LOCAL UNSKILLED
28 Labor Training Programs	TRAINING OF LOCAL UNSKILLED & SELF-HELP LABOR
29 Community Involvement	CONSIDERABLE SELF-HELP POSSIBLE WITH THE LIGHTWEIGHT CONCRETE PANELS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	PLAN & DESIGN CONCRETE COMPONENT BUILDING SYSTEM; MANUFACTURE OF PANELS

H.O.M.E.

PROPOSER

Home Ownership for Minimum Economies, Inc., Oyster Bay, New York

AFFILIATES

NODE 4 Associates, Inc., Environmental Planning, Design and Construction

A study of labor union practices which impede advanced technology and industrialization of housing is proposed by this organization. The proposal is based on the premise that the nation's housing goals may never be met unless remedial steps are taken in the area of labor union practices—and that such steps are impossible without precise information.

The study would be conducted in the major population market areas and would cover an investigation and report on all practices of the various building trades. A section of the report would be devoted to the historical reasons behind the practices discovered, and recommendations would be made for action which might be taken to improve relations, reduce restrictive practices, and increase apprentice training programs.

Several methods of research would be followed, but primarily information would be gathered by interviews with union leaders, journeymen, apprentices, contractors, municipal and governmental authorities, and materials suppliers.

BUILDING SUBSYSTEMS	
16 Structures 17 Exterior Elements 18 Interior Elements 19 Foundations 20 Comfort Systems	STUDY OF LABOR PRACTICES THAT IMPEDE NEW METHODS & TECHNOLOGY IN INDUSTRIALIZATION OF HOUSING
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection	STUDY OF LABOR UNION PRACTICES THAT IMPEDE ADVANCEMENTS IN INDUSTRIALIZATION OF HOUSING;
27 Labor	STUDY OF POSSIBLE UNSKILLED & SKILLED FOR USE AS CRAFTSMEN & FOR CONSTRUCTION
28 Labor Training Programs	RECOMMENDATIONS FOR ACTION TO INCREASE APPRENTICE TRAINING PROGRAMS & TRAINING IN CONSTRUCTION
29 Community Involvement	INTERVIEWS WITH UNION LEADERS, JOURNEYMEN, APPRENTICES, CONTRACTORS, MUNICIPAL & GOVERNMENTAL AUTHORITIES, & MATERIAL SUPPLIERS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	STUDY; RESEARCH; INTERVIEWS; RECOMMENDATIONS; REPORT PREPARATION
35 External Functions	SPECIFIC INFORMATION IN FIELDS OF URBAN CONSTRUCTION PROBLEMS
36 Market Area	REPORT COVERING BUILDING TRADE PRACTICES IN MAJOR POPULATION MARKET AREAS
GENERAL	
40 Codes	RECOMMENDATIONS FOR ACTION TO REDUCE RESTRICTIVE PRACTICES

Halbing Constructor Corporation

BUILDING SUBSYSTEMS	
20 Comfort Systems 21 Plumbing 22 Electrical 23 Furnishings	ANALYSIS OF NEW EFFICIENCIES IN MAINTENANCE OF STRUCTURAL, MECHANICAL & ELECTRICAL SYSTEMS & FURNISHINGS
ECONOMICS	
30 Construction Costs	ESTIMATED 10% INCREASE IN OPERATIONAL COST EFFICIENCY AS RESULT OF STUDY
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	STUDY TO FORMULATE INNOVATIVE MANAGEMENT & MAINTENANCE TECHNIQUES FOR OPERATION OF LOW-RENT PUBLIC HOUSING

PROPOSER

Halbing Constructor Corporation, Housing Development & Management Service Division, Easton, Pennsylvania

A proposal to analyze and evaluate the operations of local public housing authorities, and formulate a series of new management and maintenance techniques is submitted. The proposal has two parts: the first would analyze as completely as possible local housing authority operations and related regulations and requirements; the second would concentrate on maintenance operations of such authorities.

The proposer comments that a mere 10 percent increase in efficiency could mean estimated savings of up to $9 million each year on present housing authority operations; and adds that there is need for more knowledge about day-to-day problems associated with housing authority operations, in view of the fact that some 6 million subsidized dwellings may be built within the next 10 years.

Hambro Structural Systems, Ltd

PROPOSER

Hambro Structural Systems, Ltd., Ottawa, Canada.

Onsite construction of low- and high-rise housing using readily available materials, local labor, and a load-sharing structural system are the key elements of this proposal. Rather than being locked in to manufacture and transportation of highly sophisticated housing components, and erection with small, skilled crews, this proposed system requires no capital investment in plant facilities and remains free to take advantage of new materials and techniques as they arise.

The system, as presently viewed, consists of masonry bearing walls into which are integrated concrete columns, with both components of the resultant structural entity sharing the load of a steel-joist-supported, concrete floor slab system. The concrete slab, topping may be either site-cast or precast. The load-sharing masonry wall concrete column subsystem typically acts as a party wall between dwelling units and, being 8-in. thick with a 1/2-in. layer of gypsum board on each side, acts as an effective sound-privacy barrier.

Masonry infill panels complete the weather envelope at the ends of the rectangular living areas formed between party walls and act also to resist lateral and wind loadings on the structure. Riser ducts and chases built into the party walls provide for distribution of hot and cold water piping, ventilation, and waste, with horizontal ducts through beams and walls handling heating distribution.

Exteriors of the proposed units may be brick, stucco, built-up panels or curtain walls. The system is fully developed and full-scale projects have been completed in a Canadian city.

SITE SYSTEM	
1 Site Situation	URBAN
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED & BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	MASONRY BEARING WALLS; CONCRETE COLUMNS; STEEL-JOIST-SUPPORTED CONCRETE FLOOR SLAB; MASONRY INFILL PANELS CLOSE OFF ENDS OF DWELLING UNIT; BRICK, STUCCO, BUILT-UP PANELS OR CURTAINWALL EXTERIOR
19 Foundations	STRIP FOUNDATION
20 Comfort Systems	CONVENTIONAL; BUILT INTO WALLS
21 Plumbing	CONVENTIONAL
PRODUCTION	
26 Onsite Construction and Erection	SLAB CAN BE PRECAST OR SITE-CAST; STRUCTURE CONSTRUCTED ONSITE
27 Labor	UNSKILLED
28 Labor Training Programs	ON-THE-JOB TRAINING
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY—LIMITED LIABILITY
34 Internal Functions	CENTRAL CONTROL

Hamilton & Williges

PROPOSER

Hamilton & Williges, Consulting Engineers, Oakland, California

AFFILIATES

Melvin J. Bobier Associates, Planning Consultants

Proposed as a subject for further research and development is a concrete slab, 90 ft. wide, spiraling 10 revolutions into the air to form a massive reinforced concrete structure, 380 ft. in diameter, embodying roadway, parking areas, and sites for 290 single-family two-story houses.

The structure, similar in configuration and construction to a spiral parking garage but on a larger scale, is put forth as a solution to increasing urban densities without loss of open space. As an example, six city blocks (200 ft. x 300 ft.) might be merged into one superblock of 10 acres (with all but the perimeter streets and an access road being closed) and the ten-story spiral roadway structure built in one quadrant, using only three acres. Seven acres would then be left open for recreational facilities, park areas, guest parking, and landscaping.

The spiraling concrete slab, with the roadway on the inside, would ascend around an open core, 180 ft. in diameter, this dimension being great enough to nullify any effect of driving around a tight circle (as in a parking garage). Outside the 28-ft.-wide roadway (wide enough for two-way traffic and parking) would be a 5-ft.-wide sidewalk beyond which would be the 57-ft.-deep lot or building site—actually a 12-degree segment of the building's circumference. The 57-ft. depth would permit placement of a two-car carport, with a 35-ft.-deep house beyond it, extending to the edge of the trapezoidal-shaped lot.

There would be 30 segments per revolution, with two half-segments being reserved for two sets of stairs and elevators, 180 degrees apart, leaving 29 homesites per story, or 290 in the complete structure. As an alternative, by building duplexes, room would be afforded for up to 580 dwellings. The roadway-site slab would rise 8 in. each segment, for a total of 20 ft. per revolution, the 20-ft. clearance between levels being ample for erection of two-story houses with each segment being brought to level with a fill of lightweight concrete.

Lightweight concrete is proposed for the basic structure itself, with loads being transmitted from the slab to radial bearing walls separating each segment, and being extended as supporting beams under the roadway across to the inside core, where columns carry that portion of the load to the foundations.

The proposed research and development would embrace additional architectural and engineering study of the concept, investigation into potential management problems, a feasibility study, and, finally, an urban development analysis to produce techniques for measurement of both market demand and potential acceptance of the novel concept. The spiral construction is not suitable for prototype construction, the very vastness of its scale being one of the factors limiting testing to full-scale construction only.

Although a patent has been applied for, the proposer intends to make the design available for use anywhere on a royalty-free basis, subject to standard consulting engineering fees.

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
2 Density Range	29 TO 58 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	SUPER BLOCK; SPIRAL STRUCTURE SURROUNDED BY OPEN SPACE
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; WALKS & STREETS IN SPIRAL ELEVATION
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED
12 Unit Variations	2 & 3 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure	WALL, SLAB, COLUMN; CAST-IN-PLACE CONCRETE CIRCULAR STRUCTURE WITH SPIRAL ROADWAY
19 Foundations	CONVENTIONAL; FOUNDATION BEARING WALLS WITH PILES
20 Comfort Systems	CENTRAL GAS OR OIL HEATING; INTEGRATED WITH BUILDING SUBSYSTEM
PRODUCTION	
26 Onsite Construction and Erection	CASTING CONCRETE WALLS, SLAB & COLUMNS; FOUNDATION; UTILITY HOOK-UP
ECONOMICS	
30 Construction Costs	$43,800 PER 2-STORY UNIT; $21,900 PER 2-STORY DUPLEX ($16.50 PER SQ. FT.)
31 Financing Methods	CONVENTIONAL
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL ENGINEERS
34 Internal Functions	CENTRAL CONTROL
35 External Functions	URBAN ANALYSIS
GENERAL	
39 Major Innovative Concepts	CONCRETE SPIRAL STRUCTURE WITH PARKING, LIVING & PARK AREA

G. A. Hanscomb Partnership

ECONOMICS	
30 **Construction Costs**	DEVELOPMENT OF ECONOMIC DATA BANKS TO ASSIST IN COST FEASIBILITY & EVALUATIONS; COST ADVICE; COST CONTROL OF OPERATION BREAKTHROUGH PROJECTS
31 **Financing Methods**	FINANCIAL MANAGEMENT & CONTROL DURING CONSTRUCTION; ALLOCATION OF FUNDS TO REGIONAL AREAS

MANAGEMENT	
33 **Proposer Organization**	PRIVATE COMPANY
34 **Internal Functions**	CONTRACT DOCUMENTATION; COST EVALUATION; BUDGETING

PROPOSER

G. A. Hanscomb, Partnership, New York, New York
Hanscomb Roy Associates, Toronto, Canada

The nucleus of this proposal is formed by two proposed economic data banks—one for central cost reference work and the other for establishing regional cost reference points. HUD would be provided with a team of professional personnel to evaluate costs contained in proposals submitted under Operation Breakthrough and to set up grants or budget administration devoted to allocation of resources and funds to regional areas.

At the project level, construction cost advice would be given to project planners and designers to assure that contracts are kept within budget throughout the design and construction phase. Project administration would be a part of this operation.

The central economic data bank would provide a cost reference point for all aspects of the operation. The data bank providing regional cost references for all aspects of Operation Breakthrough would include feedback to the central data bank unit.

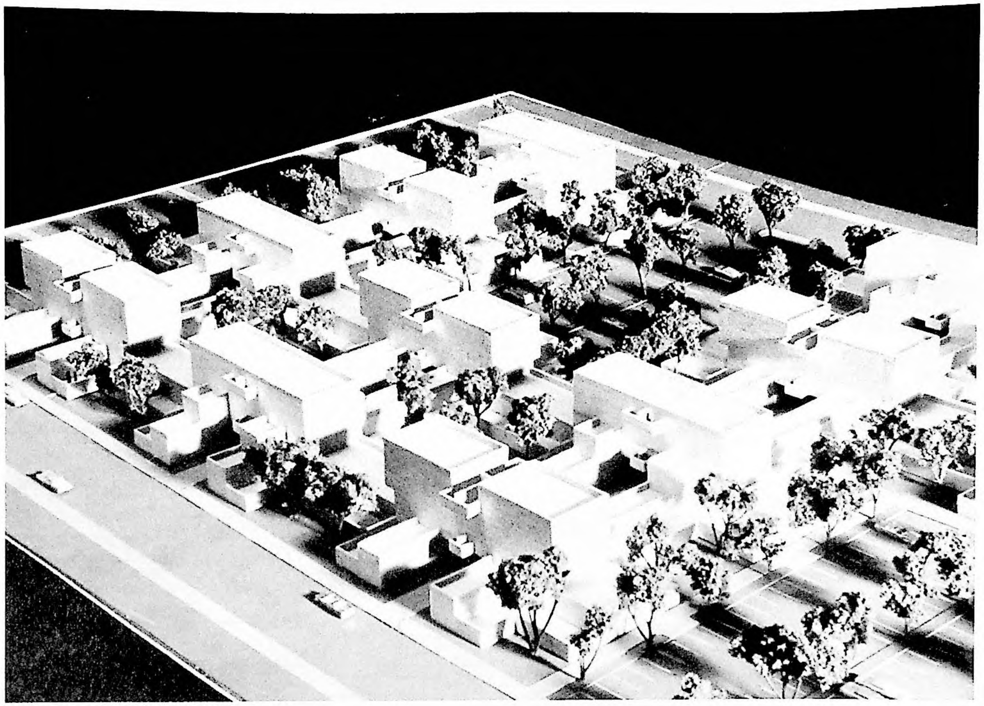
Harvard University

PROPOSER

Harvard University, Graduate School of Design, Cambridge, Massachusetts

The development of innovative housing designs and land-use concepts for later phases of Operation Breakthrough is proposed as a means of making better use of hardware and land. Housing types to be developed will be single-family attached and multifamily low-rise. Design concepts already developed by the proposer have been based on a square space module of 12 ft. x 12 ft. or 15 ft. x 15 ft. These are grouped to form dwelling units of different sizes and configuration. Space modules can be combined with service modules, thus concentrating expensive elements. Early prototypes have been built in wood, steel, and concrete frame construction.

New low-rise, high-density housing types are proposed in the land-use concepts, emphasizing private open space for each unit, direct access from street, classified system of access and circulation, limited air rights over semipublic streets, and vertical stacking of units on flat and sloping sites. Densities proposed range from 15 to 40 dwelling units per acre with building heights of one to four stories. Mixed types of housing would include single family attached, flat, duplex and triplex, with unit sizes running from efficiency to five bedrooms. Studies to date have been based on typical urban blocks and superblocks, and site situations already developed are appropriate to suburban, small city, and to most central-city areas.



SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	15 TO 40 DWELLING UNITS PER ACRE
3 Topography	TESTED ON SLOPES UP TO 35%
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	SUPERBLOCK; PRIVATE OPEN SPACE; HIGH DENSITIES; LIMITED USE OF AIR RIGHTS
6 Nonresidential Functions	SERVICE MODULES
7 Circulation	DIRECT ACCESS FROM STREET; CLASSIFIED SYSTEM; SEMIPUBLIC STREETS
8 Site Planning Services	DEVELOPMENT OF NEW LAND-USE CONCEPTS

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOWRISE
12 Unit Variations	EFFICIENCY; 1 TO 5 BEDROOMS
13 Design Selection	DEVELOPMENT OF INNOVATIVE HOUSING DESIGNS
14 State of Development	DESIGN STAGE, FURTHER RESEARCH REQUIRED

MANAGEMENT

33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	CENTRAL CONTROL; STUDY TO DEVELOP HOUSING DESIGNS & NEW LAND-USE CONCEPTS

Harvard University

PROPOSER

Harvard University, Cambridge, Massachusetts.

The basic structure of this proposed system consists of lightgauge metal framing spaced 8 ft. on center with 4-ft. x 8-ft. infill panels forming all finish surfaces. A prefabricated universal joint piece occurs at each intersection between frame members, and panels are set in the frames with simple snap-in connectors. On low-rise structures this construction method enables all assembly to be done by unskilled labor. No hoisting equipment is required. Column and beam units are easily attached and no single element weighs more than 150 lbs.

Floor, wall, and partition panels are manufactured at the building site but future offsite plant production is proposed. The system is adaptable to any height, and if above four floors, it becomes a subsystem in a megastructure. The frame for such a structure consists of columns, core walls, and floor slabs and must be built at four-story intervals. The megastructure process will require skilled labor but infill panels will be the same as proposed for low-rise construction.

All element dividing units are made of independent layers, allowing a variety of finished surfaces. This permits use of any standard insulation, thermal or acoustical, and the achievement of desired fire ratings. Stair assemblies, cabinets, partitions, and closets are premanufactured and simple mechanical installations can be made by unskilled labor. Aluminum wiring and plastic pipe are specified.

The proposed system envisions possible independence from restrictive union practices by the formation of organizations different from established trades. The possible acquisition of dwelling units by the workers, with labor input as full or partial payment, is suggested. Skills and self-confidence acquired in construction of such units might enable groups of workers to become subcontracting organizations.

The system is now in an advanced conceptual stage. A further research program will develop all architectural, structural, and mechanical components and details.

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN
2 Density Range	40 DWELLING UNITS PER ACRE MAXIMUM
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
6 Nonresidential Functions	COMMUNITY FACILITIES, LAKE
7 Circulation	SEPARATE PEDESTRIAN AND VEHICULAR TRAFFIC
8 Site Planning Services	SYSTEM DESIGN TEAM AT CENTRAL LOCATION

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY TO 3 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION

BUILDING SUBSYSTEMS

16 Structure	STEEL FRAME & PANEL; HIGHRISE-CONCRETE COLUMN, CORE WALL & SLAB FRAME
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL
20 Comfort Systems	OPTIONAL GAS OR ELECTRIC; FACTORY-FABRICATED
21 Plumbing	CONVENTIONAL
22 Electrical	

PRODUCTION

24 Offsite Production	STEEL FRAMING MEMBERS; MECHANICAL EQUIPMENT; PANELS (POSSIBLE)
25 Onsite Production	WALL, FLOOR & PARTITION PANELS
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF FRAME & PANELS; UTILITIES HOOKUP; HIGHRISE FRAMING
27 Labor	UNSKILLED, SEMISKILLED
28 Labor Training Programs	MINIMAL TRAINING
29 Community Involvement	SELF-HELP WITH EQUITY PARTICIPATION

ECONOMICS

31 Financing Methods	SELF HELP EQUITY PARTICIPATION

MANAGEMENT

33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	ARCHITECTURAL DESIGN; MARKETING; FINANCING; ENGINEERING; COORDINATION

GENERAL

39 Major Innovative Concepts	BUILDING SYSTEM—STEEL PANEL & FRAME; EQUITY SELF-HELP PARTICIPATION

Allen J. Hastings

PROPOSER

Allen J. Hastings, Inventor and Designer, Royal Oak, Michigan

Use of expandable polystyrene bead for the onsite forming of an insulating core is the key concept of this panelized housing system. The system takes advantage of a property of polystyrene, usually exploited in the factory, that under application of steam the bead expands up to 60 times its original volume. The foamed cores of typical sandwich panels, for example, usually are activated to their full thickness at the manufacturing and assembly plants, with the completed panel leaving the factory at its specified, full thickness.

In this proposed panel system, however, blankets of unexpanded polystyrene bead are laminated to one side of a 4-ft. x 8-ft. piece of plywood, resulting in a panel thickness of about 1 in. Onsite, the panel is subjected to steam, the bead blanket subsequently expanding to 4 in., 6 in., or 8 in., depending upon the thickness required for thermal or acoustical insulation.

Immediate advantages stemming from use of the unexpanded polystyrene include savings in handling and shipping—the 1-in. thick panels obviously requiring less space than fully foamed sandwich panels, both in storage and in transit, with panels for an entire house conceivably being loaded onto one flatbed trailer. Structurally, the proposed system offers an additional advantage in that the onsite expansion of the bead joins panel to panel, and panels to steel channel studs and to the roof system, so that the entire house becomes a monolithic entity, able to withstand loads comparable to that of stressed concrete construction without the disadvantage of concrete weight.

Fire resistance for the expandable-beam system is high, maintenance is claimed to be low, and esthetic considerations are offered in the variety of colors and textures which are inherent in the use of polystyrene.

SITE SYSTEM	
3 Topography	ADAPTABLE TO ALL TOPOGRAPHY AND SOILS
4 Climate	ADAPTABLE TO ALL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	INITIAL DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure	PLYWOOD, ALUMINUM OR STEEL PANELS LAMINATED WITH UNEXPANDED POLYSTYRENE CORE, EXPANDED & JOINED BY STEAM CATALYTIC AGENT ONSITE
19 Foundations	CONVENTIONAL
20 Comfort Systems 21 Plumbing 22 Electrical	INCORPORATED WITHIN THE INITIAL DESIGN FRAMEWORK OR INSTALLED ONSITE
PRODUCTION	
24 Offsite Production	PANEL ELEMENTS WITH UNEXPANDED POLYSTYRENE BEAD BLANKET
25 Onsite Production	PANEL COMPLETION & JOINING BY EXPANDING POLYSTYRENE BEAD BLANKET
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF PANELS; EXPANDING OF POLYSTYRENE BEADS
27 Labor	UNSKILLED & SELF-HELP IN PRODUCTION
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & TEST OF EXPANDABLE POLYSTYRENE BEAD PANELS
GENERAL	
39 Major Innovative Concepts	EXPANDABLE POLYSTYRENE BEAD APPLICATIONS TO MODULAR PANEL COMPONENTS ONSITE

Hauser Research

PROPOSER

Hauser Research and Engineering Company, Boulder, Colorado

AFFILIATES

Frost Engineering Development Company, Aircraft Applications Subcontract; Dr. R. Williams, Economic and Production Study, University of Colorado

Based on the premise that mass production of housing requires efficient, ordered delivery to the site of either the production facility or the house product itself, this proposed study is aimed at achieving innovative designs for the most effective transportation system or systems possible.

The proposer plans to study two modes of production and transportation: (1) A permanent production facility with deliverable houses; and (2) A relocatable production-assembly facility on the development site, with complete control of access roads during development.

Five research tasks would be required for the study: (1) Review of current practices; (2) Discovery of transport opportunities and limitations, with emphasis on the modes probably not revealed under current practices in the use of road, rail, water, and air facilities; (3) Identification of transport-induced design considerations which would affect the structure of the module or panel being shipped; for example, the buoyancy of a house to be floated in place, or the aerodynamics of a structure being helicopter-or dirigible-lifted; (4) Review of the economics of various transportation methods, to reveal the dollar savings to be realized (if any); and (5) Review of code considerations and constraints as they might affect proposed transportation systems.

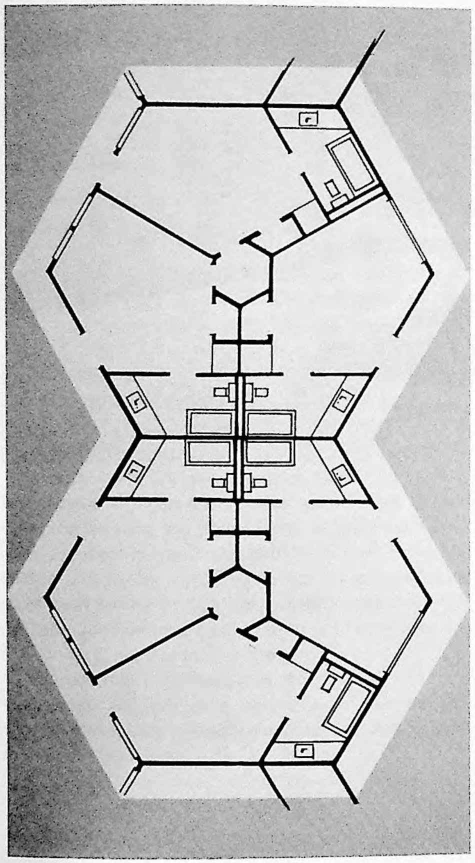
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	STUDY OF PROPERTIES & CHARACTERISTICS OF PREFABRICATED MODULES OR MODULAR COMPONENTS WHICH MIGHT BE AFFECTED BY VARIOUS TRANSPORTATION MEANS
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection	STUDY OF TRANSPORTATION REQUIREMENTS OF INDUSTRIALIZED HOUSING; TRANSPORT OF RELOCATABLE PLANT TO SITE; TRANSPORT OF MODULES & MODULAR COMPONENTS FROM PLANT TO SITE; RAIL, WATERWAYS, HIGHWAYS & AIR METHODS
ECONOMICS	
30 Construction Costs	STUDY OF REDUCED TRANSPORT COSTS THROUGH COMPONENT DESIGN CONSIDERATION
MANAGEMENT	
33 Proposer Organization	PARTNERSHIP
34 Internal Functions	CONDUCT STUDY INTO OPTIMUM TRANSPORTATION OF MASS-PRODUCED HOUSING
35 External Functions	STUDY OF AIRCRAFT APPLICATIONS, ECONOMICS & PRODUCTION
GENERAL	
40 Codes	REVIEW OF CODE CONSIDERATION & CONSTRAINTS PROPOSED

Hexagon Homes

PROPOSER

Hexagon Homes, Norman, Oklahoma

The hexagon shape is a key to the concept for this building system, a concept which the proposer arrived at after a search for a superior compromise between structural shell and human accommodation. As em-



SITE SYSTEM

1 Site Situation	SUBURBAN; RURAL
3 Topography	ADAPTABLE TO ALL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL CLIMATES
6 Nonresidential Functions	SCHOOLS; CHURCHES; MOTELS; COMMERCIAL FACILITIES, ETC.

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
12 Unit Variations	FLEXIBLE; 2 TO 4 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD OR CUSTOM DESIGN
14 State of Development	DESIGN COMPLETED; PROTOTYPE TESTED; SYSTEM MARKETED IN MIDWEST

BUILDING SUBSYSTEMS

17 Exterior Elements	PLYWOOD SANDWICH PANELS; STEEL ROOFING; ADJOINING CARPORT
18 Interior Elements	PARTITIONS; VINYL ASBESTOS TILE FLOORING
19 Foundations	PREFABRICATED; SUNKEN PIERS SUPPORT STEM WALLS; FREE-FLOATING SLAB
20 Comfort Systems	UNDER-FLOOR DUCTS; MECHANICAL CORE UNIT; ABOVE-CEILING OR UNDER-FLOOR DUCTS
21 Plumbing	HEATING & AIR CONDITIONING UNITS & ALL FIXTURES SHIPPED WITH UNIT
22 Electrical	CONDUITS & OUTLETS IN VOIDS IN PANELS

PRODUCTION

24 Offsite Production	ROOF & FOUNDATION, HEXAGONAL SPACE FRAMES; PANELS; CORE UNITS; COLUMNS
26 Onsite Construction and Erection	ERECTION OF SPACE FRAMES; COLUMNS & PANELS; INTERIOR LAYOUT
27 Labor	PRIMARILY UNSKILLED
29 Community Involvement	SELF-HELP ERECTION POSSIBLE; LOCAL CLIENT-DEVELOPERS

ECONOMICS

30 Construction Costs	\$9.74 TO \$10.45 PER SQ. FT.
31 Financing Methods	CONVENTIONAL FINANCING METHODS; FHA PROGRAMS
32 Useful Life	STRUCTURE & FINISHES—50 YEARS; OBSOLESCENCE ANTICIPATED IN 30 YEARS

MANAGEMENT

33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	SYSTEM DESIGN; TOOLING & MANUFACTURE OF COMPONENTS
35 External Functions	CLIENT-DEVELOPERS FOR CONSTRUCTION
36 Market Area	PRESENTLY FROM MISSOURI TO TEXAS INCLUDING OKLAHOMA; EVENTUALLY NATIONWIDE
37 Delivery Rate	1,000 UNITS PER YEAR

GENERAL

39 Major Innovative Concepts	HEXAGONAL SPACE FRAME & PREFABRICATED FOUNDATION

bodied in this housing system, the hexagon shape affords a 40 percent increase in usable space (compared to a rectangular plan of equivalent outside dimensions), with that space being free of columns or interior bearing walls for complete flexibility of arrangement. The system proposed has been erected in prototype, a plant for fabrication of the parts is built and the concept is currently being marketed, with nationwide distribution in view.

The hexagon-shaped structure is achieved by erection of two six-sided horizontal trusses—one for floor, one for roof—held apart by columns spaced around the perimeter. The roof truss technically is a space frame since its center, the apex of its six triangular sides, is 2 ft. higher than the edges, forming a peaked roof. A center column supports this peak during erection, but then becomes unnecessary once the shell is complete.

To the steel pipe-frame structural skeleton is affixed the skin of the space enclosure—sandwich panels of plywood veneer over 1 1/2 in. of polystyrene, and roofing of corrugated steel sheet attached to the ribs of the top truss. All components of the system are factory-produced, including trusses, panels, columns, and mechanical core units. Onsite work includes erection of the frame, attachment of panels, interior layout, cabinet installation and utility hookup.

The wall panels are precut and prefinished for site installation of standard doors and windows, and are prefinished. The exterior is epoxy-coated and gravel-finished; the floor finish can be vinyl asbestos tile or carpeting.

Advantages claimed for the panelized, hexagonal framed system are: (1) Transportibility—all components for a 4-bedroom house, including fixtures, doors, windows, hardware, cabinets weighing only 25,000 lbs. and capable of being shipped on a single truck; (2) Self-help potential—a client can erect, modify or replace panels which are nonbearing; (3) Site adaptability—the stem walls (supported by piers) may be elevated on nonlevel sites; and (4) Low cost.

Howard Holmes Engineers

PROPOSER

Howard Holmes, Engineers, Everett, Washington

In this proposal twelve triangularly-shaped dwelling units are clustered to form a multifamily low-rise hexagon, with units divided by common walls which afford economy, privacy and efficient land use. The economy of the proposed system results from the minimizing of exterior walls, (the long dimensions of each triangular living unit being the interior common walls) and through savings by shared mechanical systems built into the common walls.

A second plan proposed, also incorporating the common wall principle, is for a duplex structure, two dwelling units being backed to each other along their longest dimension wall. The proposed housing system is to be constructed from precast lightweight concrete panels. Typical of the system are the exterior wall panels, 9 ft. 4 in. high, 4 in. thick, in modular lengths, to be assembled into various wall lengths and floor plans. Exterior finish may be thin fieldstone or flagstone, the embedded stone forming an attractive, textured pattern. An optional finish would have the appearance of wood, through prior sandblasting of the plywood forms.

Interior finish for the dwellings would be cement-based paint for walls and ceilings, with rubber backed carpeting covering the floors. Trim would be minimal, with the electric baseboard panel (concealing radiant heating and wiring) doubling as trim. Simple furniture, some of it built in, would be included with the house package; for example, a card table could be folded and stored in a concealed rack in the wall.

The proposer anticipates an estimated volume production of 200,000 units per year can be achieved, with 50 plants each producing components for 20 units per day for 200 days.

SITE SYSTEM	
2 Density Range	5 TO 12 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL CLIMATES
5 Planning Concepts	SINGLE & DOUBLE CLUSTERS
7 Circulation	CUL-DE-SACS; ENTRANCES ON ALL EXTERIOR SIDES
10 Utilities	UNDERGROUND POWER SERVICE
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
13 Design Selection	FROM STANDARD PLANS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
16 Structure	PRECAST LIGHTWEIGHT CONCRETE, HEXAGONAL WALL PANELS; CONCRETE FLOOR & ROOF SLABS
17 Exterior Elements	FLAGSTONE, FIELDSTONE OR TEXTURED FACING
18 Interior Elements	RUBBER-BACKED CARPETING; EGG-CRATED CONCRETE OR WOOD FRAME PARTITIONS
19 Foundations	PRECAST PIERS
20 Comfort Systems	BASEBOARD ELECTRIC HEAT; CONVENTIONAL AIR CONDITIONING SYSTEM
21 Plumbing	PREFABRICATED & INSTALLED EXTERNALLY TO THE WALLS/PARTITIONS
22 Electrical	BASEBOARD DUCT DISTRIBUTION; LOOP INTERCONNECTIONS UNDER DOORWAYS
23 Furnishings	BUILT-IN FURNITURE SUCH AS CARD TABLE CONCEALED IN WALL RACK, SWIVEL-ARM WALL LAMPS
PRODUCTION	
24 Offsite Production	CONCRETE WALL PANELS; ROOF SLAB; MODULAR COMPONENTS; FURNISHING & APPLIANCES
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF WALLS & ROOF SLAB; UTILITIES
ECONOMICS	
30 Construction Costs	$10,000 PER 1,248 SQ. FT. UNIT, 1,000 PER YEAR
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & DEVELOP BUILDING SYSTEM
37 Delivery Rate	200,000 UNITS PER YEAR; FIFTY PLANTS AT 20 UNITS PER DAY FOR 200 DAYS
GENERAL	
39 Major Innovative Concepts	HEXAGONAL BUILDING CONFIGURATION FOR ECONOMY & LAND USE OPTIMIZATION

Howard Holmes

PROPOSER

Howard Holmes Engineers, Everett, Washington

A remote-controlled trencher, pipelayer and backfiller machine is proposed for sitework anywhere on cleared and graded land for laying pipes from 4 in. to 16 in. in diameter. The machine, which is self-propelled and unattended, receives its guidance from a complementary piece of equipment, called the director, which is based on laser and/or radar beams.

The robot machine scoops the sections of pipe (placed in sequence on the ground ahead of it), and feeds the sections into a chute (a tube-like device extending from front to rear of the machine), fits bell and spigot ends tightly together, and guides the loaded and joined sections down into the round-bottom trench which has been excavated by the digger portion. Simultaneously, backfill, from a rotary conveyor which is continuously charged by the digger, is fed to compactors and vibrator, the trench being completely covered as the machine moves along.

A fail-safe, or deadman's brake, operation is built into the control system.

SITE SYSTEM	
10 Utilities	DESIGN OF REMOTE-CONTROLLED, TRENCHER, PIPELAYER, BACKFILLER MACHINE FOR LAYING PIPES
BUILDING SYSTEMS	
14 State of Development	DESIGN & DEVELOPMENT OF MACHINE YET TO BE ACCOMPLISHED
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & PRODUCE PROPOSED TRENCHER-PIPELAYER-BACK FILLER MACHINE

Howard Holmes

PROPOSER

Howard Holmes Engineers, Everett, Washington

Design and development of a truck-mounted, footing-hole auger attachment is proposed, the device to be used primarily in conjunction with erection of factory-manufactured panelized housing. The auger would be designed as an attachment for the crane-carrier used to transport and erect house panels, and thus would accompany the house package to the site.

The machine would be capable of automatically digging footing holes to a depth to provide uniform soil bearing capacity. The auger bucket would be designed with sufficient capacity to accumulate the soil from each hole before being emptied, thereby speeding up the digging process. After the footings are dug, the proposed machine would be set aside, the carrier-mounted crane then being used to erect the panels. After erection of the house shell is completed, the auger would be remounted on the carrier, and the entire unit returned to the factory for another paneled home.

BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE REQUIRING DESIGN & DEVELOPMENT OF MACHINE
BUILDING SUBSYSTEMS	
19 Foundations	DEVELOPMENT OF A FOOTING-HOLE AUGER ATTACHMENT FOR CRANE-PANEL CARRIER
PRODUCTION	
24 Offsite Production	AUGER ATTACHMENT ACCOMPANIES PANELS & CARRIER TO SITE
26 Onsite Construction and Erection	DEVELOPMENT OF MACHINE FOR RAPID, AUTOMATIC DIGGING OF FOOTING HOLES
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	DESIGN & DEVELOPMENT

Howard Holmes

PROPOSER

Howard Holmes Engineers, Everett, Washington

A machine, called the director, is proposed for automatic guidance of various complementary earthworking machines such as scrapers, trenchers and pipelayers. The machine operates with the aid of laser and/or radar beams and will guide machinery both vertically and horizontally in shaping earth for roadbuilding on housing sites and for pipelaying.

The machine, mounted on a jeep-type truck equipped with leveling jacks, reads plans and elevations by a photoelectric tracer which moves over a level map platform on which topographic information is placed. The data are transmitted to the equipment, being guided by two dome-shaped emitters mounted at the top of the machine.

The guidance machine may be programmed also to shape the earth within individual lot areas, as required. Code problems should be resolved by a fail-safe system of machine operation.

SITE SYSTEM	
3 **Topography**	DEVELOPMENT OF A PROGRAMMED, DRIVERLESS EARTHWORKING MACHINE
10 **Utilities**	DEVELOPMENT OF A MACHINE TO GUIDE OTHER MACHINE FOR LAYING PIPE
BUILDING SYSTEMS	
14 **State of Development**	DESIGN STAGE; VARIOUS ELEMENTS MUST BE INTEGRATED INTO A WORKING SYSTEM
MANAGEMENT	
33 **Proposer Organization**	PROFESSIONAL
34 **Internal Functions**	DESIGN & DEVELOPMENT OF EARTHWORKS MACHINE WHICH GUIDES COMPANION MACHINES
GENERAL	
39 **Major Innovative Concepts**	EARTHWORKS MACHINE OPERATING ON LASER AND/OR RADAR BEAMS
40 **Codes**	FAIL-SAFE SYSTEM MAY OVERCOME ANTICIPATED CONSTRAINTS

Housing Advocates

PROPOSER

Housing Advocates, Berkeley California.

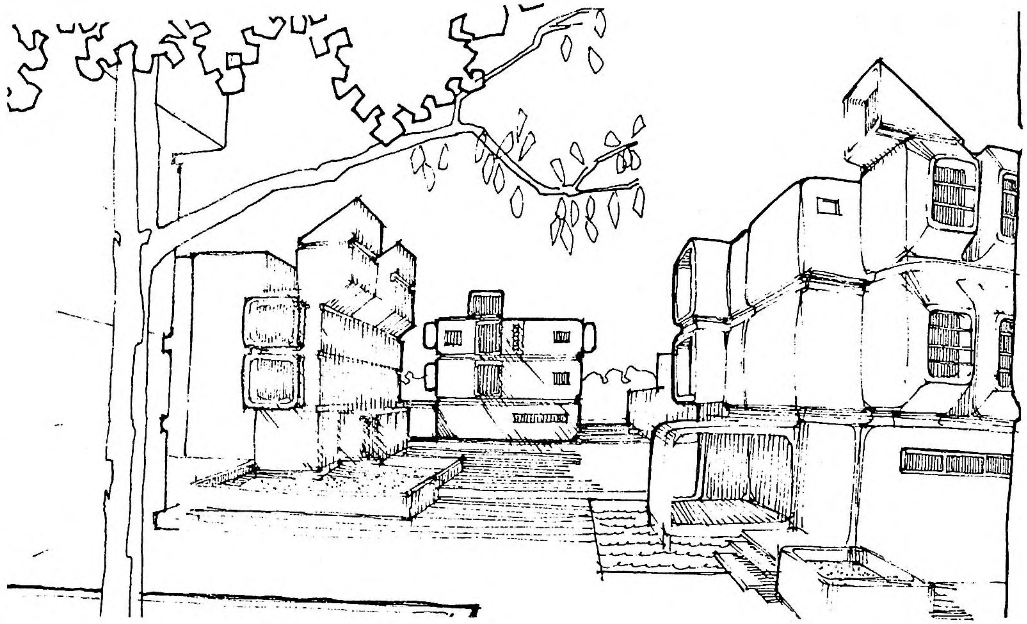
AFFILIATES

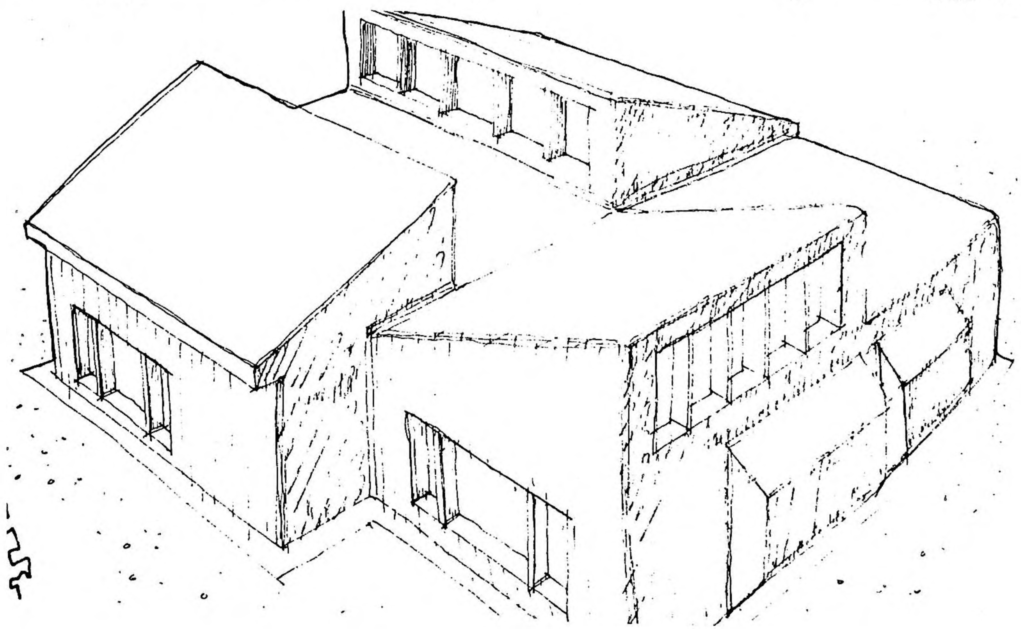
Birdair Structures, Inc.; Poly Petro Chem Products, Inc.

This system proposes use of foamed plastic (carbalon) for the formation of virtually all elements of the housing structure. Carbalon, a highly stable, closed-cell substance, is produced by the controlled polymerization of hydrocarbons. With the exception of utility cores, components are manufactured onsite by pouring or spraying the foam material around inflated molds. Previously attached door and window frames act as spacers between forms. With placement of the carbalon, they become integral with the structure, thus eliminating usual fitting and joint problems. The material flows as it is placed, bonding to previously poured sections until the structure becomes monolithic. Flow of the plastic compensates for tolerance requirements. A savings of approximately 21 percent is estimated with use of this system as opposed to conventional construction.

The monolithic nature of the structure allows diversity of plan and elevation. Construction of three-story height or less is proposed, but possibility of six-story height without reinforcement is indicated. Conventional cladding can be applied to exteriors then sprayed with carbalon to improve weatherability. Varying surface textures are achieved by adding sand, talc, or gypsum to the plastic.

Onsite fabrication is a two-step process. A highly foamed version of carbalon is sprayed onto pneumatic formwork for exterior wall formation. Interior walls are formed by pouring the material between framework elements. Forms are deflated and removed, and dense, nonfoamed version of the same material is sprayed on interior and exterior surfaces of the base structure. The resulting composite sandwich becomes the structural and weather envelope. Thermal and acoustical characteristics are achieved by combining different densities of carbalon with various additives.





Housing Advocates (continued)

Deflated molds, windows and door frames, chemicals, resins, petroleum and fillers are delivered to site along with mobile foam spraying equipment. Utilities are laid and stubbed up; ground trenches anchor a plastic foundation slab. Carbalon foam is sprayed into foundation slab cavities and over utility lines. Deflated ductwork of plastic film is unrolled onto the slab, stapled in place, tied off, and inflated. The floor surface is formed by carbalon foam sprayed onto the foundation. Room-sized and subroom-sized molds are inflated and positioned on the slab; door and window frames are placed and taped to mold surfaces. Exterior walls are sprayed, followed by interior partitions and roof. The utility wall component takes advantage of factory-controlled conditions to complete many of the time consuming and costly operations of installing services. Some site assembly operations are retained, however, to allow for easy shipment and site connection.

Summary Information

SITE SYSTEM	
1 Site Situation	
2 Density Range	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	USE OF SCATTERED SITES; CLUSTERS
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	LOCAL ARCHITECTS
9 Community Involvement	
10 Utilities	UNDERGROUND; IN-PLACE PRIOR TO PLACING OF THE FOUNDATION
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE POSSIBLE
12 Unit Variations	
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION, & TESTING
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	SELF-SUPPORTING STRUCTURAL PLASTIC CARBALON SPRAYED ON PNEUMATIC FORMWORK MODULES
17 Exterior Elements	NONFOAMED VERSION OF CARBALON SPRAYED ON EXTERIOR FORMS OUTER SURFACE
18 Interior Elements	NONFOAMED CARBALON INTERIOR SURFACE; FLOOR; INTEGRAL OR DEMOUNTABLE PARTITIONS; STAIRS
19 Foundations	FOAMED PLASTIC SLAB
20 Comfort Systems	DUCTWORK INTEGRAL WITH STRUCTURE; HOT AIR HEATING SYSTEM
21 Plumbing	ENCLOSED IN PREFABRICATED UTILITY WALL
22 Electrical	WIRING ENCLOSED IN PREFABRICATED UTILITY WALL
23 Furnishings	
PRODUCTION	
24 Offsite Production	UTILITY WALL
25 Onsite Production	FORMING OF MODULE COMPONENTS
26 Onsite Construction and Erection	FOUNDATION; FOAMING OF MODULES; INSTALLATION OF UTILITY WALL & HOOK-UPS; FINISHES
27 Labor	PRIMARILY SEMISKILLED & UNSKILLED
28 Labor Training Programs	
29 Community Involvement	USE OF LOCAL ARCHITECTS & FRANCHISE CONTRACTORS; USE OF LOCAL LABOR SUPPLY
ECONOMICS	
30 Construction Costs	
31 Financing Methods	PROPOSER SUPPLIED INITIALLY
32 Useful Life	
MANAGEMENT	
33 Proposer Organization	CORPORATION (NONPROFIT)
34 Internal Functions	SYSTEM DESIGN; PROTOTYPE CONSTRUCTION; TESTING; MANAGEMENT
35 External Functions	INFLATABLE FORMS; CARBALON DEVELOPMENT
GENERAL	
39 Major Innovative Concepts	USE OF PNEUMATIC FORMS & CARBALON FOAM FOR STRUCTURAL MODULES
40 Codes	

Huntley and Blazier

PROPOSER

Huntley and Blazier Company, La Jolla, California

AFFILIATES

Henry C. Beck Company; Woodward-Clyde & Associates; Testing Engineers, Inc.

Proposed for study is a building system based on low-cost adobe wall construction. The wall system — which would be placed on cast-in-place concrete slabs and closed in with conventional roofing materials — would be developed in two forms: (1) An adobe block wall, preferably of dry construction with interlocking blocks but, if necessary, constructed with a minimum amount of grout for bonding; and (2) sprayed application of adobe which could be varied by formwork construction as to architectural appearance.

All interior exposed wall faces require no finishing, but for applications such as bathroom and kitchen, where smooth finishes are desirable, a low-cost thincoat plaster can be applied.

Outlined as requirements and areas for study are: Soil tests from different parts of the U.S. to serve as criteria; Determination of strength of sprayed applications and development of equipment for this process; Training of unskilled labor; Methods for production and testing of dry block construction; Possible development of an extrusion method for producing the block.

BUILDING SYSTEMS	
11 Housing Types	ADAPTABLE TO SINGLE-FAMILY & MULTIFAMILY
14 State of Development	PRODUCTION FACILITIES & BUILDING SYSTEMS REQUIRE RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	DEVELOPMENT OF ADOBE BLOCK STRUCTURAL WALLS, BLOCKS INTERLOCKING OR MORTAR-BONDED; STEEL REINFORCED ADOBE STRUCTURAL WALL PANELS; VARIED APPEARANCES PROVIDED IN BLOCK MANUFACTURING & PANEL FORMING THINCOAT PLASTER FINISH IN BATHROOM & KITCHEN AREAS WITH OTHER SURFACES EXPOSED ADOBE; CONCRETE STAIR UNITS
21 Plumbing	DROP-IN KITCHENS & BATHROOMS
PRODUCTION	
24 Offsite Production	DEVELOPMENT OF FACILITY FOR PRODUCTION OF ADOBE BLOCKS; CONCRETE STAIR UNITS
25 Onsite Production	OPTIONAL ADOBE BLOCK PRODUCTION WHERE SOILS ARE SUITABLE
26 Onsite Construction and Erection	SPRAYED ADOBE WALL PANELS; PLACEMENT OF SLAB, KITCHEN, BATHROOM, & STAIR UNITS
27 Labor	UNSKILLED LABOR FOR PRODUCTION OF BLOCK & TESTING OF CONSTRUCTION
29 Community Involvement	PRODUCTION & CONSTRUCTION EMPLOYMENT ON ALMOST YEAR-ROUND BASIS
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	MANAGEMENT; PLANNING; SUPERVISION; EXPERIMENTAL CONSTRUCTION
35 External Functions	SOIL MATERIALS & PANEL TESTS; DEVELOPMENT OF FORMS & EXTRUSION MACHINERY; CONSTRUCTION
GENERAL	
39 Major Innovative Concepts	DEVELOPMENT OF MACHINERY TO MANUFACTURE EXTRUDED ADOBE BLOCK; SPRAY-ON TECHNIQUE FOR ADOBE WALL PANELS

Hutchcrete Products

PROPOSER

Hutchcrete Products, Rochester, Minnesota

Pretensioned, prestressed, insulated concrete sandwich panels are one of two key elements in this system proposed for the production of single-family ramblers. The other element is a pretensioned concrete ring beam which ties the tops of the sandwich wall panels together into a structural entity.

The wall panels, 8 ft. high, are manufactured typically in 3 lengths (8 ft., 10 ft. and 12 ft.) to afford flexibility in achieving many floor plans. With an overall 15-in. thickness, the panels are factory cast of 2 1/2-in.-thick outside courses of concrete, sheet or strip foamed insulation, with a dead air space between inner and outer walls. This discontinuity between faces of the sandwich provides thermal insulation and prevents problems of condensation on inside walls. The panels are prewired, conduit linking up outlet boxes, prior to casting of concrete in the factory.

To assure insulation effectiveness and weathertightness at the corners of the walls, usually the coldest, most vulnerable part of any structure, special corner sections (also of pretensioned, prestressed concrete sandwich construction) are provided, 8 ft. high, with legs 2 ft. long. One of the few site operations required (other than assembly steps) is casting of the prestressed concrete ring beam which ties together the tops of the panels. Anchor bolts on top of this beam secure a wooden plate to which the wood trusses of the hipped roof system are fastened.

The finished single-family 24 ft. x 40 ft. rambler-type home will include baseboard hot water heating, and full carpeting.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
BUILDING SUBSYSTEMS	
16 Structure	PRETENSIONED, PRESTRESSED, INSULATED CONCRETE SANDWICH PANELS; PRETENSIONED CONCRETE RING BEAMS; SPECIAL PRETENSIONED PRESTRESSED CONCRETE CORNERS. ANCHOR BOLTS SECURE WOODEN PLATE FOR FASTENING WOOD TRUSSES OF HIPPED ROOF
18 Interior Elements	CARPETING
20 Comfort Systems	BASEBOARD HYDRONIC HEATING
22 Electrical	PANELS PREWIRED BEFORE CASTING
PRODUCTION	
24 Offsite Production	PRODUCTION OF CONCRETE PANELS AND COMPONENTS
26 Onsite Construction and Erection	PLACING OF PANELS
ECONOMICS	
30 Construction Costs	$15,000 TO $17,000 PER DWELLING UNIT
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	CENTRAL CONTROL

IIT Research Institute

PROPOSER

IIT Research Institute, Chicago, Illinois

Seven innovative building system and subsystem concepts are proposed for study and development by this research organization. The seven areas proposed for study resulted from intensive preliminary study and review during which many concepts and postulations were tested against the following criteria: (1) Would successful execution of the proposed study have a meaningful impact upon solving the nation's housing problems? (2) Would the concept, successfully developed, be amenable to early inclusion in the housing market, either within current constraints, or within the conceivably relaxed constraints sought by HUD? (3) Does the concept have the technical and economic merit justifying further study and development?

The seven system and subsystem concepts which survived this testing are offered by the proposer as separate and distinct subproposals, each one susceptible of being funded and implemented as an independent study.

Subproposal No. 1

It is postulated that substantial economic benefits can be derived by the integration of the elements of electrical, telephone, and other home distribution systems into modular housing components such as precast wall panels or premanufactured structural elements. This approach would allow extensive use of low-voltage switching of power circuits with its recognized characteristics of increased control, switching flexibility, and copper economy.

Implementation of such a concept requires solution to problems such as: layout of wall panels in which would be incorporated power lines, low-voltage lines and radio frequency channels; layout of structural elements; provision for interconnections between panels and wall panels; bus and outlet design; and design of central electric service and distribution panels. A comprehensive techno-economic evaluation of the integrated electrical systems approach also would be performed.

BUILDING SYSTEMS	
14 State of Development	LIMITED CURRENT USE OF LOW-VOLTAGE POWER SWITCHING FOR HOUSING; DESIGN; RESEARCH, DEVELOPMENT & TESTING REQUIRED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	APPLICABLE TO MODULAR COMPONENTS INCLUDING PRECAST WALL PANELS & STRUCTURAL ELEMENTS SUCH AS BEAMS & COLUMNS
20 Comfort Systems 21 Plumbing	APPLICABLE TO MANUFACTURED CODE ASSEMBLIES
22 Electrical	PROPOSED INTEGRATION OF ALL DISTRIBUTION INTO BUILDING SUBSYSTEMS; LOW VOLTAGE POWER SWITCHING, POSSIBLE ALUMINUM WIRING
PRODUCTION	
24 Offsite Production	OBJECTIVE TO DESIGN WALL PANELS TO ASSURE MASS PRODUCTION CAPABILITY
26 Onsite Construction and Erection	WALL PANEL & BEAM ERECTION CONNECTIONS TO PROVIDE CIRCUIT CONTINUITY; WALL PIERCING EMPLACEMENT OF OUTLETS & CONTROLS
27 Labor	PREWIRED WALL PANELS WILL CONSERVE SCARCE INSTALLATION SKILLS; MINIMAL RELIANCE ON MANUAL SKILLS FOR ERECTION
ECONOMICS	
30 Construction Costs	PROPOSED SYSTEM OFFERS ECONOMIES OF MASS PRODUCTION, MATERIALS SAVINGS & REDUCED ERECTION COSTS
32 Useful Life	PROPOSED SYSTEM TO PROVIDE FLEXIBILITY FOR CHANGES EXTENDING OVER LIFE OF THE STRUCTURE
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY (RESEARCH INSTITUTE)
34 Internal Functions	CONCEPTUAL DESIGN STUDIES, DETAILED SPECIFICATION, TECHNO-ECONOMIC EVALUATION & DOCUMENTATION OF INTEGRATED ELECTRICAL ENERGY SYSTEM CONCEPT
GENERAL	
39 Major Innovative Concepts	SOLUTION OF DESIGN PROBLEMS WITHOUT REQUIRING TECHNOLOGICAL BREAKTHROUGHS
40 Codes	LOW VOLTAGE SWITCHING OF POWER CIRCUITS PRESENTLY IN USE WHERE CODES PERMIT

Subproposal No. 2

This proposal outlines the research effort necessary to develop a cost effective girder-wall system. The concept takes advantage of the load carrying capacity of a wall, designed as a deep beam, supported at the ends only, to support the roof and floor in residential buildings.

Advantages of this concept are: Perimeter foundations may be eliminated; A more rigid, permanent structure is obtained; Effect of unstable soil is minimized; Realignment is simplified if settlement occurs; If basements are required, all interior supports can be eliminated; It is compatible with other subsystems; It can be accomplished within existing technology and building code requirements; and It is cost effective.

SITE SYSTEM	
3 **Topography**	USE OF SUBMARGINAL LANDS NOT SUITABLE FOR CONVENTIONAL FOUNDATIONS
BUILDING SYSTEMS	
11 **Housing Types**	APPLICABLE TO CONVENTIONAL BUILDING PLANS, LAYOUTS & CURRENTLY USED TECHNIQUES
12 **Unit Variations**	
13 **Design Selection**	
14 **State of Development**	BUILDING SYSTEM—DESIGN STAGE REQUIRING DEVELOPMENT
BUILDING SUBSYSTEMS	
16 **Structure**	DEVELOPMENT OF WOOD-STUD, FLANGE & WEB, DEEP, CONTINUOUS BEAM,
17 **Exterior Elements**	EXTERIOR & INTERIOR LOAD-BEARING WALLS; PLATFORM & BALLOON TYPES
19 **Foundations**	PILES FOR SUBMARGINAL LAND; WALLS TO BE END-SUPPORTED ON FOUNDATION CORNER POSTS
PRODUCTION	
24 **Offsite Production**	SYSTEMS STUDY OF COMPLETE MANUFACTURING PROCESS FOR WALLS; RECOMMEND MINIMUM FABRICATION SPECIFICATIONS & QUALITY CONTROL PROCEDURES
26 **Onsite Construction and Erection**	INVESTIGATION OF FACTORS RELATED TO ERECTION OF WALLS
27 **Labor**	MOSTLY MINIMUM SKILLED FOR WALL ASSEMBLY, FOR NAILING OR FOR COMBINATIONS OF NAILING, GLUE-NAILING & PRESSURE-GLUING
ECONOMICS	
30 **Construction Costs**	PRELIMINARY COST COMPARISONS INDICATE SAVINGS OF $.75 PER SQ. FT. OF LIVING AREA BY USING PROPOSED WALL SYSTEM
MANAGEMENT	
33 **Proposer Organization**	EDUCATIONAL FACILITY (RESEARCH INSTITUTE)
34 **Internal Functions**	CONCEPTUAL STUDY; ANALYSIS & TESTING; PROTOTYPE FIELD INSTALLATION; MANUFACTURING SYSTEMS ANALYSIS; DEVELOPMENT OF ENGINEERING AIDS
36 **Market Area**	NATIONAL, WITH MEMBER FIRMS OF WOOD COMPONENT FABRICATION INDUSTRY
GENERAL	
39 **Major Innovative Concepts**	ELIMINATION OF PERIMETER FOUNDATIONS & INTERIOR SUPPORTS FOR BASEMENTS; MORE RIGID & PERMANENT STRUCTURE; MINIMIZED EFFECT OF UNSTABLE SOILS; COST EFFECTIVENESS
40 **Codes**	CAN BE ACCOMPLISHED WITHIN EXISTENT BUILDING CODE REQUIREMENTS

IIT Research Institute (continued)

Subproposal No. 3

A research program to develop a better scientific understanding of the weatherability of exterior building materials is proposed. The study would: (1) identify weathering conditions, (2) demonstrate accelerated weatherability tests applicable to all building materials, and (3) compare weatherability of materials under simulated service conditions. The study should be of importance to producers and suppliers of building materials, as well as to architects and builders.

SITE SYSTEM	
4 Climate	PROPOSED STUDY WILL INCLUDE WEATHERABILITY WITH ALL TYPES OF CLIMATES
BUILDING SYSTEMS	
14 State of Development	SOME CURRENT TEST METHODS FOR SPECIFIC MATERIALS DEVELOPED; RESEARCH & TESTING REQUIRED TO DEVELOP UNIVERSAL METHOD FOR ALL MATERIALS
BUILDING SUBSYSTEMS	
16 Structure	PROPOSED STUDY WILL MAKE AVAILABLE A METHOD FOR PREDICTING DURABILITY & PERFORMANCE OF EXTERIOR BUILDING MATERIALS & COMBINATIONS
17 Exterior Elements	PROPOSED IDENTIFICATION OF WEATHERING CONDITIONS, DEVELOPMENT & CONDUCT OF ACCELERATED UNIVERSAL WEATHERING TESTS & COMPARISON OF TEST & FIELD RESULTS FOR EXTERIOR MATERIALS
ECONOMICS	
30 Construction Costs	PROPOSED PROGRAM TO INCLUDE COST EFFECTIVENESS ANALYSIS
32 Useful Life	PROPOSED STUDY TO ENABLE BETTER ESTIMATE BUILDING'S LIFE CYCLE
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY (RESEARCH INSTITUTE)
34 Internal Functions	ANALYSIS OF PROBLEM AREA; DEVELOPMENT OF LABORATORY TESTS; COMPARISON OF WEATHERABILITY UNDER LABORATORY & FIELD CONDITIONS
36 Market Area	PROPOSED PROGRAM TO PROVIDE CONSTRUCTION INDUSTRY & SUPPLIERS WITH A TESTING METHOD TO OBTAIN IMPROVED PRODUCT SPECIFICATIONS & NEW AREAS FOR PRODUCT IMPROVEMENT
GENERAL	
39 Major Innovative Concepts	A SCIENTIFIC BASIS FOR IMPROVED WEATHERABILITY IN EXTERIOR BUILDING MATERIALS

IIT Research Institute (contined

Subproposal No. 4

A system is proposed for lowering costs of building materials through providing esthetically attractive, high strength components made by conversion of municipal solid waste products. The system would convert the oxide fraction of such wastes into cost-effective, glass-ceramic products which would have potential application for aggregates, brick, tile, pipe, filter plates, sanitary ware, fiber, and foams. The organic, metallic, and water fractions of the wastes would also be recovered and sold, thus further lowering the costs of the building materials.

SITE SYSTEM	
1 Site Situation	APPLICABLE TO SITES WITHIN MUNICIPALITIES REQUIRING NEW & REBUILT HOUSING UNITS
10 Utilities	PROPOSED MUNICIPAL INCINERATION OF SOLID WASTES FOR RECOVERY & MANUFACTURE OF RESIDUE MATERIALS INTO BUILDING PRODUCTS
BUILDING SYSTEMS	
14 State of Development	FURTHER RESEARCH & DEVELOPMENT REQUIRED
BUILDING SUBSYSTEMS	
16 Structure 21 Plumbing 22 Electrical	POTENTIAL GLASS & GLASS-CERAMICS CONSTRUCTION PRODUCTS INCLUDING AGGREGATES, SHEET BRICK, TILE, PIPE, FIBER & FOAM FROM SANITARY PRODUCTS
PRODUCTION	
24 Offsite Production	BUILDING MATERIALS & COMPONENTS PRODUCED IN CITIES WITHIN A FEW MILES OF NEW HOUSING SITES; CONVENTIONAL FORMING METHODS
ECONOMICS	
30 Construction Costs	PROPOSED SYSTEM TO RESULT IN LOWERED HOUSING COSTS WITHOUT ADDITIONAL COST TO THE MUNICIPALITY
31 Financing Methods	MUNICIPAL
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY (RESEARCH INSTITUTE)
34 Internal Functions	MANAGEMENT; ECONOMIC SURVEY OF PRODUCTS; REFUSE MELTING EXPERIMENTS; GLASS-CERAMICS PROPERTIES CONTROL EXPERIMENTS; PRODUCT DEVELOPMENT
36 Market Area	RAW MATERIALS AVAILABLE & PROCESSED IN CITIES WITHIN A FEW MILES OF HOUSING SITES NEEDING BUILDING PRODUCTS
37 Delivery Rate	PRESENT INCINERATOR PLANT PROCESSES 625 TONS OF REFUSE PER DAY & COULD YIELD 40,000 TONS OF ORGANIC RESIDUE PER YEAR
GENERAL	
39 Major Innovative Concepts	WASTES CONVERTED TO USEFUL RESOURCES; ELIMINATION OF INCINERATION POLLUTION

Subproposal No. 5

Development of a structure which can be erected in one day to serve as an onsite utility building for contractors is the subject of this proposal. The factory-assembled unit is conceived of as having a folded plate roof, interconnected with exterior walls and columns, so that the complete structure can be folded up for transport. A typical unit, providing 2400 sq. ft. of column free area, with a 16 ft. ceiling, should have transport configuration of 8 ft. x 10 ft. x 40 ft.

The cost of such a structure would be recovered through savings accruing from both a reduction in pilferage and through its use during inclement weather for onsite work such as component subassembly and vehicle and equipment maintenance.

BUILDING SYSTEMS	
14 State of Development	BUILDING SYSTEM—DESIGN STAGE REQUIRING DEVELOPMENT
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection	DEVELOP A FOLDABLE, QUICKLY ERECTED & RELOCATABLE BUILDING FOR ONSITE STORAGE, ASSEMBLY & SERVICES; FOLDED-PLATE ROOF SYSTEM WITH ARTICULATED COLUMNS & EXTERIOR WALLS; WOOD PLUS METAL SKINNED SANDWICH PANELS; PACKAGED MECHANICAL & ELECTRICAL SYSTEMS & EQUIPMENT
ECONOMICS	
30 Construction Costs	COST OF BUILDING CAN BE RECOVERED BY SAVINGS ACCRUING FROM REDUCED PILFERAGE ON A $2 MILLION PROJECT; ADDITIONAL SAVINGS ANTICIPATED
MANAGEMENT	
33 Proposer Organization	EDUCATION FACILITY (RESEARCH INSTITUTE)
34 Internal Functions	DESIGN & COST EFFECTIVENESS STUDIES; CONSTRUCTION & EVALUATION OF MODEL PROTOTYPE STRUCTURE
36 Market Area	FOLDABLE BUILDING PACKAGES TO BE DESIGNED FOR TRANSPORT BY CONVENTIONAL METHODS
GENERAL	
39 Major Innovative Concepts	FOLDABLE, RELOCATABLE BUILDING CAPABLE OF ERECTION IN LESS THAN 8 HOURS

Subproposal No. 6

Use of the Christiansen filter-concept for effecting a heat-rejecting or utilizing surface in construction of residential developments, through which air conditioning or heating power loads would be reduced, is the subject of this proposed study. The concept involves use of glass laminates which possess solar reflectance capabilities that cause heat rejection during the warm summer months, and solar energy utilizing radiation-absorption during the cold months. The cost savings to occupants of buildings so equipped are expected to be substantial.

BUILDING SYSTEMS	
14 State of Development	RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 20 Comfort Systems	RESEARCH ON SOLAR ENERGY REFLECTANCE & ABSORPTION CONTROL TECHNIQUES TO REDUCE HEATING & AIR-CONDITIONING REQUIREMENTS; APPLICABLE TO WINDOW & ARCHITECTURAL-STRUCTURAL GLASS & TO COATINGS FOR ROOFS & EXTERIOR WALL SURFACES
ECONOMICS	
30 Construction Costs	PRINCIPAL GOAL TO CONTRIBUTE TO GREATLY REDUCED HEATING & AIR CONDITIONING COSTS
MANAGEMENT	
33 Proposer Organization	EDUCATION FACILITY (RESEARCH INSTITUTE)
34 Internal Functions	LITERATURE SURVEY; FEASIBILITY ANALYSIS; EXPERIMENTAL STUDIES & CONSTRUCTION; (POSSIBLE DEVELOPMENT & ENGINEERING ENVISIONED)
GENERAL	
39 Major Innovative Concepts	USE OF SCATTERING CHRISTIANSEN FILTER CONCEPT

IIT Research Institute (continued)

Subproposal No. 7

The object of this study is to demonstrate the feasibility of some utilities providing, or subsidizing the provision for, major appliances and electric wiring in households. A double effect is anticipated: greater profitability to the utilities so involved; and a cost reduction of 5 to 10 percent for low and moderate income housing owners and renters. The major appliances to be considered for such a scheme would be, among others, heaters, hot water sources, dryers, refrigerators, freezers, and security lights.

SITE SYSTEM	
1 **Site Situation**	PROPOSED DEMONSTRATION SITE TO BE SELECTED
9 **Community Involvement**	PROPOSED STUDY INCLUDES NATIONAL SURVEY FOR USER ACCEPTANCE
10 **Utilities**	APPLICABLE PRIMARILY TO ELECTRIC UTILITY CONSUMPTION, WITH PROVISION FOR POSSIBLE SWITCH OVER TO GAS OR OIL FUELS AT PEAK LOAD PERIODS
BUILDING SYSTEMS	
14 **State of Development**	FURTHER RESEARCH REQUIRED FOR DEMONSTRATION & IMPLEMENTATION
BUILDING SUBSYSTEMS	
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	PROPOSED ITEMS PROVIDED FREE TO USER INCLUDE: HEATING PLANT, AIR CONDITIONING, DRYER, HOT WATER HEATER, OUTSIDE LIGHTS, REFRIGERATOR, FREEZER, ELECTRIC BLANKETS, TOASTERS, IRONS, & DUAL GAS & ELECTRIC RANGE; SUBSIDIZED ITEMS INCLUDE WASHING MACHINE, DISHWASHER, WATER PUMP & MANY OTHER ITEMS
ECONOMICS	
30 **Construction Costs**	PROPOSED UTILITY COMPANY—PROVIDED, OR SUBSIDIZED, APPLIANCES & WIRING FOR LOW- & MODERATE-INCOME HOUSING; COST SAVING OF 5% TO 10
31 **Financing Methods**	UTILITY COMPANY
MANAGEMENT	
33 **Proposer Organization**	EDUCATIONAL FACILITY (RESEARCH INSTITUTE)
34 **Internal Functions**	RESEARCH & DOCUMENTATION NECESSARY TO EVALUATE APPLICATION OF CONCEPT
36 **Market Area** 37 **Delivery Rate**	APPLICABLE ON LOCAL, REGIONAL & NATIONAL BASIS; DEVELOP INDEX OF MARKETABILITY & RATE VARIOUS MARKET REGIONS; DEMONSTRATE FEASIBILITY OF INCREASING DEMAND & PRODUCTION OF HOUSING UNITS BY USE OF PROPOSED COST-CUTTING TECHNIQUE
38 **Consumer Protection**	STUDY TO INCLUDE EVALUATION OF USER CONSTRAINTS INCLUDING LENDING, LEASING, & TRANSFERRING OF COMPONENT PROPERTIES
GENERAL	
39 **Major Innovative Concepts**	COSTS CUTTING TECHNIQUE
40 **Codes**	PROPOSED STUDY WILL ANALYZE REGIONAL CONSTRAINTS, DETERMINE THEIR LIKELY EFFECTS & RECOMMEND SYSTEMS FOR EACH TYPE OF REGION

ISD, Incoporated

PROPOSER CONSORTIUM

ISD Incorporated, Interior Space Designer, Chicago, Illinois
Ewing Miller Associates, Architects-Engineers, Terre Haute, Indiana
Marsteller, Inc., Markey Survey, Chicago, Illinois

This is basically a behavioral research program. The proposer would establish and record needs, attitudes, preferences, and requirements through a controlled program yielding pertinent data for a typical community. Categorization of data would include socio-economic and age subgroups in defining design parameters relative to types and amounts of space, material, maintenance, interior-exterior features, and amenities. Parallel relationships would be established for community and subcommunity requirements.

An analysis of pertinent data would be conducted to determine space allocations for single- through multiple-dwelling unit structures, community facilities, and support systems. Additional determinations would be made concerning adjacency priorities, intra-community relationships for the foregoing elements and intercommunity relationships for outside support systems. The proposer, in addition, plans to coordinate marketing and promotional campaigns, concentrating effort towards overcoming any negative attitudes and to consumer-education in housing system application and features.

The study results would be translated to requirements instrumental in shaping housing and would be made available for distribution to industry.

SITE SYSTEM	
6 Nonresidential Functions	RESEARCH PROGRAM TO DETERMINE NECESSARY COMMUNITY FACILITIES FOR VARIOUS SOCIO-ECONOMIC GROUPS
9 Community Involvement	STUDY OF INTERCOMMUNITY AND INTRACOMMUNITY RELATIONSHIPS
BUILDING SYSTEMS	
11 Housing Types 12 Unit Variations 13 Design Selection	STUDY OF SPACE REQUIREMENTS IN SINGLE-FAMILY & MULTIFAMILY DWELLINGS
14 State of Development	RESEARCH PROPOSAL
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions 35 External Functions 36 Market Area	BEHAVIORAL RESEARCH PROGRAM TO ESTABLISH & RECORD NEEDS, ATTITUDES, PREFERENCES & REQUIREMENTS THROUGH A CONTROLLED PROGRAM YIELDING PERTINENT DATA FOR A TYPICAL COMMUNITY. COORDINATION OF MARKETING & PROMOTIONAL CAMPAIGNS TO EDUCATE CONSUMERS IN SYSTEM HOUSING FEATURES

Insulating Products

PROPOSER

Insulating Products, Inc., Las Vegas, Nevada

Research, development and design of building products made of, or incorporating, a proprietary insulation material manufactured from lightweight aluminum silicates, is proposed by the owner. It is claimed that extensive use of the material for varying applications throughout a typical home would result in lowering volume housing cost to $8.00 per sq. ft. (exclusive of land).

Some of the projected uses for the material include building blocks, panels, stucco for exteriors, plastering for interiors, insulation of pipes, acoustical treatment, and casting of monolithic roof slabs. The insulating product may be mixed with materials, cast in place, pumped into forms, or spray-applied. Advantages cited for the light-weight, white-colored product include: insulation against heat and cold, resistance to sound transmission, weather resistance, crack resistant (in plaster or stucco), fire resistance, and nonsolubility in water or ordinary acids.

The proposer mines, processes, and calcines the raw material which results in the end insulating product, and, after its further development, would make it available on a licensing basis to building contractors in any part of the country.

BUILDING SUBSYSTEMS	
16 **Structure**	RESEARCH, DEVELOPMENT & DESIGN OF: BUILDING BLOCKS, PANELS, STUCCO
17 **Exterior Eelements**	FOR EXTERIORS, CAST MONOLITHIC ROOF SLABS, PLASTERING, ACOUSTICAL
18 **Interior Elements**	TREATMENT, & INSULATION INCORPORATING ALUMINUM SILICATE MATERIALS
PRODUCTION	
24 **Offsite Production**	ALL PRODUCTS & COMPONENTS
27 **Labor**	UNSKILLED LABOR PROPOSED
29 **Community Involvement**	SELF-HELP CONSTRUCTION
ECONOMICS	
30 **Construction Costs**	$8.00 PER SQ. FT. PER UNIT SUGGESTED
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH, DEVELOPMENT & DESIGN OF BUILDING PRODUCTS INCORPORATING LIGHTWEIGHT INSULATING ALUMINUM SILICATES
35 **External Functions**	HOUSING SYSTEM DESIGN; CONSTRUCTION; CONTRACTING
36 **Market Area**	NATIONWIDE MARKETING PROPOSED

Insulation Systems, Inc.

PROPOSER

Insulation Systems, Inc., Santa Ana, California

The feasibility and producibility of a proprietary, chemically formed material in the manufacture of fire-resistant interior wall sections, ceiling panels, and doors is the subject for the proposed research and development program. The material, operating on the principle of reflection of infrared radiation when exposed to temperatures generated by fire, is expected to produce interior elements with at least one- and preferably four-hour fire resistant ratings, without damage to adjacent room, dwelling unit, or overhead structure.

Conditions expected to be met by the proposed components include the following: (1) Panel structure of standardized design with minimum number of variations, providing rooms of variable sizes with access door and closet openings; (2) Electrical and telephone outlets located in panels or joints; (3) Quick attachment of adjacent wall panels and at corners; (4) Either sound-absorbent or sound-retarding wall, door, and ceiling panels; (5) Walls capable of developing minimum bearing capacity of 300 lbs. per sq. in., with 600 lbs. per sq. in. or greater being desirable; (6) Wall panels capable of quick and rigid attachment to concrete floors.

The proposer expects to reduce the number of standard panel sizes to: 4-ft. x 8-ft. door and wall panels, 2-ft. x 8-ft. blank panels, and 4-ft. x 2-ft. and 2-ft. x 2-ft. ceiling panels. These standardized panel sizes will provide for room design of 2-ft. incremental size beginning at 4 ft. Panel surfaces will be finished in predetermined color and texture so that no further finishing will be required onsite.

Although the proposal embraces factory installation of electrical and communications systems in the panels, the thinness of the structures precludes installation of plumbing, heating and air conditioning service lines in the same manner. These requirements would be provided conventionally in floor and roof structures.

An anticipated byproduct would be the means to modify existing low-cost housing to provide fire-resistant structures by finishing existing surfaces with a coating of the same chemical formulation used in panel manufacture.

BUILDING SUBSYSTEMS	
18 **Interior Elements**	DEVELOPMENT OF FIRE-RESISTANT INTERIOR WALL & CEILING PANELS USING CHEMICALLY FORMED MATERIAL (PLASTONIUM)
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	PANEL THINNESS PRECLUDES FACTORY INSTALLATION OF MECHANICAL SYSTEMS IN PANELS
PRODUCTION	
24 **Offsite Production**	DEVELOPMENT OF FIRE-RESISTANT PREFINISHED PANELS
25 **Onsite Production**	COATING OF EXISTING INTERIOR SURFACES TO PROVIDE FIRE-RESISTANT STRUCTURE
26 **Onsite Construction and Erection**	INTERIOR PANELS DESIGNED FOR RAPID ASSEMBLY
ECONOMICS	
30 **Construction Costs**	COST OBJECTIVE: $7.00 PER LINEAR FOOT OF WALL SECTION; $0.40 PER SQ. FT. OF CEILING STRUCTURE
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions** 35 **External Functions**	RESEARCH & DEVELOPMENT TO UTILIZE CHEMICALLY-FORMED MATERIAL IN THE MANUFACTURE OF ONE- TO FOUR-HOUR FIRE RESISTANT INTERIOR WALL & CEILING PANELS & DOORS
GENERAL	
39 **Major Innovative Concepts**	CHEMICALLY-FORMED TO PROVIDE FIRE-RESISTANT COMPONENTS

Inter-American Academic Associates

PROPOSER CONSORTIUM

Inter-American Academic Associates, Inc., Dallas, Texas
Foresight Building Corporation, Dallas, Texas
Bishop College, Dallas, Texas
Dallas Baptist College, Dallas, Texas

This proposal propounds the necessity for a feasibility study of motivational factors underlying desirability of providing low-cost, high-quality housing for low-income groups. The reasons for the approach are based on the postulation that the true impact of motivational factors and cultural attitudes of low- and moderate-income groups ultimately determines receptivity or resistance to new housing areas. Without such study a program may achieve technological success while succumbing as a sociological failure.

The proposed study, to be conducted in the Dallas Standard metropolitan statistical area, in addition to determining motivational factors will be directed to determining the effective demand for modular type housing and to developing a comprehensive community action curriculum providing the fundamentals of constructive and responsible citizenship. The latter consideration is based on the theory that emphasis on technological skills and increasing income has obscured the necessity for learning the elementary art of living.

The results of this study in the selected area would be readily adaptable to other parts of the United States. The results of the study on desirability of modular type construction may prove appropriate for other regions. The citizenship curriculum developed should be of interest to other urban areas on a nationwide basis.

SITE SYSTEM	
9 **Community Involvement**	STUDY OF MOTIVATIONAL FACTORS & CULTURAL ATTITUDES OF LOW-INCOME GROUPS
BUILDING SYSTEMS	
15 **Community Involvement**	SURVEY OF EFFECTIVE DEMAND ON THE PART OF LOW-INCOME FAMILIES FOR MODULAR TYPE HOUSING
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions** 35 **External Functions**	STUDY OF MOTIVATIONAL FACTORS UNDERLYING DESIRABILITY OF PROVIDING LOW-COST, HIGH QUALITY HOUSING FOR LOW-INCOME GROUPS. DEVELOPMENT OF COMMUNITY ACTION CURRICULUM TO PROVIDE FUNDAMENTALS OF CONSTRUCTIVE & RESPONSIBLE CITIZENSHIP
36 **Market Area**	STUDY TO INVOLVE DALLAS, METROPOLITAN AREA, BUT WILL BE APPLICABLE NATIONWIDE

International Computer Graphics

PROPOSER

International Computer Graphics, Inc., Bryan, Texas

Application is proposed of numerous computer-oriented techniques to building systems – including production, scheduling of operations, cost analyses, and operations. It is pointed out that application of such computer systems has led to product innovation and more orderly and progressive approaches to problems, since it concentrates on bottlenecks and missing links in the total system activity.

However, since much of systems technology now available has been used to monitor very large operations, it is necessary to study, refine, test and evaluate available systems for application to housing work.

A number of systems already in use and fully developed for other uses are proposed for testing and evaluation. These include the following:

Systems Network Analysis Program (SNAP): This permits not only total evaluation of the cost of the system, but also simulation of innovations or changes and appraisal of these changes in terms of their worth.

Planning and Scheduling System (PASS): Developed specifically for operational managers, it utilizes techniques familiar to the construction industry such as PERT, and CPM as well as other methods, to produce a better activity schedule.

Run Out Costing (ROC): By this technique total and final cost of a program is projected at the earliest possible point in the project.

Activity Indicator Method (AIM): This technique is used to select and rank all activities in a network in terms of cruciality.

Accounting Reporting Management System (ARMS): Specifically developed to aid small business operations, this system produces final accounting and management reports from journal and checkbook entries.

Project Accounting Reporting System (PAR): Applicable to PERT networks the system gives cost information by activity, but does not require a large computer system to make it useful, permits ready comparison of bid or target cost of any element, and progressive or cumulative cost against that element.

PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection	EVALUATION OF: COMPUTERIZED PLANNING & SCHEDULING SYSTEM (PASS) USING CONCEPTS OF CPM, PERT & GANTT CHARTS FOR PLANNING & SCHEDULING PROGRAM; ACTIVITY INDICATOR METHOD (AIM) SYSTEM TO SELECT & RANK ACTIVITIES IN NETWORK BY PRIORITY
ECONOMICS	
30 Construction Costs 31 Financing Methods	EVALUATION OF: COMPUTERIZED PROJECT ACCOUNTING REPORT SYSTEM (PAR) USEFUL IN COST CONTROL BY ACTIVITY, PERMITS COMPARISON OF BID & PROGRESSIVE COST; RUN OUT COSTING SYSTEM (ROC) TO PROJECT TOTAL COST & COMPLETION SCHEDULE OF PROJECT, FACILITIES FINANCING; ACCOUNTING REPORTING MANAGEMENT SYSTEM (ARMS) SYSTEM UTILIZING ADVANCED MATHEMATICAL CONCEPTS TO PRODUCE ACCOUNTING & MANAGEMENT REPORTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	EVALUATION OF: COMPUTERIZED SYSTEMS FOR APPLICATION TO THE BUILDING PROCESSES
GENERAL	
39 Major Innovative Concepts	EVALUATION OF: COMPUTERIZED SYSTEMS NETWORK ANALYSIS PROGRAM (SNAP) TO EVALUATE IMPACT OF INNOVATION ON WHOLE SYSTEM

International Research and Technology

PROPOSER CONSORTIUM

International Research and Technology Corporation, Washington, D. C.
Kent Cooper and Associates, Architects, Washington, D. C.
Smith & Lee-Thorpe, Engineers, Rockville, Maryland
Montgomery County Housing Authority, Montgomery County, Maryland

The proponents of this program propose a research project to define attributes of new-form, low-cost, multiunit housing, to carry out technological, economic, and design studies, and to select a site on which such a complex might be erected. Optionally, the proposition is to design and make available a factory plan for manufacture of resultant units. A possible satellite project would be federal funding of a given housing authority to build a demonstration complex.

The proposal includes a study of family groupings and complex sizes which would result in optimums being established and made the basis for construction of a mathematical model. This model would treat costs as a function of location and institutional variables, number of units, and configuration.

Among the investigations proposed is the feasibility of joint design of a total utility complex. This investigation would include: the potential for refuse burning as an energy source; use of waste heat generated from power as a source for winter heat, for air-conditioning and year-round hot water; and the recycling of water in a complex to reduce dependence on costly regional distribution systems which use water as a waste carrier. Development of a utility system offering extreme flexibility of expansion, contraction, or rearrangement, and maintaining options to disconnect and reconnect to a central service depot, would be a program goal. Design of a fully integrated depot is also incorporated.

The study will also provide for examination of mortgage markets and development of possible innovations; packaging of supportive services, and investigation of prepayment for various service combinations.

The needs and preferences of tenants and neighborhoods explicitly would be introduced into the design process.

The proposer would expect to test and apply other methodological and design innovation in the actual selection of site, design, engineering, evaluation, and preparation of plans for a federally subsidized, low-income housing project.

SITE SYSTEM	
1 **Site Situation**	URBAN; SUBURBAN
5 **Planning Concepts**	ANALYSIS WITH STRESS ON GEOMETRY, FLOW PATTERNS, INTERRELATIONSHIP BETWEEN ACTIVITY TYPES, E.G. PRIVACY VS. "OPENNESS"
6 **Nonresidential Functions**	STUDY OF CENTRAL SERVICES FEASIBILITY FOR CHILD CARE, LAUNDRY, HOUSECLEANING, PAINTING, REPAIRS, ETC.
8 **Site Planning Services**	PLANNING USING TOTAL SYSTEMS CONCEPT
9 **Community Involvement**	TENANT SURVEY TO DETERMINE NEEDS; EQUITY PARTICIPATION BY TENANTS IN CENTRAL SERVICES
10 **Utilities**	DEVELOPMENT OF DESIGN FOR CENTRAL UTILITIES DEPOT FOR HOUSING COMPLEX OF OPTIMAL SIZE
BUILDING SYSTEMS	
14 **State of Development**	SYSTEMS CONCEPT IN DESIGN STAGE; FURTHER RESEARCH & DEVELOPMENT REQUIRED
15 **Community Involvement**	TENANT SURVEY TO DETERMINE HOUSING DEFICIENCIES & PRIORITIES
BUILDING SUBSYSTEMS	
19 **Foundations** 20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	DESIGN OF CENTRAL UTILITIES DEPOT FOR HOUSING COMPLEX CONNECTING HOUSING UNITS; SURVEY OF EXISTING TOTAL ENERGY SYSTEMS, COMPACT SEWAGE TREATMENT & WATER RECLAMATION; MECHANICAL CORE; STUDY OF THERMAL INSULATION & THERMAL ENERGY STORAGE
PRODUCTION	
24 **Offsite Production**	USE OF HOUSING SYSTEMS
ECONOMICS	
30 **Construction Costs** 31 **Financing Methods**	OPTIMAL AGGREGATION NUMBER OF HOUSING UNITS' UTILITY SYSTEMS TO REDUCE COSTS; AGGREGATION FOR PACKAGING OF PROFESSIONAL SERVICES TO REDUCE COSTS STUDY OF MORTGAGE MARKET & OPPORTUNITIES FOR INNOVATIONS
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	TECHNOLOGICAL, ECONOMIC, & DESIGN STUDIES OF A NEW-SYSTEMS FORM OF LOW-COST, MULTIUNIT HOUSING & SELECTION OF APPROPRIATE SITE
36 **Market Area**	MONTGOMERY COUNTY, MARYLAND; STUDY TO BE APPLICABLE NATIONWIDE

International Technology

PROPOSER

International Technology, Inc., Subsidiary of Electronic Modules Corporation, Baltimore, Maryland

A completely new power distribution system for residential construction is proposed using a highly conductive elastomeric material which is easy to install during factory fabrication of housing components. Conductive strips circle a room at baseboard or chair-rail height, serving both as electrical conductor and outlet. The strip is an infinite connector, allowing electrical taps to be made at any point. The system holds promise of being safe in use because the conductive strips have no surface conductivity and are waterproof and abrasion resistant. The strip material is pliable, which greatly facilitates installation.

Electrical connections are made with a special plug device. This is conventional in size and appearance but employs two retractable pins. When not in use, pins are retracted into the plug body. In making connections, the plug is placed against the strip and pressure is applied to the rear activating the connecting pins which insert into the strip, making electrical contact at the strip's core.

Problems of code compliance and union acceptance have prevented widespread marketing of the product and have kept the system from further development.

BUILDING SYSTEMS	
14 **State of Development**	DESIGN STAGE; FURTHER RESEARCH & DEVELOPMENT REQUIRED
BUILDING SUBSYSTEMS	
22 **Electrical**	SYSTEM OF CONDUCTIVE ELASTOMERIC STRIPS FOR PERIMETER BASEBOARD LEVEL OR CHAIRRAIL HEIGHT POWER DISTRIBUTION
PRODUCTION	
24 **Offsite Production**	ELECTRICAL DISTRIBUTION SYSTEM FOR INSTALLATION AT MODULE/COMPONENT FACTORY
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEVELOPMENT OF ELASTOMERIC STRIP ELECTRIC DISTRIBUTION SYSTEM; DESIGN & TESTING OF LOW- & HIGH-POWER CIRCUITS
35 **External Functions**	FACILITIES & STAFF OF PARENT COMPANY WILL BE UTILIZED
GENERAL	
39 **Major Innovative Concepts**	CONDUCTIVE ELASTOMERIC STRIP SYSTEM FOR ELECTRICAL POWER DISTRIBUTION
40 **Codes**	LOCAL CODE PROBLEMS REMAIN TO BE RESOLVED

Inter Technology

PROPOSER

InterTechnology Corporation, Warrenton, Virginia

AFFILIATES

McKee-Berger-Mansueto, Inc., Cost Estimating; Istvan Botond, AIA, Architect

Development of an automatic means of evaluating the effect of innovative building techniques on housing costs is proposed. The computer-based system, for example, could be used to determine the reduction in housing unit cost (dollars per sq. ft.) due to substitution of a completely new material for a conventional material, or due to replacement of an older technique by a new technique, by providing a catalog of influence coefficients. That is, the printout would list exact pluses or minuses in unit cost changes due to the proposed new material or technique in relation to all other elements in the building and condense them to a one difference figure.

Probably the greatest advantage the proposed system offers the building industry is that it would make possible automatic, unbiased assessment of the value of committing scarce research and development funds to support proposed new techniques, materials, fastening, emplacements, aggregations and other innovations.

SITE SYSTEM	
4 Climate 5 Planning Concepts	DEVELOPMENT OF A SYSTEM WHICH MAKES POSSIBLE DESIGN OF THE LOWEST COST HOUSE FOR GIVEN TECHNOLOGY, CLIMATE & CODES, AND MEANS TO PERMIT BUILDING OF SATISFACTORY, DURABLE, PLEASING, & EVEN DESIRABLE HOUSING AT LOWEST COST
BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE REQUIRING RESEARCH, DESIGN, DEVELOPMENT & TESTING
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	QUANTITATIVE DEFINITION OF PHYSICAL CHARACTERISTICS OF THE STRUCTURAL MATERIALS & STRUCTURAL DESIGN REQUIREMENTS
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection 27 Labor	DETERMINATION OF EMPLACING & FINISHING REQUIREMENTS
ECONOMICS	
30 Construction Costs	DEVELOPMENT OF LAID DOWN & EMPLACED BUILDING MATERIAL COSTS, & COSTS OF MAINTENANCE & PROTECTION; DEVELOP AUTOMATIC MEANS OF EVALUATING THE EFFECT OF INNOVATIVE CONCEPTS ON THE UNIT COSTS OF HOUSING
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	COMPUTER PROGRAM; ECONOMICS; ENGINEERING
35 External Functions	ARCHITECTURAL & PLANNING; MATERIALS COST & ENGINEERING DATA
GENERAL	
39 Major Innovative Concepts	DEVELOPMENT OF MEANS TO IDENTIFY & IMPLEMENT MAJOR INNOVATIONS IN HOUSING PRODUCTION
40 Codes	MEASURE IMPACT OF NATIONAL BUILDING CODES, RANGING FROM NO CODE REQUIREMENTS TO MOST DEMANDING CODES IN FORCE

InterTechnology

PROPOSER

Intertechnology Corporation, Warrenton, Virginia

A year-long technical-economic investigation of a community based on the condominium service system concept is proposed. The study would be more specifically addressed to heat energy, work energy, and mass reuse (water and by products) so that the community would be virtually self-sustaining. The program visualizes elimination of capital investment or maintenance-operation cost defrayal by tax authorities. Benefits include reduced homeowner's cost, reduced air, land and water pollution, and an improved environment. The system can be located anywhere regardless of existing facilities and service systems. Important end-products would be higher quality housing, highly reduced abuse of the total environment, reduction in need for tax funds, and a reduction in usage rate of natural resources.

The proposer intends to demonstrate the advantage of the closed loop system of waste disposal. The system carries the advantage of water recovery for reuse, the conversion of combustion heat from sewage gas and sludge to provide power for heating and cooling facilities, thus reducing capital and operating costs.

The program would include architectural-planning-engineering and esthetic aspects, including conceptual design of site developments. It relates to the total environment, prototype models of housing units and their variations and preliminary design of various service buildings required by the overall studies. Attendant graphics and visual material would be supplied.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL. REMOTE SITES COULD BE UTILIZED WITH LITTLE REGARD TO AVAILABILITY OF MUNICIPAL UTILITIES
5 Planning Concepts	EMPHASIS ON TOTAL ENVIRONMENT CONCEPT; COORDINATION OF ALL SITE REQUIREMENTS
10 Utilities	RESEARCH & DEVELOPMENT OF SELF-SUSTAINING UTILITIES SERVICE SYSTEM, INDEPENDENT OF MUNICIPAL UTILITIES
BUILDING SYSTEMS	
14 State of Development	RELATED OPEN LOOP UTILITY SYSTEMS COMPLETELY DESIGNED; CLOSED LOOP SYSTEMS IN DESIGN STAGE
BUILDING SUBSYSTEMS	
21 Plumbing 22 Electrical 23 Furnishings	WASTE HEAT FROM SOLID WASTE INCINERATION USED TO RECOVER WATER FROM SEWAGE EFFLUENT. SEWAGE FLOW SYSTEMS COLLECTS HEAT IN SUMMER & PROVIDES HEAT IN WINTER THROUGH COMBUSTION OF SEWAGE GAS. COMBUSTION HEAT FROM SEWAGE GAS & SOLID WASTE INCINERATION USED TO GENERATE ELECTRICITY. DILUTE SEWAGE EFFLUENT (AFTER GAS COMBUSTION, DESALINIZATION, AND/OR REVERSE OSMOSIS) NEED NOT BE PUMPED GREAT DISTANCES FOR DISPOSAL
ECONOMICS	
30 Construction Costs	ANTICIPATED SAVINGS OF FUEL, WATER, ELECTRICITY, & MUNICIPAL CAPITAL OUTLAY FOR UTILITIES (REDUCING TAXES), & IN CONSUMER UTILITY COSTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	INTEGRATE HEATING, WATER, SEWAGE, SOLID WASTE, & ELECTRICAL SYSTEMS TO REDUCE POLLUTION, WASTES, & COSTS
GENERAL	
39 Major Innovative Concepts	"CLOSED LOOP" UTILITY-SEWAGE-SOLID WASTE SYSTEMS

InterTechnology

PROPOSER

InterTechnology Corporation, Warrenton, Virginia

This program is for a precise systematic analysis of condominium heating, ventilating, and air conditioning, water supply, and sewage treatment systems for low-cost homes, at a specific site in the Washington suburban area. In addition there would be a study of the additional possible benefits of fuel and water conservation, and reduced air, water, and land pollution.

Earlier studies by the proposer indicate condominium-owned systems result in a savings of 50 percent over the cost of individual systems. Sewage system savings are of similar attraction.

Economic gain is not the only advantage to the approach: It requires no new construction techniques; locates anywhere; conserves capital, resources, land, materials, and water; helps solve common municipal problems such as location of disposal facilities and rights-of-way condemnation; reduces air, land, and water pollution; affords greenbelts anywhere; provides more house for less money, calculated over the lifetime, or the same house at lower life-cycle cost; and air-conditioning is virtually free. Briefly, the concept provides innovation without concomitant technological revolution.

The proposed study would concern itself with architectural-planning-engineering and esthetic aspects of site development, prototype models, and architectural design and would provide consultation in design adaptation as optimization constraints require. Graphics and visual material for illustration and highlighting of parts of the studies would be produced.

SITE SYSTEM 1 **Site Situation** 2 **Density Range** 3 **Topography** 4 **Climate** 5 **Planning Concepts** 6 **Nonresidential Functions** 8 **Site Planning Services** 10 **Utilities**	PROPOSED ANALYSIS OF CONDOMINUM OWNED & OPERATED HVAC, WATER SUPPLY & SEWAGE SYSTEMS FOR A HOUSING DEVELOPMENT, USING SUBURBAN WASHINGTON, D. C. SITE. STUDY TO INCLUDE: CONCEPTUAL SITE DESIGN; SITE ENGINEERING REQUIREMENTS; DESIGN AND/OR SELECTION, & EVALUATION OF SUITABLE PROTOTYPE HOUSING UNITS; PRELIMINARY ARCHITECTURAL DESIGN OF REQUIRED SERVICE BUILDINGS; DEVELOPMENT OF COMPUTER PROGRAM FOR ANALYSIS OF SPECIFIC SITES. STUDY OF POSSIBLE BENEFITS IN FUEL & WATER CONSERVATION & REDUCED AIR, WATER & LAND POLLUTION. COMMUNITIES CAN BE LOCATED WITHOUT REGARD TO EXISTING WATER, SEWER OR OTHER MUNICIPAL UTILITY EXCEPT POSSIBLY ELECTRICITY
BUILDING SYSTEMS 11 **Housing Types** 12 **Unit Variations**	APPLICABLE TO CONVENTIONAL & NEW HOUSING TYPES; VARIOUS SIZES & QUALITIES TO BE STUDIED
14 **State of Development**	BROAD PARAMETRIC STUDY OF CONDOMINIUM HVAC & SEWAGE SYSTEMS COMPLETED; FURTHER RESEARCH REQUIRED FOR SPECIFIC SITE SITUATION
BUILDING SUBSYSTEMS 16 **Structure**	
ECONOMICS 30 **Construction Costs**	COST ANALYSIS; ANTICIPATED HOMEOWNER & MUNICIPAL BENEFITS; AIR-CONDITIONING FUNCTION VIRTUALLY FREE
MANAGEMENT 33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	SITE PLANNING & DESIGN; PROTOTYPE HOUSING & SERVICE BUILDING DESIGN; ENGINEERING; COMPUTER PROGRAM; REPORT
GENERAL 40 **Codes**	ADAPTABLE TO ALL NATIONAL MODEL CODES

James River Building Supply

PROPOSER

James River Building Supply Company, Sandston, Virginia

Single-family housing units of wood-framed construction, but furnished for site erection in either a panelized package or as modules, is proposed. The houses are suitable for single-family attached and multifamily low-rise construction, but more typically are produced in conventionally styled, gabled-roof, detached configuration.

Construction of the two versions of the system is essentially the same, the difference being mainly in sequence of operations. For the panel system, the wall elements are erected on the site and the shell enclosed by placement of wood roof-ceiling trusses, covered with plywood roof decking. For the module system, these same wall panels are assembled at the factory into half-dwelling-sized modules, with each module topped by its respective half of the truss roof-ceiling subsystem. One of the modules embodies all the mechanical and plumbing subsystems, the other consists of living and bedroom areas.

Exterior finish of the houses may be either hardboard siding or brick, with windows and doors being wood for the panelized system and sliding aluminum for the module system. Interior partitions for both systems are nonbearing, of 2-in. x 4-in. stud construction, and may be shifted or removed at any time. Interior finish for the houses will be gypsum board walls and ceiling. Floors will be sealed, varnished oak, with vinyl asbestos tile in kitchen and bath areas.

The low-cost structure is said to meet or exceed all applicable codes, although the modular version actually has not done so, because building inspectors where the system presently is being manufactured and marketed have been unwilling to make in-plant inspection in relation to installation of subsystems.

SITE SYSTEM	
1 Site Situation	URBAN, SUBURBAN, RURAL
3 Topography	ADAPATABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	3 BEDROOM
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAME CONSTRUCTION FURNISHED AS PANELS OR MODULES
17 Exterior Elements	HARDBOARD OR BRICK SIDING
18 Interior Elements	GYPSUM BOARD PARTITIONS, OAK OR VINYL ASBESTOS TILE FLOORING
20 Comfort Systems	FACTORY FABRICATED UNIT
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	MODULE SYSTEM OF PANELS
26 Onsite Construction and Erection	PANELS ERECTED ONSITE TO ENCLOSE SHELL OR PLACING OF MODULE
ECONOMICS	
30 Construction Costs	$12,000 PER UNIT
MANAGEMENT	
33 Proposer Organization	COMPANY
34 Internal Functions	DEVELOPMENT OF PANEL & MODULE SYSTEM

Ervin A. Jaster

PROPOSER

Ervin A. Jaster, General Contractor, Falls Church, Virginia

A system of site-casting an entire single-family dwelling on its end, then tipping it into place without elaborate foundation work, is proposed for study.

The proposal envisions the use of lightweight concrete, or possibly a similar cementitous material which might cut the cost of the walls considerably below that of concrete. Under the proposal, an endwall would be carefully cast on the ground—possibly using a ground-built form containing special liners or material for architectural appearance; then slip-forms could be erected (also with special liners if desired), in which the entire remainder of the dwelling (including floors and partitions for a one-story structure) could be formed. Reinforcing, mechanical, plumbing and electrical systems, and provisions for knock-out or blanked panels for windows, doors and other openings could be made during this casting operation.

When the entire house had been cast, with the exception of the endwall at the top, the form could be lifted and moved to the next casting stage, while the final wall is formed. The resulting structure would then be tipped and brought to rest on the ground in its final position. The only construction—beyond finishing and decorating—that would then be required would be the bathroom and wet areas, plus final installation of heating-cooling equipment.

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED
14 State of Development	BUILDING SYSTEM IN DESIGN STAGE REQUIRING FURTHER RESEARCH & TESTING

BUILDING SUBSYSTEMS

16 Structure	MONOLITHIC MODULE CONSTRUCTION OF LIGHTWEIGHT CONCRETE OR SIMILAR MATERIAL
19 Foundations	NOT REQUIRED; "WEARING SURFACE" SUBSTITUTED

PRODUCTION

25 Onsite Production	SLIP-FORM TECHNIQUE; ONSITE CASTING OF COMPLETE UNIT
26 Onsite Construction and Erection	TILTING BUILDING INTO POSITION; INSTALLATION OF UTILITIES
29 Community Involvement	SELF-HELP COMPLETION OF INTERIOR-PARTITIONS & FINISHING

ECONOMICS

30 Construction Costs	\$2.50 TO \$4.25 PER SQ. FT.

MANAGEMENT

33 Proposer Organization	PRIVATE COMPANY; OWNER WISHES TO FORM CONSORTIUM FOR EXECUTION OF PROPOSAL
34 Internal Functions	CENTRAL CONTROL
37 Delivery Rate	COMPLETE UNIT SHELL IN 48 HOURS

GENERAL

39 Major Innovative Concepts	SITE CASTING OF BUILDING UNIT

Kaykor Products

PROPOSER

Kaykor Products Corporation (Division of Continental Oil Co.), Yardville, New Jersey

Research and development of plastic doors and wall panels which would be competitive with conventional materials is proposed. Made by welding polyvinyl chloride sheets with extruded supports of the same material to a core of polystyrene foam, the prefabricated modular components offer many advantages, provided their cost can be reduced. The doors, typically 3 ft. x 7 ft. 2 in. x 1 3/4 in., now cost $20.00; a reduction to $15.00 is sought. The 4 ft. x 8 ft. x 1 1/2 in. wall panels cost $17.00 presently, a reduction to $12.00 is desired.

Among the advantages claimed for the plastic products (and motivating the request for the proposed research) are: fire resistance; insulative properties; high strength; attractiveness, a variety of colors and design may be furnished; ease of cleaning and maintenance, painting is never required; long life; and ease of installation, a panel weighs no more than 50 lbs.

In addition to cost reduction, the research is expected to produce improved production processes and to develop techniques and hardware needed for assembly and installation of the doors and panels.

BUILDING SUBSYSTEMS
18 Interior Elements — RESEARCH & DEVELOPMENT OF FIRE RESISTANT POLYVINYL CHLORIDE/POLYSTYRENE FOAM INTERIOR PANELS & DOORS

PRODUCTION
24 Offsite Production — RESEARCH TO IMPROVE PRODUCTION PROCESSES FOR PLASTIC DOORS & PANELS; REDUCTION OF RAW MATERIALS AND SCRAP.

ECONOMICS
30 Construction Costs — $12.00 FOR INTERIOR PLASTIC PANELS; (4 FT. X 8 FT. X 1.5 IN.); $15.00 PER INTERIOR DOOR (3 FT. X 7 FT. X 2 IN.)
32 Useful Life — GREATER THAN 20 YEARS

MANAGEMENT
33 Proposer Organization — CORPORATION
34 Internal Functions — FURTHER DEVELOPMENT OF PLASTIC DOORS & PANELS, INSTALLATION TECHNIQUES & HARDWARE
37 Delivery Rate — OBJECTIVE TO INCREASE PRODUCTION RATE

Kaykor Products

PROPOSER

Kaykor, Division of Continental Oil Company, Yardville, New Jersey

Research and development of a prefinished, low-cost, nonbearing, light-weight, plastic building wall panel, low in heat conductivity and non-flammable, is proposed by this organization. Envisioned as a result is a low-cost versatile panel, 4 ft. x 8 ft. x 1 5/8 in., weighing no more than 60 lb.

The proposed study would develop improved formulas for the foam panel (a high-frequency, heat-treated expansion product, with inert mineral particles dispersed throughout polystyrene), would develop improved molding techniques, and would include thorough testing in accordance with ASTM E-119 and other applicable specifications.

The advantages which are expected to accrue, should such a panel be developed, are: flame-resistant and insulative qualities; relatively high strength characteristics, permitting the panel's use for interior walls or, with suitable structural support, for exterior walls; attractive appearance with the use of polyvinyl chloride resins permitting many colors, patterns, and textures, on one or both sides of the panel; ease of cleaning and maintenance, the plastic facing sheet being washable with soap and water and never requiring painting or other attention; and low installation costs, the panels being dimensionally uniform, the result of being cast in a metal mold.

BUILDING SUBSYSTEMS
16 Structure — DEVELOPMENT OF NONBEARING LIGHTWEIGHT PLASTIC WALL PANEL, POSSESSING SUCH CHARACTERISTICS AS NONFLAMMABILITY, HEAT RESISTANCE, HIGH STRENGTH, EXCELLENT INSULATION PROPERTIES

PRODUCTION
24 Offsite Production — DEVELOPMENT OF IMPROVED FORMULAS & MOLDING TECHNIQUES FOR POLYSTYRENE PANEL

ECONOMICS
30 Construction Costs — ESTIMATED $50.00 (4-FT. X 8-FT. X 1 5/8-IN. PANEL)

MANAGEMENT
33 Proposer Organization — CORPORATION
34 Internal Functions — RESEARCH & DEVELOPMENT OF POLYSTYRENE PANELS

Kemaxco, Inc.

PROPOSER

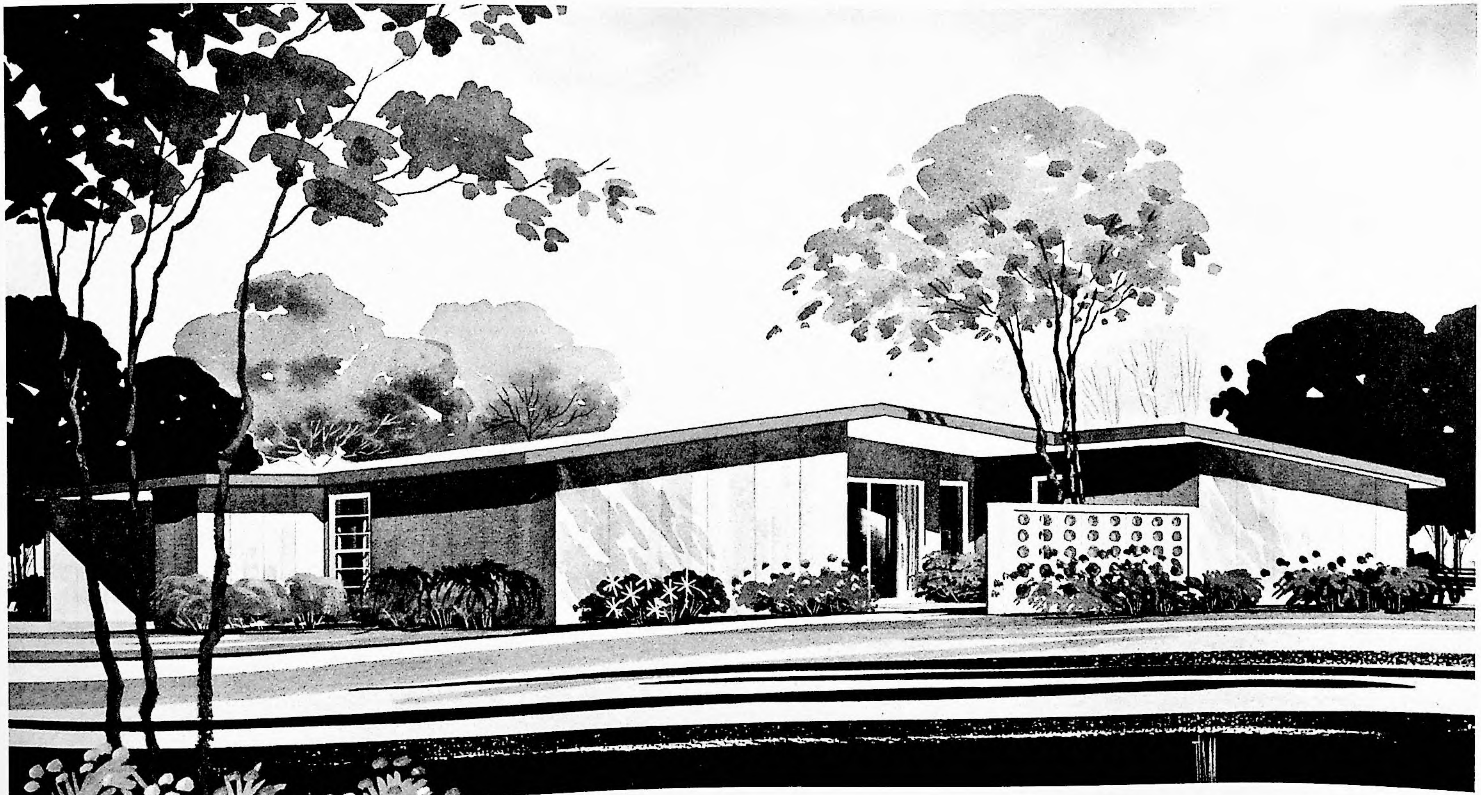
Kemaxco, Inc., Houston, Texas

A three-part proposal is offered for adapting an existing precast concrete panel system to national housing needs. The system has been used in locations in Mexico and Vietnam and is being adapted to single-family attached and detached and multifamily low-rise applications in the United States.

The basic system consists of a series of machine-cast concrete panels of standard and special sizes: 4-in. thick panels are used for exterior bearing walls, some interior partitions and filler members; similar panels, 2-in. thick for interior partitions and nonbearing areas; roof members are also of similar panel construction to form pitched or flat designs to suit desire and climate. In addition, the proposer will conduct further tests with various types of solar panels for use in areas of exterior walls, roofs, grilles, security guards, and safety railings. Other precast items are planned for such uses as stair treads, base supports, and railings. Special units are machine cast for forming corners and wall intersections.

The panels may be joined over conventional slab or other foundations by projecting dowels and bolts, as in conventional construction, if so specified. However, it is recommended that wall panels will be set on a 2-in. x 4-in. brick ledge cast in the concrete foundation; Epoxy adhesive is spread and the base splines are aligned and anchored with power driven studs. Kerfs at the bottom and sides of a corner wall panel are filled with epoxy adhesive and the unit is set on the base spline, aligned and braced. Metal splines are inserted in the vertical kerfs and contiguous wall panels are erected in similar manner. This method is used for single-family or low-rise structures; for higher-rise buildings they are placed on precast slab floors using the lift-slab techniques.

Interiors may be painted or plastered. Exterior walls (which can be constructed as cavity walls for insulation



Kemaxco, Inc. (continued)

and moisture barriers) may be of exposed aggregate, simulated brick or stone, or various other finishes to conform with the desires of the architect or owner.

The concept envisions a central plant, with a shipping radius of 300 miles, producing the standard items, and stockpiling them for later shipment upon order by local contractors or owners. Use of the slabs for roofing helps eliminate other supporting members, results in a fire-resistant structure, and facilitates quick onsite erection.

Rough plumbing and wiring (plumbing would be of plastic pipe, wherever admissable) would be installed in appropriate wall panels at the factory. Conventional heating/cooling systems are possible.

SITE SYSTEM	
1 Site Situation	5 DWELLING UNITS PER ACRE
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	CLUSTER; VILLAGE GROUPINGS, COMMON OPEN SPACES
6 Nonresidential Functions	GOLF COURSE; PARK; UNIVERSITY; CIVIC CENTER; SHOPPING CENTER; ZOO
7 Circulation	HIGHWAYS BY-PASS SITE; MASS TRANSPORTATION SYSTEM SERVICES; CUL-DE-SACS
8 Site Planning Services	
9 Community Involvement	INFORMAL MEETINGS WITH TOWN OFFICIALS & SUBSEQUENT PUBLIC HEARINGS
10 Utilities	
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	DEVELOPMENT & TESTING REQUIRED
15 Community Involvement	INFORMAL MEETINGS WITH TOWN OFFICIALS & SUBSEQUENT PUBLIC HEARINGS
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE WALL, FLOOR & ROOF PANELS; DOWEL/EPOXY OR METAL SPLINE CONNECTIONS
17 Exterior Elements	CONCRETE PANELS, BALCONY RAILS, SOLAR PANELS, GRILLES
18 Interior Elements	CONCRETE STAIR TREADS; INTERIOR PARTITIONS; FILLER MEMBERS
19 Foundations	CONVENTIONAL; SLAB ON BANK SAND
20 Comfort Systems	GAS FORCED WARM AIR HEATING & COOLING
21 Plumbing	CONCRETE DRAINAGE SYSTEM; COPPER & IRON PIPES; PLASTIC WHERE PERMISSABLE
22 Electrical	COPPER WIRING IN CONDUIT; CHASES IN WALLS
23 Furnishings	
PRODUCTION	
24 Offsite Production	PANELS; SPECIAL COMPONENTS; PARTIAL INTEGRATION OF UTILITY SYSTEMS
25 Onsite Production	OPTIONAL PRODUCTION OF PANELS & OTHER BASIC COMPONENTS
26 Onsite Construction and Erection	FOUNDATION; JOINING OF COMPONENTS; INSTALLATION OF UTILITIES
27 Labor	
28 Labor Training Programs	THROUGH MANUALS, APPRENTICE PROGRAM, & FRANCHISE TRAINING PERIOD
29 Community Involvement	
ECONOMICS	
30 Construction Costs	$6,885 PER 1,274 SQ. FT. UNIT ($7.32 PER SQ. FT.)
31 Financing Methods	CONVENTIONAL
32 Useful Life	IN EXCESS OF 50 YEARS USEFUL LIFE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN; PRODUCTION; CONSTRUCTION; FRANCHISING
35 External Functions	DISTRIBUTION OF COMPONENTS & CONSTRUCTION THROUGH FRANCHISES
36 Market Area	NATIONWIDE; 300-MILE RADIUS OF PLANTS
37 Delivery Rate	588,800 SQ. FT. HOLLOW CORE PANELS; PLUS REQUIRED COMPONENTS PER 221 DAY PERIOD
38 Consumer Protection	
GENERAL	
39 Major Innovative Concepts	
40 Codes	UNIFORM BUILDING CODE; SOUTHERN STANDARD BUILDING CODE; NATIONAL BUILDING CODES

Kurtz-Gery

PROPOSER

Kurtz-Gery Corporation, Reading, Pennsylvania

Brick-panel bearing wall sections, reinforced concrete floor slabs and roof components comprise the structural shell of this proposed residential housing system.

The assembly-line produced panels consist of a single course of brick, bonded with a specially formulated mortar, reinforced with steel rods, and backed with 1 1/2 in. of rigid urethane foam, to which is adhered gypsum board or interior paneling. The resultant structural entity is durable enough to be handled, to be transported to the job, crane-erected, and to carry the dead load of concrete floor slabs and roof system, plus snow and wind loadings.

Onsite, the panels, which are manufactured in multiples of the system's 4-ft. design module, are intersperced with prefabricated window and door panels and are set in place around the perimeter of the foundations, tied by steel anchors below, and a top wall plate above. The roof system, (and floor slab, in the case of more than one story) is positioned and fastened and the house is essentially closed-in. In addition to the economies of manufacture and erection claimed for the system, its potential for rapid enclosure serves as a deterrent to vandalism.

All other components of the structure also are factory manufactured or preassembled, with the exception of the conventionally designed and placed concrete foundations. Partitions are of wood stud construction sheathed with gypsum board; an alternate roofing system to the concrete slab with built up roofing may be wood truss, plywood deck with shingle finish. The kitchen-bathroom core unit is completely unitized, prewired and prepiped, ready for installation with the shell of the house, needing only connection. Stairs and closets are packaged and installed, prefinished. Interior finishing consists of painting (which may be by self-help) of walls and ceiling, and installation of wall-to-wall carpeting.

Production on a regularly scheduled basis of the brick panel units, the window and door panels, and the core units, is under way in an existing plant, with several additional plants being planned. The proposer is actively engaged in a marketing program to sell the concept to house builders. Shipments of the brick panels are economically feasible within the same limitations as shipment of loose brick.

SITE SYSTEM	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY AND SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	3 BEDROOM
14 State of Development	PRODUCTION PLANT & BUILDING SYSTEM DEVELOPED; PROTOTYPE CONSTRUCTED
BUILDING SUBSYSTEMS	
16 Structure	BRICK BEARING WALL PANELS; PRESTRESSED CONCRETE FLOOR & ROOF SLAB (OR WOOD TRUSS)
17 Exterior Elements	BUILT-UP ROOFING OVER CONCRETE, PLYWOOD & SHINGLE ON TRUSS
18 Interior Elements	WOOD STUD GYPSUM BOARD PARTITIONS; WALL-TO-WALL CARPETING;
19 Foundations	CONVENTIONAL; DESIGNED TO SITE CONDITIONS;
20 Comfort Systems	ELECTRIC FORCED AIR
21 Plumbing	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM; PLASTIC PIPE WHERE APPROPRIATE
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM
PRODUCTION	
24 Offsite Production	BRICK PANELS; FLOOR & ROOF SLABS; ROOF TRUSSES; KITCHEN/BATH CORE UNITS
26 Onsite Construction and Erection	FOUNDATIONS; ERECTION OF COMPONENTS; UTILITY HOOKUPS
27 Labor	UNSKILLED AT FACTORY; SKILLED FOR ONSITE CONNECTIONS
28 Labor Training Programs	ON-THE-JOB TRAINING FOR FACTORY
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$15,015 PER DWELLING UNIT ($14.30 PER SQ. FT.) 1,000 UNITS PER YEAR (BEST RATE)
31 Financing Methods	CONVENTIONAL
32 Useful Life	FOUNDATIONS-100 YEARS; ROOFING-20 YEARS; WINDOWS AND DOORS-75 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL; MANAGEMENT; DEVELOPMENT; MANUFACTURING
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
GENERAL	
39 Major Innovative Concepts	PREFABRICATED BRICK BEARING WALL PANELS

Kurtz-Gery

PROPOSER

Kurtz-Gery Corporation, Reading, Pennsylvania

AFFILIATES

Kurtz Precast Corporation; Kurtz Brothers Concrete, Inc.; Kurtz Materials Corporation

A prefabricated masonry and concrete structure is proposed, suitable initially for single-family residences but capable of being used for multifamily and multistory structures on acceptance by code officials.

An unusual feature of the proposal is the use of prefabricated brick bearing wall panels as units that can be factory-assembled and shipped for installation. Using a special mortar with very high bonding qualities, the wall panels are made in one-brick thicknesses (thus 4 in.). Numerous variations of brick color, texture and designs can be incorporated to achieve variety and satisfactory architectural appearance.

In addition to the prefabricated brick bearing wall panels, structural elements include precast concrete wall, ceiling and floor panels. The structure thus formed is supplemented by wood trusses for the roof, and wood panels as gable end infills, and for window and door components.

The resulting building would be conventional in appearance, designed by architects to fit into any neighborhood situation, and equipped with an all-electric heating system. Cooling can be provided as an integral part of the heating system. A prefabricated and assembled wet module is contemplated at the center for kitchen and bath, laundry room and other uses requiring plumbing. The use of plastic piping is planned wherever possible, though conventional steel and copper piping may be used.

The only site work, other than assembly of the panels, would be casting of a slab or basement foundation and utility hookups. The program is designed to provide on-the-job training for unskilled labor, and for erection by local contractors.

A constraint in the use of these brick panels is the customary limitation that a masonry bearing wall must be constructed so that its height is limited to about 20 times its thickness—thus imposing a height limitation of 80 inches for a single-brick thickness. The proposer cites tests to prove that the panel construction can be used to much greater heights without commensurate increase in thickness.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
10 Utilities	UNDERGROUND POWER SUPPLY
BUILDING SYSTEMS	
11 Housing Types	SINGLE FAMILY ATTACHED & DETACHED; FUTURE MULTIFAMILY HIGH-RISE & LOW-RISE
13 Design Selection	FLEXIBLE OPEN PLANNING OPTION
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure	PRECAST BRICK WALL PANELS; PRECAST CONCRETE WALL, CEILING & FLOOR PANELS; TRUSS ROOF
17 Exterior Elements	SHINGLE ROOFING; WOOD GABLE-END INFILL PANELS
18 Interior Elements	KITCHEN/BATH MODULES; CONVENTIONAL FINISHES
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems	ELECTRIC AIR HEATING SYSTEM; INTEGRAL COOLING OPTIONAL
21 Plumbing	KITCHEN-BATH MODULE; PLASTIC PIPING WHERE APPROPRIATE
22 Electrical	CONVENTIONAL
PRODUCTION	
24 Offsite Production	PRECAST CONCRETE BRICK & WOOD PANELS; ROOF TRUSSES; BATH/KITCHEN MODULES
26 Onsite Construction and Erection	ERECTION OF PANELS & COMPONENTS; FOUNDATIONS; UTILITY HOOK-UPS
28 Labor Training Programs	ON-THE-JOB TRAINING FOR UNSKILLED
29 Community Involvement	LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$16.36 PER SQ. FT., 1000 DWELLING UNITS PER YEAR
32 Useful Life	STRUCTURE AND ROOFING-75 YEARS; FOUNDATIONS-100 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; CONSTRUCTION OF PROTOTYPE
35 External Functions	CONSTRUCTION OF PERIMETER WALL; PRODUCTION OF KITCHEN-BATH CORE UNITS
36 Market Area	200 MILE RADIUS OF READING, PENNSYLVANIA
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Denton Lambert

PROPOSER

Denton Lambert, Design and Development, Clovis, New Mexico.

The basic premise behind the proposed system is to achieve components which may be put together easily and rapidly with a minimum of skilled labor, or even with unskilled labor. Research, design, and development are proposed for five prefabricated subsystems which together produce the basic structural shell for a single-family, one-story home (30 ft. wide and up to any length designed in multiples of 4 ft.)

The proposer sets forth a three-part program to arrive at a fully developed, improved system which would be geared for high-volume production: (1) Research to investigate and analyze every facet of the five-subsystem approach; (2) Design to complete plans, specifications, and procedures for such a concept; and (3) Development to construct, test, and evaluate a prototype.

The subsystems which comprise the system are: a foundation system; a floor system; an exterior wall component system; a roof system; and a structural component system which combines the functions of roof truss, ceiling beam, wall studs, and floor joist into a single entity.

The foundation system consists simply of four rows, 10 ft. apart, of concrete piers or pads on about 10-ft. centers, the pads being spanned the length of the house by prefabricated beams (similar to those used to support mobile homes.) The multifunction component system resembles a conventional roof truss to which has been added a pair of vertical legs (about 8 ft. long), these being joined by a floor joist. The combination joist-truss-beam-stud components are placed at right angles to the beams (on 4-ft. centers), followed one-by-one with the wall components, which are simple wood frames covered with an exterior skin (plywood, vinyl, or other material) which fit snugly and fill the space between the studs. Other components of the wall subsystem include door and window sections, and gable wall sections.

The roof subsystem is similar to the wall subsystem, consisting of simple framed elements covered with a plywood skin, with specialized sections providing for soffit and roof rake. The floor subsystem consists of 4-ft. x 8-ft. plywood with the tongue-and-groove edges eliminating need for any support along the lengths of the sheets, the sheets serving both as subfloor and underlayment for the floor covering.

With the structural shell of the house completed, finish work would be accomplished by a combination of conventional onsite operations and new systems under development, or to be developed. Fourteen working days are estimated as being required to deliver a complete home, from staking the lot to clean-up.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	3 BEDROOM
13 Design Selection	SELECTION FROM STANDARD PLAN
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure	WOOD FRAME JOIST-TRUSS-BEAM-STUD SYSTEM, WALL, FLOOR & ROOF SYSTEMS
17 Exterior Elements	PLYWOOD, VINYL OR HARDBOARD EXTERIOR WALLS; SHINGLE ROOFING
18 Interior Elements	METAL OR WOOD STUD PARTITIONS; GYPSUM BOARD OR SUSPENDED ACOUSTICAL CEILINGS
19 Foundations	PRECAST FOUNDATION BEAMS RESTING ON CONCRETE FOUNDATION PIERS
PRODUCTION	
24 Offsite Production	PRECAST CONCRETE FOUNDATION BEAMS; WALL, FLOOR & ROOF SUBSYSTEMS
26 Onsite Construction and Erection	CAST-IN-PLACE FOUNDATION PADS OR PIERS; ERECTION OF COMPONENTS
27 Labor	UNSKILLED FOR CONSTRUCTION OF PIERS & FOUNDATIONS
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	CENTRAL CONTROL; RESEARCH, DESIGN & DEVELOPMENT OF COMPONENT SUBSYSTEMS
37 Delivery Rate	1 DWELLING UNIT EVERY 14 DAYS
GENERAL	
39 Major Innovative Concepts	BUILDING SYSTEM OF FOUR WOOD FRAME SUBSYSTEMS; FOUNDATION SYSTEM

Morris Lapidus Slab Corporation

PROPOSER

Morris Lapidus Slab Corporation, Brooklyn, New York.

Fabrication and production of two different automatic machines for manufacture of the structural elements of a building are proposed by the inventor. Elements produced by the machines may be used in construction of any type of housing, from low-rise to multifamily high-rise structures up to 30 stories.

The only machines of this nature, they are described as follows:

(1) An automatic machine for making cored reinforced concrete floor slabs and solid exterior and interior wall slabs, the slabs being 32 ft. long x 8 ft. wide x 8 in. thick, with the rate of production being 30 million sq. ft. per year—present methods produce only one million sq. ft. of floor slab, and wall slabs at a lesser rate.

(2) An automatic machine for making lightweight concrete furring and partition slabs, the slabs being 8 ft. long x 8 in. wide x 2 5/8 in. thick, with the rate of production being 47 million sq. ft. per year—there is no present method for making such slabs. The same machine also is capable of producing 19 million concrete blocks per year.

Utilization of this proprietary system of automatic machines would be expected to cut drastically the cost the producing reinforced concrete building elements.

BUILDING SYSTEMS	
11 **Housing Types**	PROPOSED MACHINES TO PRODUCE CONCRETE COMPONENTS FOR ALL HOUSING TYPES
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements**	PROPOSED FABRICATION & PRODUCTION OF MACHINES FOR MAKING CONCRETE BUILDING PRODUCTS: MACHINE FOR MOLDING CORED REINFORCED CONCRETE FLOOR SLABS & SOLID REINFORCED CONCRETE EXTERIOR & INTERIOR WALL SLABS; & MACHINE FOR MOLDING FURRING & PARTITION SLABS & CONCRETE BLOCK
PRODUCTION	
24 **Offsite Production**	(1) AUTOMATIC MACHINE FOR PRODUCING CORED REINFORCED CONCRETE FLOOR SLABS & SOLID EXTERIOR & INTERIOR REINFORCED CONCRETE WALL SLABS; (2) AUTOMATIC MACHINE FOR PRODUCING FURRING & PARTITION SLABS & CONCRETE BLOCK
ECONOMICS	
30 **Construction Costs**	MACHINES ARE DESIGNED TO CUT DRASTICALLY THE COST OF PRODUCING CONCRETE BUILDING COMPONENTS
MANAGEMENT	
33 **Proposer Organization**	PRIVATE COMPANY
34 **Internal Functions**	FABRICATION & PRODUCTION OF AUTOMATIC MACHINES
37 **Delivery Rate**	FLOOR & WALL SLAB MOLDING MACHINE: 30 MILLION SQ. FT. PER YEAR; FURRING & PARTITION SLAB MACHINE: 47 MILLION SQ. FT. PER YEAR; 19 MILLION CONCRETE BLOCKS PER YEAR
GENERAL	
39 **Major Innovative Concepts**	MACHINES FOR AUTOMATICALLY PRODUCING CONCRETE BUILDING COMPONENTS
40 **Codes**	CONCRETE COMPONENTS CONFORM TO RELEVANT CODES

Rocco A. LaPorta

PROPOSER

Rocco A. LaPorta, Construction Consultant, Chicago, Illinois

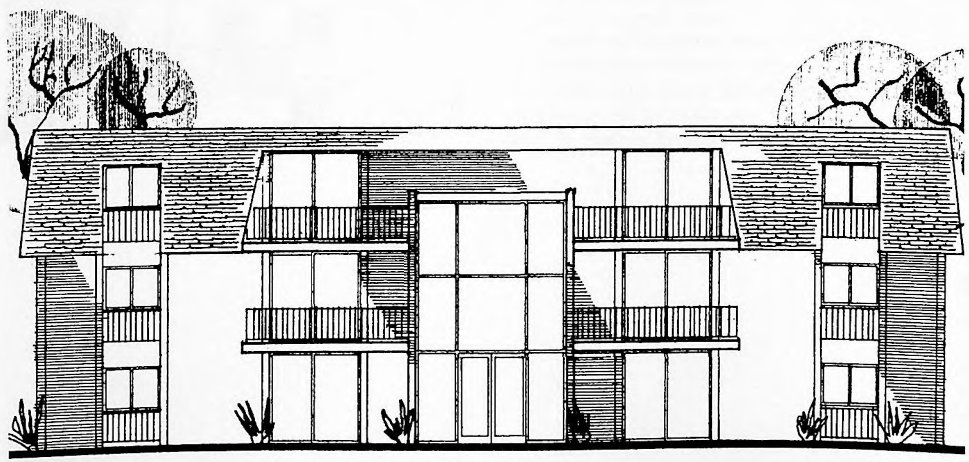
Basic to the system proposed for construction of multifamily housing is an engineered, fire-resistant floor system priced competitively. The floor system consists of precast, prestressed, lightweight concrete joists set 2 ft. on center, spanning bearing walls 20 ft. to 40 ft. apart, with specially designed lightweight filler block spanning between the joists. A monolithic concrete floor slab poured onsite over the joists and filler blocks completes the floor system. The components for the system can be produced on equipment locally available with a minimum of start-up costs. The filler blocks can be manufactured on most block machines, the joists in inexpensive self-stressing steel molds.

The precast joists are 5 in. x 5 in. in section and are prestressed by two cables, 7/16-in. diameter each, with 270,000 lbs. per sq. in. ultimate strength. A 1-in. x 2-in. nailer strip on the bottom of the joist facilitates hanging of ceiling material. The filler blocks are 5 1/2-in. thick hollow core units, notched or recessed at their ends to permit them to rest on the joists without slipping. With the cast-in-place concrete slab, the total thickness of the floor system is 12 in.

Several advantages are claimed for the system; (1) Components can be produced in limited space; any block producer with a 3-block machine can make the joists and filler blocks. (2) The system reduces weight of usual floor components—a typical 30-ft. joist, for example, weighs only 500 lbs. (3) The system provides completely accessible space for utility runs between the joists. (4) It reduces floor construction costs compared to other systems—for example, $500 to $1000 savings per dwelling unit are claimed when the system is used in lieu of flat plate and column construction in high-rise buildings.

The system is fully developed, but is not presently being marketed.

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	COMMON OPEN SPACES
9 Community Involvement	RECOGNITION THAT NEIGHBORHOOD REHABILITATION SHOULD BE BY LOCAL PEOPLE
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 AND 2 BEDROOMS
13 Design Selection	STANDARD PLAN ONLY
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
15 Community Involvement	PILOT PROGRAM TO TEACH & CONSULT WITH NEIGHBORHOOD GROUPS
BUILDING SUBSYSTEMS	
16 Structure	LIGHTWEIGHT, PRECAST, PRESTRESSED CONCRETE JOIST FLOOR SYSTEM
18 Interior Elements	CAST-IN-PLACE CONCRETE SLAB
PRODUCTION	
24 Offsite Production	PANELS
26 Onsite Construction and Erection	ERECTION OF COMPONENTS
ECONOMICS	
30 Construction Costs	$10.00 PER SQ. FT. FOR 3-STORY, 42 UNITS; $10.50 PER SQ. FT. FOR 4-STORY, 46 UNITS
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	SYSTEM DESIGN
GENERAL	
39 Major Innovative Concepts	PRECAST, PRESTRESSED CONCRETE JOIST & FILLER BLOCK FLOOR SYSTEM



Jean LeBreton

PROPOSER

Jean LeBreton, Architect, Le Chesnay, France

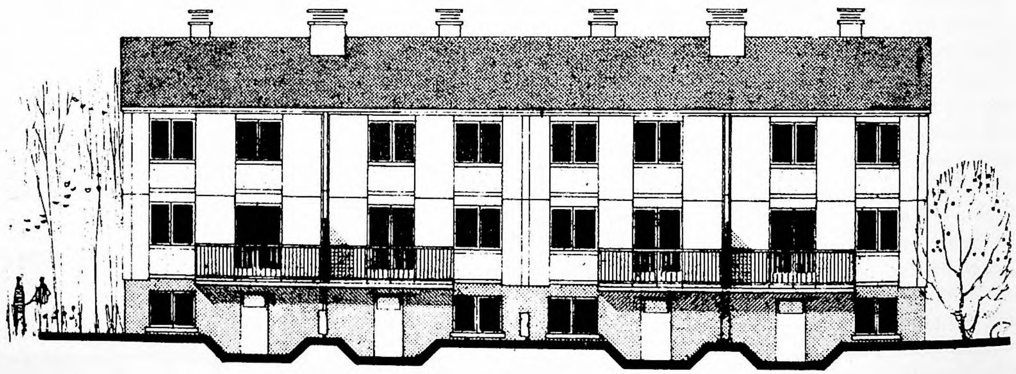
Precast, lightweight wall panel construction, modulated in feet for easy adaptation to several building types, is advocated in this proposal by a French architect. These load-bearing wall components are erected, without framing, to build single-family detached and multifamily low-rise housing. The system is developed and has been marketed in Europe; approximately 200 houses and flats have been constructed by the method.

The panels can be factory-cast in various sizes in steel or plastic molds. Exterior surfaces can be painted after erection or receive application of finish coats at the plant. The maximum weight of each panel is 1,400 lb. (They also can be cast economically onsite in concrete molds.)

The panels are cast with edge flanges to form frames for openings or with edges rabbeted to receive a sealing strip for joining the elements in continuous runs. Corner panels are filled with reinforced concrete and the panels are anchored to the foundation by use of plant-fabricated steel rods which are sealed in holes with concrete fortified by a plastic material. A horizontal flange permits reinforced concrete bracing to provide rigidity to the upper portion of the panels.

Interior walls consist of hollow panels formed by joining prefabricated plaster sheets using cellular elements for bonding and introducing an insulation layer of expanded polystyrene. Exposed surfaces of these interior panels are painted.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	2, 3, 4, & 6 BEDROOMS
14 State of Development	SYSTEM COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED IN EUROPE
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE PANELS; JOINED BY STEEL RODS & GROUTING TO FOUNDATION
19 Foundations	CONVENTIONAL
PRODUCTION	
24 Offsite Production	CONCRETE PANELS
25 Onsite Production	CONCRETE PANELS (POSSIBLE)
26 Onsite Construction and Erection	FOUNDATIONS, ERECTION OF PANELS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	CENTRAL CONTROL



R.G. LeTourneau

PROPOSER

R. G. LeTourneau, Inc., Longview, Texas

AFFILIATES

Upjohn Company, CPR Division, Design and Construction; Hirschen and Van Der Ryn, Architects; Dr. Billy J. Harris (Le Tourneau College), Technical Advisor

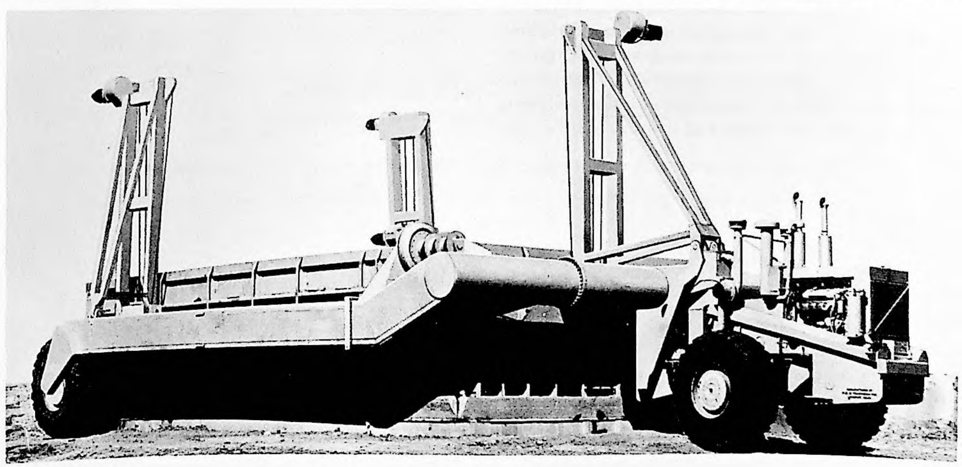
This program and its resultant products are dependent on the updating and modification of a method of housing construction conceived and placed in operation some twenty-five years ago. The proposer, after extensive research and development, has concluded that polyurethane materials are far superior to formerly used conventional structural materials such as concrete.

The theory advanced provides for shipment of liquid raw materials and flat shipped facing materials directly to the building site, thus minimizing transportation costs and difficulties. Modernized foaming equipment will be utilized to expand the liquids within forms to form a monolithic structure. The structure possesses superior insulating properties and is strong and lightweight.

Plumbing and electrical networks are preinstalled in slab floors and preplaced within the roof structure prior to foaming. Facing and internal wall structures may be of optional construction and may be installed by the occupant or local contractor as desired. Door frames are preinstalled in the foamed structures; windows are cut to size and positioned after the structure has cured.

Production is planned for single-family or multifamily structures and, with utilization of a single forming unit, can reach several thousand units a year. The only constraint appears to be that some jurisdiction building codes do not countenance use of polyurethane materials in structural components.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
BUILDING SUBSYSTEMS	
16 Structure	POLYURETHANE FOAMED MODULES
19 Foundations	CONVENTIONAL
20 Comfort Systems	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM
21 Plumbing	
22 Electrical	
PRODUCTION	
25 Onsite Production	POLYURETHANE FOAMED MODULES
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF VOLUMETRIC MODULES BY HOUSELAYER MACHINE
29 Community Involvement	SELF-HELP; LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	$1,741.38 PER UNIT AT 1,000 PER YEAR (BEST RATE)
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	MANAGEMENT; COORDINATION
35 External Functions	ARCHITECTURAL DESIGN; TECHNICAL
37 Delivery Rate	1,000 DWELLING UNITS PER YEAR
GENERAL	
40 Codes	RESTRICTION OF USE OF POLYURETHANE AS A STRUCTURAL ELEMENT



Arthur D. Little

PROPOSER

Arthur D. Little, Inc., Cambridge, Massachusetts

The purpose of the work outlined in this proposal is to assist HUD in addressing the issues concerned with providing sites to meet the nation's low- and moderate-income housing needs. Providing a basis for structuring long range federal policy in connection with housing is seen as a further result of the proposed program.

The work to be performed by the proposer is divided into two major phases, with each phase divided into several tasks. Phase 1 concerns research, data collection, and design of a site delivery program, the first task being an estimate of housing needs and potentials. Inputs in this area include development of site criteria, review of incentives, and estimate of site availability. Task 2 identifies alternate public and private steps required to meet housing needs. Task 3 is concerned with design of a site delivery program for Operation Breakthrough, including both testing of the concept and an implementation procedure.

Phase II of the proposed work plan is broadly concerned with overall implementation of the results produced in Phase 1. Four major tasks in this area are defined: (1) Training and assistance to HUD and developers in achieving a site delivery program; (2) Organization of federal technical assistance in the program; (3) Assistance to FHA in organization of site processing procedures; and (4) Issuance of monthly and final reports.

SITE SYSTEM	RESEARCH & DATA COLLECTION TO ESTIMATE SITE AVAILABILITY; TO ESTIMATE SITE NEEDS; TO CREATE FRAMEWORK FOR SITE AGGREGATION; DATA COLLECTION ON SITE PLANNING FOR LOCAL GOVERNMENT; ASSISTANCE TO HUD/FHA IN SITE PROCESSING PROCEDURE; TECHNICAL ASSISTANCE TO STATE & LOCAL GOVERNMENT ON SITE EVALUATION
1 Site Situation	
2 Density Range	
3 Topography	
4 Climate	
5 Planning Concepts	
6 Nonresidential Functions	
7 Circulation	
8 Site Planning Services	
9 Community Involvement	
BUILDING SYSTEMS	
14 State of Development	DESIGN STAGE REQUIRING FURTHER RESEARCH
15 Community Involvement	DATA COLLECTION ON USER NEEDS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL; COLLECTION & PROCESSING OF DATA

Liu Urban Design

PROPOSER

Liu Urban Design Associates, Inc., New York, New York

Design and development are proposed for unitized structural modules which can be mass produced with assembly-line economy at regional factories, packaged for efficient shipping, and capable of being erected on-site by unskilled, self-help labor.

The system to be studied would be capable of producing flexible units to permit application to varying types of housing and varying site situations, with a modifiable unit size and arrangement making use of all available materials. Specially designed units could be developed for use as ancillary structures as well. Because each unit will be complete—including plumbing and electrical wiring, except for connection to utility feeders or water lines—site erection will be limited to lifting the units from the carrier and placing them in the configuration desired by the owner or architect. Units would be designed for integration into almost any desired space and arrangement.

SITE SYSTEM	
1 Site Situation	APPLICABLE TO VARYING SITE SITUATIONS
2 Density Range	APPLICABLE MORE READILY IN LOW TO MEDIUM DENSITIES—UP TO 10 UNITS PER ACRE
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PERMIT UNIT PRIVACY; PROVIDE FLEXIBILITY IN PLANNING & MORE EFFECTIVE LAND USE
6 Nonresidential Functions	TO BE RESPONSIVE TO CONTEMPORARY LIFE SYSTEMS
7 Circulation	TO ACCOMMODATE SEPARATE VEHICULAR & PEDESTRIAN CIRCULATION
9 Community Involvement	PROGRAM USER NEEDS AS PART OF DESIGN PHASE
10 Utilities	ELIMINATION OF SITE MECHANICAL NETWORK
BUILDING SYSTEMS	
11 Housing Types	ADAPTABLE TO VARYING HOUSING TYPES
12 Unit Variations	ADJUSTABLE & MODIFIABLE DURING PROJECT DESIGN & AFTER CONSTRUCTION
13 Design Selection	FLEXIBLE
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION OF BUILDING SYSTEM
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF LIGHTWEIGHT UNITIZED STRUCTURAL MODULES; EXPERIMENT WITH MATERIALS
17 Exterior Elements	FUNCTIONAL DESIGN
18 Interior Elements	INTERCHANGEABLE MODULAR ROOMS; FACTORY FINISHES
19 Foundations	INTEGRATED WITH STRUCTURAL MODULES
20 Comfort Systems	IMPROVED CONTROL OF ENVIRONMENT WITHIN HOUSING SYSTEM UNIT
21 Plumbing	SELF-CONTAINED, REPLACEABLE MECHANICAL MODULE; CHEMICAL TOILETS
22 Electrical	WIRING CONDUITS & FIXTURES INTEGRATED IN STRUCTURAL WALL
PRODUCTION	
24 Offsite Production	MODULES
26 Onsite Construction and Erection	PLACEMENT OF MODULES
27 Labor	RANGES FROM HIGHLY SKILLED IN FACTORY PRODUCTION TO UNSKILLED FOR ONSITE
29 Community Involvement	SELF-HELP LABOR FOR ONSITE ERECTION; LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs	UP TO 50% LESS THAN CONVENTIONAL
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	RESEARCH, DESIGN & DEVELOPMENT OF PROTOTYPE MODULE HOUSING SYSTEM
37 Delivery Rate	LIMITED ONLY BY SIZE OF MARKET
GENERAL	
39 Major Innovative Concepts	SELF-CONTAINED & SELF-SUFFICIENT HOUSING SYSTEM; USE OF CHEMICAL TOILET

J. C. Long

PROPOSER

J. C. Long, & Associates, Charleston, South Carolina

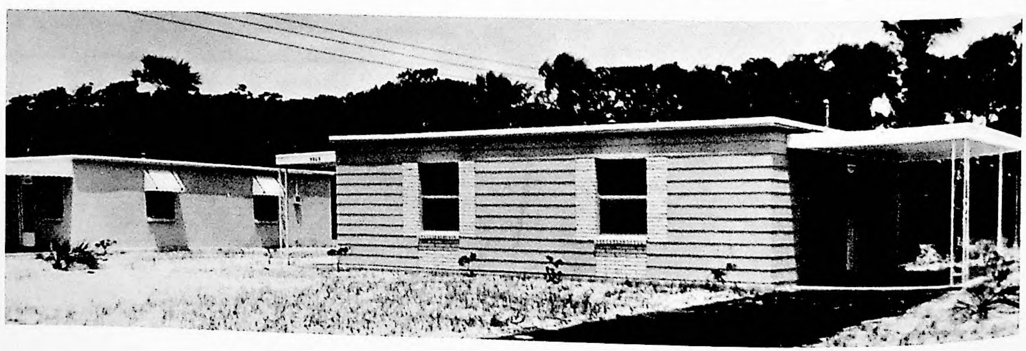
A patented system of jacking reinforced concrete floor and roof slabs into place for one- and two-story single-family homes is proposed as a means of achieving moderate- and low-income housing at reduced cost.

The lowered costs result basically because ceiling-roof construction is accomplished at ground level, with consequent elimination of scaffolding, erection of formwork, shoring and reshoring, and because unskilled or semiskilled labor may be used.

Construction of a typical unit is accomplished in the following sequence: (1) A specially designed steel form is placed on the ground, outlining the shape of the floor and the roof. (2) Earth is leveled within the form; the ground is covered with polyethylene film; concrete is placed for the floor slab, filling approximately half of the form. (3) After the slab has taken initial set, polyethylene film is spread over it and welded wire fabric or bar reinforcement is positioned for a structural one-way roof slab; terra cotta pipe sections are positioned as required with bell ends resting on top of the floor slab and spigot end protruding through polyethylene and reinforcement to serve as chimneys and vents through roof slab. (4) Concrete is placed for the roof slab to the top of the form. (5) After the roof slab has cured sufficiently, tongue-like lifting elements or jacks are inserted in grooves which have been shaped into edges of floor and roof slabs by the steel form. (6) Vertical legs of the jacking system—worm drives within tubular steel sections—are erected at ends, mid-points, or other points along each side of the slab as required, depending upon its length; jacks along each side of the slab are interconnected by horizontal tubular sections; the jacks on one side are interconnected with those on the other by a sprocket-and-chain arrangement; a V-belt pulley from the top of one jack at one end of the slab is connected to a 2 1/2 h.p. gasoline engine on the ground. (7) The roof slab is lifted to above ceiling height in approximately 45 min. The slab, weighing typically about 35,000 lb., remains jacked up while exterior walls (for example, load-bearing block masonry) are built below it around the perimeter of the foundation slab. Then the lifting motor is reversed, and the jacking system lowers the roof-ceiling slab onto the walls below.

Completion of the house then follows conventional procedures, with exterior finish being stucco, waterproof paint over the block, or clay brick facing. Interior partitions typically are wood-stud finished with gypsum board. The underside of the lift slab, having been placed over polyethylene, is smooth and ready for painting.

SITE SYSTEM	
1 Site Situation	SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL SOILS; NOT EXCEEDING GRADIENT OF 10%
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
14 State of Development	PRODUCTION PLANT OPERATIONAL; SYSTEM MARKETED
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE FLOOR & ROOF SLABS; CONCRETE MASONRY WALLS
17 Exterior Elements	CONVENTIONAL FINISHES
18 Interior Elements	MASONRY & WOOD PARTITIONS
19 Foundations	CONVENTIONAL SLAB WITH PERIMETER WALLS
PRODUCTION	
25 Onsite Production	CONCRETE FLOOR & ROOF SLABS
26 Onsite Construction and Erection	MECHANICAL JACKING SYSTEM TO RAISE CONCRETE FLOOR & ROOF INTO POSITION
27 Labor	UNSKILLED & SEMISKILLED
ECONOMICS	
30 Construction Costs	$7,428 PER UNIT ($8.44 PER SQ. FT.)
31 Financing Methods	CONVENTIONAL
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	CENTRAL CONTROL; JACKING SYSTEM DEVELOPMENT
GENERAL	
39 Major Innovative Concepts	JACKING SYSTEM FOR ERECTION OF CONCRETE FLOOR & ROOF SLABS



Louisiana State University

PROPOSER

Division of Engineering Research, Louisiana State University, Baton Rouge, Louisiana

Proposed by this organization is the development of a problem-oriented language for operation of a computer program which gives the building designer a method of systematic analysis. The computer program, known as "A Generalized Linear Model for Optimization of Architectural Planning" was originally developed by the proposers, but its full utilization has not been realized because the program requires that the prospective user know mathematical programming.

The presently proposed work, however, would result in a language which would allow the architect or planner to structure a problem according to his own constraints in terms with which he is familiar. The language to be developed will be structured around the basic functional operations of the problem. Thus, each word or character fed to the computer by the operator, using the language, will represent an operation or group of operations which will be performed in analyzing or manipulating the data associated with that particular command.

BUILDING SYSTEMS	
11 Housing Types 12 Unit Variations 13 Design Selection	STUDY TO DEVELOP A PROBLEM-ORIENTED LANGUAGE FOR OPERATION PLANNING OF GENERALIZED LINEAR MODEL FOR OPTIMIZATION OF ARCHITECTURE; THE LANGUAGE WOULD ENABLE AN ARCHITECT OR PLANNER TO MANIPULATE OR ANALYZE DATA WITHOUT USING MATHEMATICAL PROGRAMMING.
14 State of Development	FURTHER DEVELOPMENT OF COMPUTER PROGRAM INCORPORATING USER LANGUAGE
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY (RESEARCH DIVISION)
34 Internal Functions	CENTRAL CONTROL & DEVELOPMENT OF PROBLEM-ORIENTED LANGUAGE FOR USE WITH COMPUTERIZED LINEAR MODEL FOR OPTIMIZATION OF ARCHITECTURAL PLANNING

Lutes & Admundson

PROPOSER

Lutes & Amundson, Architects, Springfield, Oregon

Citing its belief that maximum utilization of existing housing is mandatory in solving the total housing problem, this proposer offers to develop a program of housing conservation through rehabilitation, using market concentration and aggregation. Although the program would be applied specifically to a metropolitan statistical area in a western state, it is stated that the techniques developed could serve as models for nationwide application.

Some of the steps to be taken in the proposed work would include: assessment of the overall need for rehabilitation; defining areas of critical need; discovery of the resources available for rehabilitation; setting up a critical path for rehabilitation work; establishment of a system for developing the skills of small contracting firms to do rehabilitation; and evaluation of time, costs, and effects on neighborhoods and regions of pilot projects.

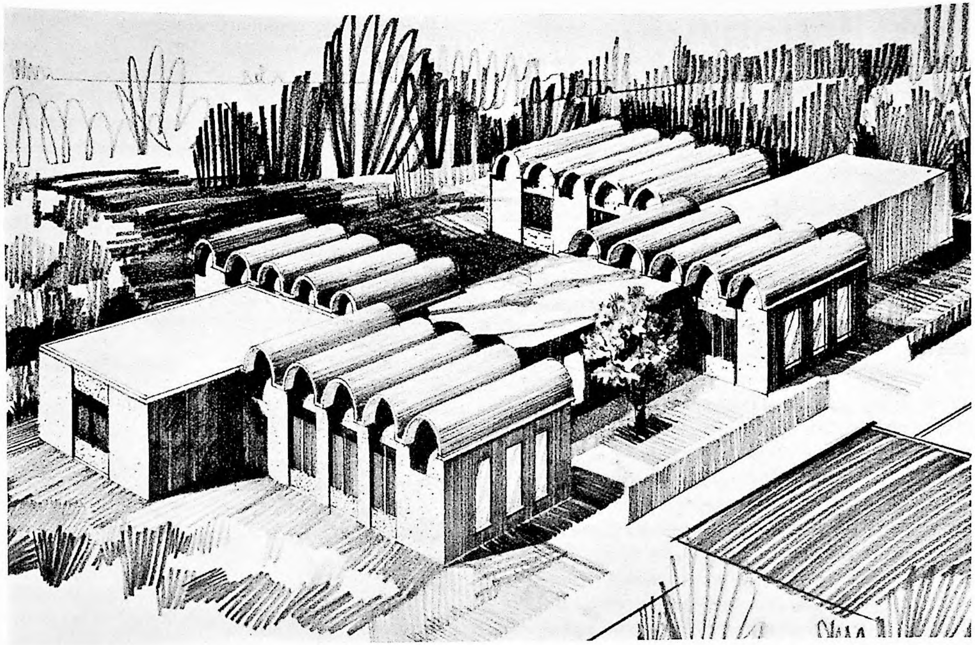
MANAGEMENT

PROFESSIONAL

33 **Proposer Organization**
34 **Internal Functions**
35 **External Functions**
36 **Market Area**

STUDY TO DETERMINE NEED FOR REHABILITATION IN LANE COUNTY, AREAS OF CRITICAL NEED, RESOURCES AVAILABLE FOR REHABILITATION; SYSTEM FOR DEVELOPING THE SKILLS OF SMALL CONTRACTING FIRMS TO PERFORM REHABILITATION WORK; EVALUATION OF TIME, COSTS & EFFECTS OF PILOT PROJECTS

Lynema Enterprises



PROPOSERS

Lynema Enterprises, Inc. and Subsidiaries, Bronson, Michigan
Wren Research and Development Company, Inc.; Patriark, Inc.

AFFILIATE

Mayne, Osetoff, VanDesien & Associates, Architects & Planners

Six basic room-sized modules, factory-assembled from rigid polyurethane foam panels, comprise the housing system proposed. The modules are so designed that they can be grouped in a variety of arrangements to produce both attached and detached single-family housing and multifamily low-rise apartments.

The components of the modules are manufactured as homogeneous entities. A wall panel, for example, typically 20 ft. long, 8 ft. high and 8 in. thick, would be fitted with convenience outlets and concealed wiring prior to application of its interior surface, and openings would be provided for later installation of doors, windows and louvres. Assembly of such panels with corresponding subfloor and vaulted roof panels to form a 12-ft. x 20-ft. module (in plan) would be accomplished with fiberglass-reinforced plastic resins which would render the panels into a single entity, structurally self-supporting stacked two high, and well able to withstand the racking stresses of transportation and erection.

The required number of modules for a dwelling unit (two or more depending upon the plan desired), are shipped to the site completely equipped and finished, including plumbing, heating, kitchen and bathroom facilities, hardware and shelving, and require only siting on the foundations and hookup.

A plant to produce the modules is built and in operation, but further development of the concept is proposed.

BUILDING SYSTEMS

11 **Housing Types**	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE; POSSIBLE HIGH-RISE
12 **Unit Variations**	1 TO 4 BEDROOMS
13 **Design Selection**	FLEXIBLE
14 **State of Development**	PRODUCTION PLANT OPERATIONAL; BUILDING SYSTEMS-DESIGN STAGE

BUILDING SUBSYSTEMS

16 **Structure**	FIBERGLASS-REINFORCED RIGID FOAM, SELF-SUPPORTED MODULES; FRAME FOR HIGH-RISE
17 **Exterior Elements**	FIBERGLASS REINFORCED PLASTIC ROOF FINISH; FLAT & VAULTED ROOF SHAPES
18 **Interior Elements**	FIBERGLASS-REINFORCED PLASTIC PARTITIONS
19 **Foundations**	CONCRETE UNIT MASONRY BEARING WALLS DESIGNED FOR SPECIFIC SITE CONDITIONS
20 **Comfort Systems**	HEATING SYSTEM INTEGRATED WITH BUILDING SUBSYSTEM; OPTIONAL COOLING
21 **Plumbing**	INTEGRATED WITH BUILDING SUBSYSTEMS
22 **Electrical**	OUTLETS & WIRING INTEGRATED WITH BULDING SUBSYSTEMS

PRODUCTION

24 **Offsite Production**	COMPONENT FABRICATION & ASSEMBLY INTO FINISHED MODULES
26 **Onsite Construction and Erection**	FOUNDATIONS; MODULE PLACEMENT; UTILITIES HOOK-UPS

MANAGEMENT

33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH; DEVELOPMENT; MANUFACTURING; TESTING

McClaughry Associates, Inc.

PROPOSER

McClaughry Associates, Inc., Financial Consultants, Washington, D.C.

The proposer approaches two problem areas which tend to be obscure in the arena of federal program design and mortgage financing. These areas are identified as (1) Financing of publicly assisted housing and (2) Flexible Mortgage financing for young families.

Six types of Federal subsidy programs exist today, encompassing: (1) direct federal lending, (2) federal mortgage purchase, (3) public housing, (4) rent supplements, (5) rent subsidy, and (6) interest subsidy.

The proposer suggests replacing these programs with a single program based upon the principles of: (1) assistance by government to private enterprise to expand the supply of dwellings, (2) assistance in proportion to need, (3) permitting broadest possible choice, and (4) imposition of minimum burdens for owner and tenant policing. The proposed consolidated program incorporates the following characteristics: financing based upon FHA-insured mortgages; applicability to new, rehabilitated, or existing housing; sponsorship by private limited entities; technical features comparable to existing FHA programs; established cost limits as in present FHA legislation; 40-year terms and loan-to-value ratios as in current programs; compatibility with local government and zoning involvements; allowance of mortgages eligible through GNMA; subsidy via a coupon mortgage payment; dependence upon initial cost of housing with government payments to mortgagees not varying with family income; provision for income tax surcharge to adjust the net subsidy of participants; allowance for direct payments to the aged and disabled; and provision for government recapture of partial equity of participant's subsidies at the time of sale.

In addition to consolidating and supplanting existing programs, the proposed concept: places reliance upon the private sector; avoids otherwise inherent policing; broadens owner's opportunities; affords efficient computer processing of mortgagee administrative costs; diminishes use of tax-exempt authority bonds; and gains support for increased appropriations in other private market assistances.

The second concept from the proposer impacts the need for a new type of mortgage instrument which is flexible. It is adaptive in that it is applicable to young families who begin financing on a nonpermanent dwelling, and as needs change with increasing family size and commensurate earning powers, it shifts to a more permanent mortgage structure applied to an extended-term home. The concept is fostered on behalf of a temporary dwelling and transfer of equity to a second, permanet home. Separate mortgage instruments would not be required but would include a package with fixed interest rates and a specified term for exercise of option to effect mortgage transfer from the nonpermanent to the permanent dwelling.

ECONOMICS	
31 **Financing Methods**	DEVELOPMENT OF SINGLE, FEDERAL PROGRAM FOR FINANCING OF PUBLICALLY ASSISTED HOUSING, & FLEXIBLE MORTGAGE FINANCING FOR YOUNG FAMILIES
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEFINITION OF UNITIZED CONCEPT FOR FEDERALLY ASSISTED HOUSING; CONSTITUTING & FORMALIZING OF FLEXIBLE MORTGAGE CONCEPT FOR YOUNG FAMILIES.

McTerry Contracting Company

PROPOSER

McTerry Contracting Company, Lakeville, Connecticut

Development and testing of a concept utilizing a massive balloon form, sprayed with foamed urethane, is the subject of this proposal. An experimental version of such a concept has been under research at one of the prominent architectural schools, but because the building lacked doors, windows, plumbing and wiring, and has had no testing, the need for the proposed developmental work emerged.

Under the program put forth, a prototype house would be constructed and subjected to load testing at every stage of the work, with particular attention to the effect of door and window openings on the structural strength of the rigid shell, and to the ability of these appurtenances to remain secure in the shell after repeated use. Sections of the exterior urethane surface would be coated or painted with a variety of different materials and their weathering characteristics noted.

Construction sequence would be as follows: (1) The balloon form is positioned on a graded site, a pipe is slid into the hem around the bottom diameter of the form which is anchored to the slab or wood deck. (2) The form is inflated and sprayed. Door and window frames, wiring and radiant heating cable are taped to the form and foam is applied. (3) Portions of the wall are cut away for insertion of prefabricated units such as unitized kitchens and bathrooms or for attachment of other forms. (4) Additional forms are sprayed. (5) Window openings are cut and windows are foamed in place.

Two overall configurations in layout are possible: in one, a single, large form encloses the various living facilities with freestanding partitions being constructed independently of the rigid shell, and a second level arrangement being possible. In the other configuration, each room is a separate form-sprayed structure, with the various forms being connected, probably on one level.

The concept is believed to offer great flexibility to the occupant and to be adaptable to his changing need with inflation and spraying of an added form being easily accomplished.

BUILDING SYSTEMS	
14 **State of Development**	BUILDING SYSTEM; REQUIRES FURTHER RESEARCH FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements**	FOAMED-IN-PLACE MODULES: URETHANE FOAM SPRAYED OVER INFLATED FORM FOR MONOLITHIC WALL & ROOF STRUCTURE; FORM MATERIAL BONDED TO FOAM FOR INTERIOR SURFACES; POSSIBLE FOAM FLOOR, PARTITIONS OF VARIOUS MATERIALS OR INTERIOR SPACES FORMED OF SEPARATE FOAMED BALLOONS
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical** 23 **Furnishings**	POSSIBLE FIBERGLASS KITCHEN-BATHROOM-LAUNDRY-HEAT & POWER SUPPLY UNIT; WIRING, RADIANT HEATING CABLE OF AIR DUCTS FOAMED IN PLACE;
PRODUCTION	
24 **Offsite Production**	BALLOON FORMS
25 **Onsite Production**	PROPOSED POSSIBLE ONSITE CUTTING & STITCHING OF BALLOON MATERIAL; FORM INFLATION & ERECTION; FOAM SPRAYING
26 **Onsite Construction and Erection**	
MANAGEMENT	
33 **Proposer Organization**	PRIVATE COMPANY
34 **Internal Functions**	RESEARCH, DESIGN, CONSTRUCTION & TESTING OF URETHANE FOAMED HOUSE
36 **Market Area**	PROPOSED SYSTEM COULD BE PACKAGED UNINFLATED FOR TRANSPORT ANYWHERE
37 **Delivery Rate**	A 2 BEDROOM HOUSE COULD BE INFLATED & FOAMED IN ONE DAY
38 **Consumer Protection**	
GENERAL	
39 **Major Innovative Concepts**	FOAM SPRAYED STRUCTURE OVER BALLOON FORM

Magic Homes, Inc.

PROPOSER

Magic Homes, Inc., Birmingham, Alabama

Aluminum extrusions, masonite, and epoxy adhesives are the basic materials selected by this proposer to achieve a modular wall and roof truss system for production of single-family houses. Using this concept, per sq. ft. costs ranging from $6.00 to $10.00 are claimed for any part of the country.

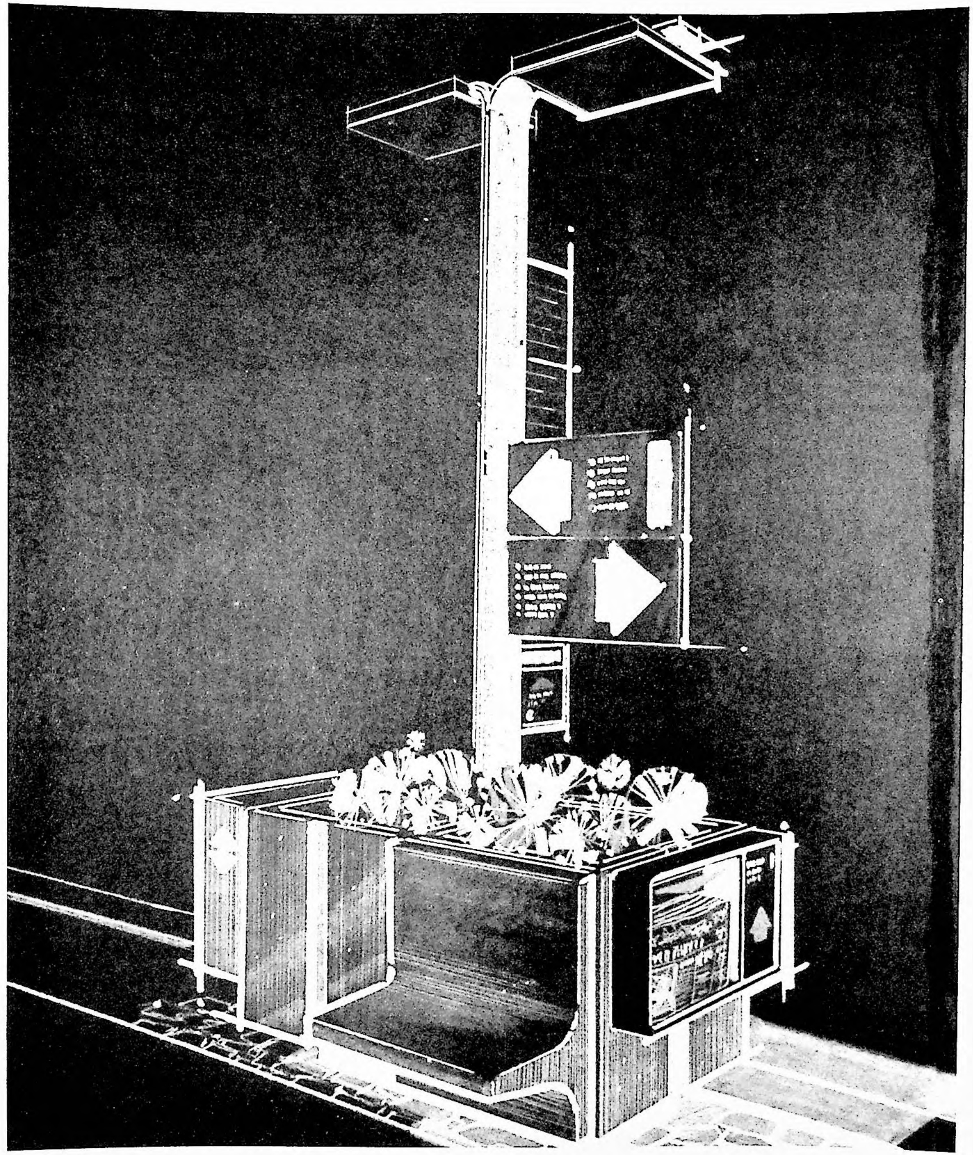
Basic modular dimension for the system is 40-in., with the 8-ft. high wall panels (except for door sections) meeting that dimension, and the roof/ceiling trusses being on 40-in. centers. Each of the wall panels embodies a specific function—window, door, solid partition, or built-in electrical panel—and all are fitted with electric outlets, switches, conduit for wiring, and fiberglass insulation.

Construction of the wall panel is aluminum stud, faced on the exterior with 3/8-in. rough masonite, on the interior with 1/4-in. smooth masonite, these skins being adhered by a combination of expoxy adhesive and keyways formed into the extruded shape, which add the strength of mechanical bonding to the joining. Both interior and exterior of the panels may be painted; the masonite surfaces permitting a variety of treatments and affording a conventionally constructed, contemporary appearance.

Construction follows an erector-set, simple sequence: base plates are fastened to slab or wood flooring; wall module elements are set on base plastes and fastened; top plates are bolted to wall modules; roof trusses are bolted to top plates; and plywood decking is screwed to trusses. In a test, a two-bedroom model was erected completely, including interior and exterior painting, in 48 man-hours—and was disassembled and restored to the truck in 9 man-hours.

BUILDING SUBSYSTEMS	
16 **Structure**	WALL PANELS OF ALUMINUM STUD FRAME, MASONITE SKINS, EPOXY ADHESIVE; ROOF TRUSSES
17 **Exterior Elements**	CONVENTIONAL EXTERIOR FINISHES
18 **Interior Elements**	PLYWOOD PARTITIONS; CONVENTIONAL INTERIOR FINISHES
19 **Foundations**	SLAB
22 **Electrical**	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY; ELECTRICAL PANEL
PRODUCTION	
24 **Offsite Production**	WALL PANELS; ELECTRICAL PANELS; ROOF TRUSSES
26 **Onsite Construction and Erection**	PLACING OF WALL PANELS ON BASE PLATE & FASTENING; FOUNDATION
27 **Labor**	UNSKILLED ON SITE
ECONOMICS	
30 **Construction Costs**	$6.00 TO $10.00 PER SQ. FT.
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	CENTRAL CONTROL

Harold Lewis Malt Associates, Inc.



PROPOSER CONSORTIUM

Harold Lewis Malt Associates, Inc., Management of Environmental Design, Washington, D. C.
Brown, Wright, Mano, Architects, Site Planning, Washington, D. C.
W. R. Ewald, Jr., Planners, Community Planning, Washington, D. C.
Alex Lurkis Associates, Engineers, Environmental Engineering, New York, New York
Henry Cohen Associates, Engineers, Cost Control, Buffalo, New York
Dow Chemical Company, Materials, Midland, Michigan

This is a multifaceted proposal dealing with three distinct concepts of site-planning. Concept A centers on a single plan adaptable to any neighborhood situation for the design, integration and production of street furniture. Concept B addresses the systems development, integration and consolidation, and machine production and installation, of utilities, services and paved surfaces. Concept C comprises an operation-oriented cost-projecting information system for use in decision making during planning, design and engineering of proposed sites.

Among the numerous items to be considered under Concept A—a clustered street furnishing system—are such elements as streets, curbs, gutters, sidewalks, traffic lights, signs and mounting posts, street lighting, bus shelters, landscaping, canopies, and planter boxes. All would be designed by the proposer as an integrated whole to coincide with the existing or desired character of neighborhoods as functional and easily recognizable parts of a total plan. Services and fixtures would be consolidated or regrouped into new functional subsystems and components.

The organizing device for Concept B is a surface-recessed and industrialized utilities container or chase, with the aim being to eliminate the traditional fragmented and costly approach in which streets, sidewalks, alleys and similar circulation elements (which account for 25 to 50 percent of the land area of a

Harold Lewis Malt (continued)

typical housing development), as well as service elements, are handled by one or more local governmental departments. The proposer points out that the individual consideration of street lighting has posed a problem in an increasing number of areas where all utilities are buried underground. Additional problems arise in city situations where gas mains, water mains, sewers, electrical circuits and many other utilities are buried in haphazard fashion, causing constant problems in repair and reconstruction, and preventing any integrated development of pedestrian-level vistas.

It is proposed, instead, to containerize movement, communications and service systems, (such as water, telephone, electric and gas service) along with ancillary hardware. (Deep trunk sewers are excluded at this time.) The container or chase would be installed in a modular grid pattern, aligned vertically under pedestrian walks—which could be of slab construction to permit easy access to the chase below without undue disruption of pavement, traffic or convenience of pedestrians. One side of the chase, in fact, could be in the configuration of the gutter, to reduce the number of components. A further refinement might be the use of plastic foamed panels as underlayment for streets, to provide insulation and waterproofing, and, again, improve ease of access for service of repair.

Concept A

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; URBAN RENEWAL
5 Planning Concepts	PLAN FOR THE DESIGN, INTEGRATION & PRODUCTION OF STREET FURNISHINGS—SUCH AS STREETS, CURBS, GUTTERS, SIDEWALKS, TRAFFIC LIGHTS, SIGNS & MOUNTING POSTS, STREET LIGHTING, BUS SHELTERS, LANDSCAPING, CANOPIES, & PLANTER BOXES—ADAPTABLE TO ANY NEIGHBORHOOD SITUATION
8 Site Planning Services	NEIGHBORHOOD DESIGN OF STREET FURNISHINGS
BUILDING SYSTEMS	
14 State of Development	SYSTEM DEVELOPED
PRODUCTION	
24 Offsite Production	STREET FURNISHINGS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	CENTRAL CONTROL, DESIGN, INTEGRATION & PRODUCTION OF STREET FURNISHINGS
GENERAL	
39 Major Innovative Concepts	DESIGN, INTEGRATION & PRODUCTION OF STREET FURNISHINGS

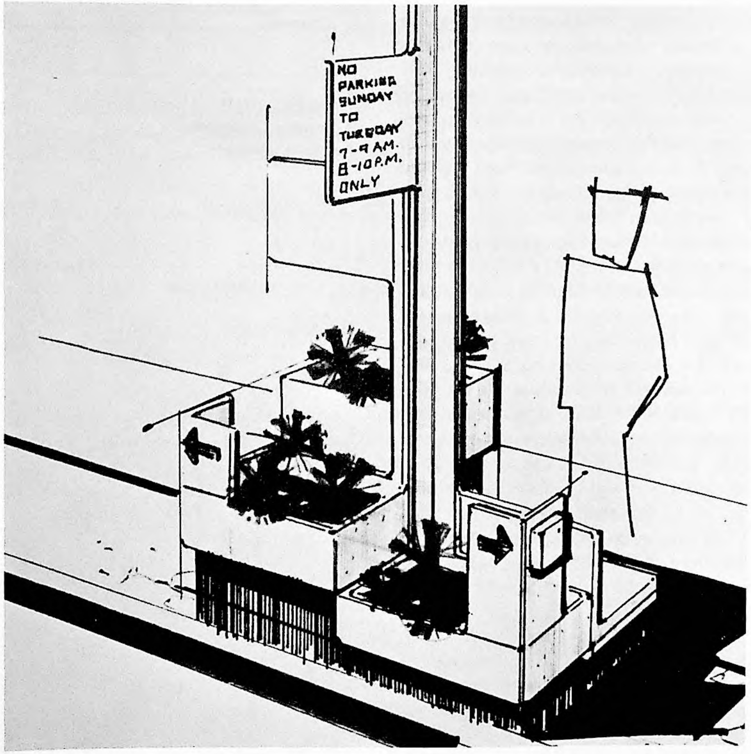
Concept B

SITE SYSTEM	
10 Utilities	INDUSTRIALIZED FOAM PLASTIC UTILITIES CHASE SYSTEM INTEGRATING ALL SITE UTILITIES INTO A UNIT FOR EFFICIENT INSTALLATION, REPAIR & MAINTENANCE
BUILDING SYSTEMS	
14 State of Development	SYSTEM COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED
PRODUCTION	
24 Offsite Production	MANUFACTURE OF FOAM PANELS FOR UTILITY CHASE; POSSIBLE STREET UNDERLAYMENT
26 Onsite Construction and Erection	EXCAVATION & INSTALLATION OF UTILITY PANELS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	CENTRAL CONTROL; INTEGRATED DESIGN & PRODUCTION OF FOAM PANELS
GENERAL	
39 Major Innovative Concepts	CONTAINERIZED SYSTEM FOR SITE UTILITIES
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Under Concept C, the information system to be developed would make use of applicable segments of HUD and nonproprietary developments already available, such as the Urban Renewal Information System and the Integrated Building Industry System. Necessary steps in developing the concept will be establishment of user needs, research of applicable techniques and procedures, structuring of the program and preparation of necessary software.

Concept C

SITE SYSTEM	
8 Site Planning Services	OPERATION-ORIENTED INFORMATION SYSTEM FOR USE IN DECISION MAKING IN PLANNING; DESIGN & ENGINEERING OF PROPOSED SITES BY PROJECTING COSTS.
BUILDING SYSTEMS	
14 State of Development	INFORMATION SYSTEM IN DESIGN STAGE; SOFTWARE METHODOLOGY & HARDWARE CONFIGURATIONS TO BE DEFINED
ECONOMICS	
30 Construction Costs	INFORMATION SYSTEM TO PROJECT COSTS FOR PLANNING & DESIGN OF PROPOSED SITES
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	CENTRAL CONTROL, DEVELOPMENT OF INFORMATION SYSTEM



Man Factors

PROPOSER

Man Factors, San Diego, California

Recognition of the human factor and awareness of the need to design homes in terms of the eventual occupant—rather than in terms of materials, codes, costs and purely esthetic considerations—directs this proposal toward study into the broad areas of human engineering and man-housing interface. Specifically, the study would examine current housing needs in order to develop a design guide built around human engineering principles.

The proposed research would consist of two phases. Phase I, a literature survey, would analyze home user requirements by review of current literature relative to architectural concepts, community planning and service requirements, environmental and geographic characteristics versus construction requirements, and current design concepts for houses, apartments and all related facilities. A second portion of Phase I would consist of preparation of an annotated bibliography and data bank derived from the literature survey.

Phase II, designated Human Engineering Guide Development, consists of four tasks: (1) Analysis of functional requirements for each element in a typical community, to determine user needs; (2) Time-based description of all user functions performed within each household space—for example, cooking, washing, and cleaning; (3) Link analysis of activities by the user, both within the house and in relation to outside facilities (such as school and recreational) in order to establish a preliminary definition of sizes, shapes, room relationships and traffic flow and possibly alternate configurations; and (4) Examination of all interface characteristics to determine pertinent data relative to design, the prior steps in the study having assured that all criteria produced will be oriented toward user efficiency, safety and comfort.

Results of the study would be threefold: (1) A summary of the state of the art; (2) A guide for design of housing which recognizes human factors; and (3) A final report on future planning and research needs into further development of human factors.

SITE SYSTEM	
1 Site Situtation 2 Density Range 3 Topography 4 Climate	DEVELOPMENT OF ANNOTATED BIBLIOGRAPHY & DATA INFORMATION BANK ON GEOGRAPHIC CHARACTERISTICS
7 Circulation	DEVELOPMENT OF ANNOTATED BIBLIOGRAPHY & DATA INFORMATION BANK ON TRAFFIC FLOWS & SERVICE RELATIONSHIP
8 Site Planning Services	REVIEW OF CURRENT LITERATURE DEALING WITH COMMUNITY PLANNING & SERVICES
BUILDING SYSTEMS	
11 Housing Types 12 Unit Variations 13 Design Selection	DEVELOPMENT OF ANNOTATED BIBLIOGRAPHY & INFORMATION DATA BANK ON DESIGN CONCEPTS
14 State of Development	PROPOSED STUDY
15 Community Involvement	TIME & MOTION STUDY OF HUMAN FACTORS FOR USE BY DESIGNERS & DESIGN EVALUATORS; USER NEEDS STUDY
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF ANNOTATED BIBLIOGRAPHY & INFORMATION DATA BANK ON ENVIRONMENTAL AND GEOGRAPHIC CHARACTERISTICS VERSUS CONSTRUCTION REQUIREMENTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF ANNOTATED BIBLIOGRAPHY & DATA INFORMATION BANK

Manor Manufacturing

PROPOSED

Manor Manufacturing Company, Incline Village, Nevada

Production and marketing of a series of single-family homes, shipped from the factory as a single legal load, ready for occupancy after siting and utility hook-up, is proposed by this manufacturer. The homes, which are of stressed-skin plywood construction and are manufactured in five floor sizes, all 26 ft. 8 in. wide, and ranging in length from 24 ft. 8 in. to 56 ft. 8 in., are available in three levels of finish. Thus, the economy line, with its unfinished plywood and absence of some cabinetry, offers the owner a potential for self-help completion; while the luxury line is far better finished and equipped down to items such as Roman tub baths.

The proposer has drawn heavily upon the experience of mobile home manufacturers in the production line fabrication and assembly of components into a fully integrated product and has realized significant cost advantages. The product departs from mobile homes in being heavier, built to housing standards, rather than mobile home standards (for example, halls are wider, room sizes are conventional), and although delivery is similar to that of a mobile home on an undercarriage and wheels, the unit probably will not be moved again. When once sited on the foundation or piers, the home rests closer to the ground than does the typical mobile home. The shipping undercarriage usually is returned to the factory but may be retained optionally for later use.

One-half to one working day only is required for normal placement and hookup, the full day generally indicating that optional architectural additions such as decks, and patios have been called for.

The proposer anticipates volume production to be accomplished in 20 plants located strategically around the country, with a total production of 100 units per day.

SITE SYSTEM

1 Site Situation	MOBILE HOME PARKS; RURAL; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
6 Nonresidential Functions	HOUSING UNITS TO BE PLACED ON SITES PLANNED & DEVELOPED BY OTHERS
7 Circulation	
8 Site Planning Services	

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
13 Design Selection	STANDARD PLANS WITH OPTIONS
14 State of Development	BUILDING SYSTEM & PRODUCTION FACILITIES IN DESIGN STAGE

BUILDING SUBSYSTEMS

16 Structure	PLYWOOD STRESSED-SKIN SELF-SUPPORTED MODULES; POSSIBLE STEEL FRAME SYSTEM
17 Exterior Elements	PLYWOOD WALL SURFACES; OPTIONAL DECKS, CARPORTS, GARAGES
18 Interior Elements	PLYWOOD WALLS, FLOORING & CEILINGS; OPTIONAL WALL & FLOOR COVERINGS
19 Foundations	PIERS OR OTHER CONVENTIONAL
20 Comfort Systems	WALL FURNACES; OPTIONAL AIR CONDITIONING

PRODUCTION

24 Offsite Production	MODULE & UNDERCARRIAGE
26 Onsite Construction and Erection	FOUNDATIONS; PLACEMENT OF MODULES; OPTIONAL FINISHING
27 Labor	UNSKILLED LABOR FOR ONSITE FINISHING (OPTIONAL)
29 Community Involvement	SELF-HELP LABOR FOR FINISHING (OPTIONAL)

ECONOMICS

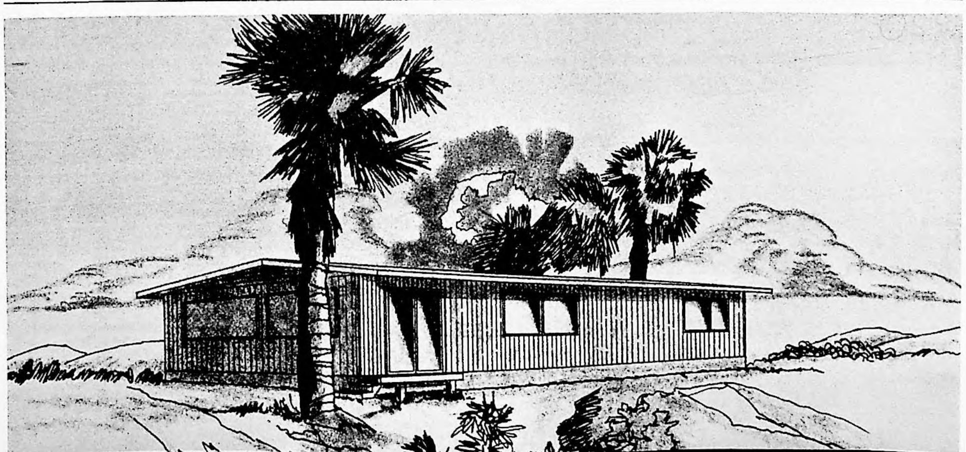
30 Construction Costs	$7,920 PER UNIT, 24 TO 100 UNITS PER MONTH

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN & ENGINEERING; PRODUCTION; MARKETING; DELIVERY & PLACEMENT OF UNITS
35 External Functions	SITE DEVELOPMENT
36 Market Area	NATIONAL; 20 PROPOSED PRODUCTION PLANTS LOCATED STRATEGICALLY
37 Delivery Rate	5 UNITS PER PLANT PER DAY; 100 UNITS PER DAY TOTAL FOR 20 PLANTS

GENERAL

40 Codes	ADAPTABLE TO ALL NATIONAL CODES



Massachusetts Institute of Technology

PROPOSER

Massachusetts Institute of Technology, Cambridge, Massachusetts

A cost comparison of push-up versus conventional methods of constructing a 20-story apartment building is proposed. The push-up method consists of building the top floor first at ground level and successively building the lower floors, using a jacking system to lift the entire structure, floor by floor. A cost savings of 12 percent has been estimated, based on preliminary studies.

No modifications of standard constructions are contemplated with the exception of minor changes in framing detail. Major impact is on sequence of construction, coordination of the several building trades, and efficiency of the total operation. Major savings are realized from the shortened construction time; analysis shows a reduction from 580 working days to from 400 to 440 working days for a high-rise office building.

A building erected by this push-up system is totally enclosed at all levels by use of temporary enclosures surrounding the lowest three or four floors, and permanent wall panels and glazing on all upper floors. Thus, with the exception of site preparation and foundation construction, all-weather construction can be achieved.

The objective of the proposed study will be to determine if there is an advantage (and if there is, its magnitude) in use of the push-up method applied to a typical apartment structure. The study will use plans developed for a 20-story apartment to be constructed in New York City. Alterations necessary to permit erection of the steel-framed building by the push-up concept will be determined. Also to be determined in the study are the impact on total project cost using the push-up method compared with conventional construction techniques, and the influence on other factors significant to the construction sequence. These other factors will include labor usage, ordering and delivery of materials, and installed equipment.

The proposed study will prove or disprove such potential advantages for the method as: (1) more efficient use of onsite labor with all activities localized near ground elevation; (2) more efficient distribution of materials since all equipment and materials used on a particular floor can be placed on that floor while it is near grade elevation; and (3) shorter time for completion, leading to less interest charges on construction funds and earlier return on investment.

SITE SYSTEM	
3 Topography	SUITABLE FOR LEVEL SITES BUT ADAPTABLE TO UNDULATING & ROLLING TERRAIN
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY HIGH-RISE
14 State of Development	PROPOSED ECONOMIC STUDY IN CONCEPTUAL STAGE; PUSH-UP CONCEPT PREVIOUSLY USED IN EUROPEAN CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure	STUDY TO BE CONDUCTED ON STEEL-FRAMED, MULTISTORY CONSTRUCTION
PRODUCTION	
26 Onsite Construction and Erection 27 Labor	STUDY OF PUSH-UP CONCEPT TO DETERMINE IMPACT ON EFFICIENT DISTRIBUTION OF MATERIALS, REDUCED CONSTRUCTION TIME, & MORE EFFICIENT USE OF ONSITE LABOR
ECONOMICS	
30 Construction Costs	STUDY OF RELATIVE ECONOMIC ADVANTAGE OF PUSH-UP CONSTRUCTION CONCEPT APPLIED TO HIGH-RISE APARTMENT CONSTRUCTION; CONSTRUCTION SAVINGS OF 12% ESTIMATED
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY (RESEARCH LABORATORY)
34 Internal Functions	ECONOMIC STUDY OF PUSH-UP METHOD OF CONSTRUCTION
GENERAL	
39 Major Innovative Concepts	PUSH-UP CONSTRUCTION CONCEPT

Mechaneer, Inc.

PROPOSER

Mechaneer, Inc., Mechanical Contractors, Arlington, Virginia

Creation of a new labor classification, tentatively called "housing mechanic," is suggested for study, along with the creation of a work manual.

The thought is that such mechanics could be drawn from low-income areas of a community and specially trained in selected skills below that of journeymen, but above that of laborers. A mechanic grade would be established in each separate building trade; and, for example, under such grade, fabrication and installation of vent piping and connection of plumbing fixtures might be included, while the fabrication and installation of basic soil and waste piping systems and water systems would be reserved for the journeymen. The proposal is based in part on the fact that work operations in housing construction are highly repetitive and lend themselves to operations by less skilled workers.

An instruction manual, developed for contractors, architects, engineers and labor, would describe: How to specify these new categories of labor; How to develop, organize and effectively utilize such workers; and, How new opportunities in specialty subcontracting could be developed, increasing possibilities for minority group entrepreneurs.

PRODUCTION	
27 Labor 28 Labor Training Programs 29 Community Involvement	STUDY TO DEVELOP A "HOUSING MECHANIC" LABOR CATEGORY IN EACH TRADE TO FACILITATE ENTRANCE & RETENTION OF MINORITY WORKERS IN SKILLED TRADES; "HOUSING MECHANICS" WOULD RANK ABOVE UNSKILLED & BELOW SKILLED CRAFTSMEN ON THE WAGE SCALE; APPROPRIATE TRAINING PROGRAM MANUAL TO BE WRITTEN; "HOUSING MECHANIC" PLAN WOULD EXPEDITE & ECONOMIZE ONSITE CONSTRUCTION
ECONOMICS	
30 Construction Costs	"HOUSING MECHANIC" PLAN COULD ALLOW A 12.5% REDUCTION IN CONSTRUCTION COSTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN & DEVELOP A "HOUSING MECHANIC" LABOR CATEGORY; PROVIDE A TRAINING MANUAL FOR NEW CAREER CATEGORIES
35 External Functions	CONSULTANT WORK
GENERAL	
39 Major Innovative Concepts	DEVELOPMENT OF "HOUSING MECHANICS" LABOR CATEGORY FOR BUILDING TRADES

Midwest Research Institute

SITE SYSTEM		
3 Topography	PROPOSED STUDY OF MATERIALS & TECHNIQUES FOR CHEMICAL CONSOLIDATION OF MARGINAL SOILS	
MANAGEMENT		
33 Proposer Organization	RESEARCH INSTITUTE	
34 Internal Functions	CENTRAL CONTROL; STUDY TO DEVELOP MATERIALS & TECHNIQUES FOR CHEMICAL STABILIZATION OF MARGINAL SOILS	

PROPOSER

Midwest Research Institute, Kansas City, Missouri

Capability for construction of housing on reclaimed land is the long range goal which stimulates this proposed research into chemical consolidation of soils. With land costs soaring, the need to build in marginal areas such as in flood plains, on poorly drained soils, on unstable or high-volume-change soils, or on those of high organic content, make imperative a solution to the problem of marginal land reclamation.

A two-phased program has been set forth to achieve the proposal's overall purpose of developing new technology for soil consolidation. The first task, using an experimental approach, would be to define the composition of materials to be used for consolidation, including modified portland cements. (Materials specifically designed for soil consolidation are not yet available—both lime and portland cement have found widespread use to date only because they are relatively cheap.) A second part of this first phase would be to determine the properties of soils treated with the derived materials.

The second phase of the work would entail a laboratory study of field methodology from which should emerge the sought-for new technology of chemical consolidation. A first-round evaluation to assess the economies of marginal land reclamation would conclude the study.

Neal Mitchell

PROPOSER

Neal Mitchell Associates, Inc., Architects and Engineers, Cambridge, Massachusetts.

Research aimed at determining the housing needs and desires of low-income families is proposed. Recognizing that, in general, the markets for individual building firms have been too small to justify the research and development effort necessary for adequate investigation of large-scale housing production, and that, specifically, standards for low-income, high-volume housing have not reflected the needs of low-income families, the proposer would remedy this by a five-year program in this area.

A proprietary "family technique," developed and tested by the proposer, would be used to uncover needs and desires, through nonverbal communication with low-income persons. Two elements of this technique are photo-recording (by trained observers) of present utilization of household facilities and spaces, and a gaming procedure which simulates new and potentially more desirable configurations and uses. New design concepts and materials, advances such as modular and component designs, plastic and synthetic materials, use of built-in furniture, integrated environmental subsystems, and integrated mechanical systems are among the possible fresh solutions which might be tested in this fashion.

The information flowing from this part of the research would be computerized for use in construction of a computer model of low-income housing, with specific social and technical inputs subsequently being accepted as a base for generating performance specifications.

Other tasks in the program would include a review of present building inspection procedures, construction of a systems framework for implementing and reviewing government housing programs, development of a framework for design implementation, and, finally, testing and evaluation of the systems framework.

BUILDING SYSTEM	
15 Community Involvement	RESEARCH TO DETERMINE THE NEEDS AND DESIRES IN HOUSING OF LOW-INCOME FAMILIES WITH REGARD TO HOUSEHOLD FACILITIES AND SPACES
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	PROPOSER WOULD USE PHOTO-RECORDING & TRAINED OBSERVERS TO DISCOVER USE OF HOUSEHOLD FACILITIES AND SPACES. INFORMATION TO BE COMPUTERIZED FOR USE IN CONSTRUCTION OF A COMPUTER MODEL OF LOW-COST HOUSING. OTHER TASKS INCLUDE REVIEW OF BUILDING INSPECTION PROCEDURES, CONSTRUCTION OF A SYSTEMS FRAMEWORK FOR IMPLEMENTING & REVIEWING GOVERNMENT HOUSING PROGRAMS

Neal Mitchell

PROPOSER CONSORTIUM

Neal Mitchell Associates, Inc., Architects and Engineers, Cambridge, Massachusetts
James P. Collins & Associates, Inc., Cambridge, Massachusetts.

Foundation cost is one of the greatest problems in low-rise urban construction, because most urban land has been used previously and, therefore, the properties of its soil vary greatly. Under these circumstances, conventional design techniques, without benefit of detailed subsurface investigation under each site (economically unfeasible), result in foundations that may risk failure or, more often as a safety measure, they are overly conservative in design and unnecessarily costly. Resolving this problem is the purpose of the investigation proposed.

Recognizing that the raft foundation concept appears to be the most logical and economical solution to building over rubble, because it averages loads (allowing for rubble's variations in properties), the proposers seek to extend the concept. Design of the raft foundation requires determination of a soil coefficient for implementation of its analysis. Arriving at such a coefficient is very difficult, particularly for rubble.

The proposed research would investigate the engineering properties of rubble and develop and refine field tests to allow a simple and inexpensive determination of average properties and of variations in rubble fill for a particular site, to the end that the soil coefficient could be determined and a raft foundation design, therefore, could be rationally achieved.

The program would be in three phases: (1) Some detailed subsurface investigation; (2) Computer simulation of raft foundations; and (3) Full-scale testing to check the preceding steps on raft foundations in service and on those constructed for the program.

SITE SYSTEM	
3 Topography	RESEARCH OF RUBBLE FILLS IN URBAN AREAS FOR DEVELOPMENT OF FOUNDATION DESIGN
BUILDING SUBSYSTEMS	
19 Foundations	RESEARCH TO INVESTIGATE THE ENGINEERING PROPERTIES OF RUBBLE; FURTHER DEVELOP DESIGN OF RAFT FOUNDATIONS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	TESTS TO DETERMINE SOIL COEFFICIENT OF RUBBLE TO ACHIEVE RAFT FOUNDATION DESIGN; DETAILED SUBSURFACE INVESTIGATION; COMPUTER SIMULATION OF RAFT FOUNDATIONS; FULL SCALE TESTS ON RAFTS IN SERVICE & ON SOME CONSTRUCTED FOR THE PROGRAM

Neal Mitchell

PROPOSER

Neal Mitchell Associates, Inc., Architects and Engineers, Cambridge, Massachusetts.

Investigation into the user needs of inner-city residents and arriving at techniques and methods of implementing these needs in terms of physical site solutions is proposed. The focus of the study would be the uncovering from the residents, their desires and preferences and the establishing of priorities for space requirements such as playing fields, tot lots, and areas for community dialogues—such as benches, or even the traditional "soap box."

This would be accomplished mainly through use of urban simulation gaming techniques developed by the proposer. Using information derived from a survey of open space and existing site facilities, the game would be played between investigators and residents to test a variety of user requirements and to test hypotheses concerning future site utilization. The game is played in conjunction with photographic records of similar and comparable facilities and their use, and with small-scale models of the components of neighborhoods such as homes, streets, parks, and various shapes of open areas which can be used to construct a neighborhood in any configuration.

Data flowing from this part of the study would be used to construct a computer model of site use, which subsequently would accept social and technical inputs, as a basis for generation of site development performance criteria. Another portion of the three-year study would investigate the role in government in connection with site use relating to regulations, constraints, and legislation. At the completion of the program, a positive program for the utilization of site space should result, with design criteria being responsive to evolving technology and to differentiated user needs.

SITE SYSTEM	
6 Nonresidential Functions 7 Circulation 8 Site Planning Services 9 Community Involvement	PROPOSER TO USE URBAN SIMULATION GAMING TECHNIQUES PLAYED BETWEEN INVESTIGATORS & RESIDENTS TO TEST USER REQUIREMENTS & HYPOTHESES CONCERNING FUTURE SITE UTILIZATION. DATA FROM THE STUDY TO BE USED TO CONSTRUCT MODEL OF SITE USE ACCEPTING SOCIAL & TECHNICAL INPUTS AS BASIS FOR GENERATION OF SITE DEVELOPMENT PERFORMANCE CRITERIA. THE 3-YEAR STUDY ALSO WOULD INVESTIGATE ROLE OF REGULATIONS & LEGISLATION IN SITE USE

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions 35 External Functions 36 Market Area 37 Delivery Rate 38 Consumer Protection	STUDY OF USER NEEDS OF INNER-CITY RESIDENTS & PROPOSAL OF TECHNIQUES & METHODS OF IMPLEMENTING THESE NEEDS IN TERMS OF PHYSICAL SITE SOLUTIONS

Neal Mitchell

PROPOSER

Neal Mitchell Associates, Inc., Architects and Engineers, Cambridge, Massachusetts.

The possibility of reducing the cost of the structural framework, the critical part of any house, motivates this proposal. In reinforced concrete design, the actual design load expected to be borne by the structure usually is multiplied by a load factor which acts as a factor of safety against failure of a member. In addition to this load factor, the capacity reduction factor must be added, making the design even more conservative.

This capacity reduction factor relates to such variances as dimensional accuracy, variations in concrete strength, and errors in analysis. Until recently these variances could not be separated because most concrete buildings were cast in place and close inspection was prohibitively expensive, thus obviating any possibility of controlling variances and resultant lowering of the capacity reduction factor. However, with an increase in precasting of structural members, under rationalized close-tolerance, factory conditions, it becomes possible to insist on greater quality control.

In order to determine what changes can be made in the capacity reduction factor due to such increased quality control, study of these variances should be made under controlled test conditions. The proposer suggests that a series of rectangular, reinforced lightweight concrete columns be tested to enable the critical parameters to be separated into three subdivisions—dimensional tolerance, variation in material strength, and uncertainty in design assumption. Columns were selected for testing because they represent the most conservative design with the capacity reduction factor often causing overdesign by 143 percent. Refuting or confirming the necessity of this conservative design would be the result of this research; and refutation could result in considerable savings in the cost of construction.

The tests would be in three phases: (1) Casting, with dimensional variations in steel reinforcing cage and resultant column being noted; (2) Cylinder testing, with three cylinders from the concrete batch for each column being tested and averaged; and (3) Testing to destruction of each eight test columns cast, with loads applied to each in 12 different modes of eccentricity. The results of the tests will be plotted in several different ways to reveal how the variances in each of the three critical areas of dimensions, concrete strength, and theory affect the ratio of predicted load to actual ultimate load.

BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE REQUIRING FURTHER RESEARCH AND TESTING
BUILDING SUBSYSTEMS	
16 Structure	RESEARCH TO DETERMINE THE PARAMETERS OF STRUCTURAL FRAMEWORK WITH REGARD TO CAPACITY REDUCTION FACTOR; SERIES OF TESTS ON LIGHTWEIGHT PRECAST CONCRETE COLUMNS TO ESTABLISH VALIDITY OF MARGIN-OF-SAFETY FACTORS
PRODUCTION	
24 Offsite Production	RESEARCH & TEST OF STRUCTURAL CAPACITY OF FOUR FACTORY-PRODUCED COMPONENTS—COLUMN, CANTILEVER BEAM, TRI-BEAM, SLAB
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	TESTING ON RECTANGULAR, PRECAST, REINFORCED CELLULAR CONCRETE COLUMNS. FOR IMPROVED INFORMATION ON THE CAPACITY REDUCTION FACTOR

Module Construction

PROPOSER

Module Construction, Inc., Walnut, California

In the building system proposed a membrane core building panel is utilized which causes all stresses handled by the core to fall within its surface confines. The system has been successfully used in Japan, and indications are that a complete building could be erected in a matter of hours by unskilled labor.

An exterior covering of 1/8" transite is suggested, laminated to a styrene core. Interior treatment utilizes 3/8" gypsum board. The resultant unit withstands 20 lbs. per sq. ft. wind loads. A structural metal frame is used to distribute roof-loading throughout the wall structure. Similar panels can be used for roof and ceiling structures as well.

Conduit for heating and cooling can be incorporated in wall panels creating a radiant wall system, and the proposer also indicates that printed circuits for electrical distribution can be laminated in the panels, as is being employed in Japan.

Core material used in the product is economical with a pound of styrene making three sq. ft. of core. With the availability of reclaimed plastic the cost of production can be lowered.

SITE SYSTEM	
1 **Site Situation**	SUBURBAN
BUILDING SYSTEMS	
14 **State of Development**	BUILDING SYSTEM DEVELOPED & MARKETED IN JAPAN
BUILDING SUBSYSTEMS	
16 **Structure**	WALL, CEILING & ROOF LOAD BEARING SANDWICH PANELS; METAL FRAME
18 **Interior Elements**	GYPSUM BOARD PARTITIONS
20 **Comfort Systems**	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
22 **Electrical**	CONVENTIONAL; POSSIBLE USE OF PRINTED WIRING CIRCUIT INCLUDED IN PANEL CONSTRUCTION
PRODUCTION	
24 **Offsite Production**	WALLS, CEILING & ROOF PANELS; FRAME COMPONENTS
26 **Onsite Construction and Erection**	ERECTION OF FRAME; PLACING OF PANELS; UTILITY HOOK-UP
27 **Labor**	UNSKILLED LABOR FOR ERECTION
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	CENTRAL CONTROL

Modumatic Building Units

PROPOSER

Modumatic Building Units, St. Petersburg, Florida

Research, development, and manufacture are proposed for a modular, unitized wall component, which could be assembled with ease by unskilled labor and built into complete wall systems for housing development. In one aspect, the prefabricated modular unit would consist of prefinished interior and exterior faces, with insulation applied to the inner sides of the faces, and a void formed between them by a nonbearing structure web.

These modular units of a wall system would be joined together by tie rods running through the inner core from foundation to roof, with the joints between units sealed with adhesive. The units alone would comprise the entire structure of a wall system, being capable of spanning openings for doors and windows.

Although subject to final determination by the proposed research and development program, the unitized wall elements probably would be made of metal and/or plastic, although cane fiber, masonite, treated wood and plywood would also be considered. Research and development also are proposed for unitized partition and roof systems.

BUILDING SYSTEMS	
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	RESEARCH TO DEVELOPMENT OF A PANEL WALL SYSTEM, WITH TIE RODS EXTENDING THROUGH INNER WALLS FROM FOUNDATION TO ROOF; MATERIALS TO BE EXAMINED INCLUDE PLASTICS, METALS, CANE FIBER BOARD, MASONITE, TREATED WOOD, PLYWOOD; JOINTS SEALED BY ADHESIVE. PARTITION AND ROOF SYSTEMS ALSO TO BE CONSIDERED
PRODUCTION	
24 Offsite Production	RESEARCH & DEVELOPMENT OF WALL PANEL PRODUCTION
26 Onsite Construction and Erection	PLACING OF PANELS
27 Labor	UNSKILLED FOR FACTORY ASSEMBLY
29 Community Involvement	SELF-HELP
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	RESEARCH & DEVELOPMENT OF WALL PANEL SYSTEM

William Morgan

PROPOSER

William Morgan, Architect, Jacksonville, Florida

AFFILIATES

Haley W. Keister, Structural Engineers; William J. Mouton, Structural Engineers; Evans & Hammond, Inc., Mechanical Engineers; Ed Heist, Jr., Interiors; Ed Stone Jr. & Associates, Landscape Architects; Mareou & O'Leary, Planning; Sylvan R. Shemitz & Associates, Lighting; Ross Construction Company, Cost Control

A housing system, particularly suitable for multifamily structures from 5 to 22 stories high, is proposed. The system, based on panelized concrete elements, evolved from experiments begun in the 1960's and is claimed to save construction costs and to be especially suitable for low- and moderate-income housing. For example, typical 15-story structures erected from the panelized components are said to cost 15 percent less than a comparable structure of conventionally cast-in-place concrete.

The claimed cost reduction is partially attributable to site rather than factory casting of the main structural elements—floor slabs and bearing walls—with a resultant savings in time and handling of materials. The flat-plate floor slabs are cast one on top of another at a further savings, because the only forming required is for the edges. A volume production rate of 5,000 units per year is anticipated using this site casting system.

Savings are achieved also through careful scheduling of the crane to the site, only after all the precast elements are ready for erection, and using it continuously so that equipment rental is minimized and the erection crew is used effectively. The flat slabs are designed so that each weighs less than the 10-ton capacity of most cranes.

After the bearing walls for each floor are placed, they are post-tensioned before being loaded by the slabs for the next floor, thus the entire structure is self-scaffolding, the post-tensioning enabling the structural entity to resist wind loads from any direction.

Interior partitions for the panelized system are of gypsum board on metal studs with a painted finish. Infill, endwall panels will be insulated, as required, with a knock-out section being provided for future through-the-wall air conditioning, at the occupant's option. Exterior finish for the high-rise structures generally will be exposed concrete.

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL
2 Density Range	50 TO 100 DWELLING UNITS PER ACRE FOR HIGH-RISE
3 Topography	ADAPTABLE TO ALL NORMAL SOILS & FLAT OR UNDULATING TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	CLUSTER
6 Nonresidential Functions	RECREATIONAL FACILITIES
7 Circulation	SEPARATE PEDESTRIAN & VEHICULAR TRAFFIC; UNDER PASSES, OVERPASSES
8 Site Planning Services	SYSTEM DESIGN
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY HIGHRISE
12 Unit Variations	EFFICIENCY; 1 TO 5 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED
15 Community Involvement	
BUILDING SUBSYSTEMS	
16 Structure	PRECAST CONCRETE FLOOR SLABS & WALL PANELS
17 Exterior Elements	EXPOSED CONCRETE FINISHES; ENDWALL INFILL PANELS
18 Interior Elements	GYPSUM BOARD & METAL FRAME STUD PARTITIONS; KITCHEN/BATH MODULE
19 Foundations	CONVENTIONAL; CONCRETE RAFT SLAB
20 Comfort Systems	CENTRAL HEATING INTEGRATED IN FACTORY FABRICATED UNIT; OPTIONAL CODING UNITS
21 Plumbing	CONVENTIONAL
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM
23 Furnishings	
PRODUCTION	
24 Offsite Production	KITCHEN/BATH MODULES
25 Onsite Production	WALL PANELS; FLOOR SLABS
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF PANELS; UTILITY HOOK-UP
27 Labor	SEMISKILLED
28 Labor Training Programs	
29 Community Involvement	SELF-HELP COMPLETION OF INTERIOR
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ARCHITECTURAL DESIGN
35 External Functions	STRUCTURAL ENGINEERING; PLANNING; LANDSCAPE ARCHITECTURE
36 Market Area	
37 Delivery Rate	5,000 UNITS PER YEAR (BEST RATE)
GENERAL	
39 Major Innovative Concepts	SITE CASTING OF STRUCTURAL ELEMENTS
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Multi-Racial Corporation

PROPOSER

Multi-Racial Corporation, Washington, D.C.

AFFILIATE

Interstate Research Associates, Washington, D.C.

The object of this proposal is the development and perfection of housing development corporations (HDC's) which would be set up in various urban and rural areas to design and operate integrated housing programs at the local level. The rationale for the program is the conviction that cost reductions in the manufacture and erection of physical structures will not necessarily in themselves result in low- and medium-cost housing. Until such systems are transported to a site, installed, financed, and inhabited, volume housing has not been achieved, and only through changes in certain institutional mechanisms will it be achieved.

The HDC's to be organized would engage in activities in the following areas: land purchase, financing, site preparation, relationships with Operation Breakthrough contractors, local codes, self-help housing, community information about housing, and manpower training.

Two other objectives of the proposed program would supplement and complement the HDC's. One would be to lower the cost of housing at the local level by excluding as many costs as possible from mortgage funds and arranging to have such costs financed by other programs. Specifically, labor costs for land clearance, offsite work, foundation work, assembly and other house construction activities might be financed from manpower training funds, and not from contractors' funds which ultimately end up in the mortgage.

The other objective would be to develop an effective information flow system at the community level about housing preferences for size, style, materials and costs; this information would flow back to the housing industry companies involved, as an independent check against information obtained by them directly.

SITE SYSTEM	
1 Site Situation	URBAN; RURAL
8 Site Planning Services 9 Community Involvement	DEVELOPMENT & PERFECTION OF HOUSING DEVELOPMENT CORPORATIONS TO DESIGN & OPERATE INTEGRATED HOUSING PROGRAMS. HDC WOULD ENGAGE IN SITE PREPARATION
PRODUCTION	
28 Labor Training Programs 29 Community Involvement	HOUSING DEVELOPMENT CORPORATION TO DEVELOP MANPOWER TRAINING, DIRECT SELF-HELP HOUSING & LOCAL CONTRACTORS
ECONOMICS	
30 Construction Costs 31 Financing Methods	POSSIBILITY OF LABOR COSTS FOR LAND CLEARANCE, FOUNDATION WORK, ASSEMBLY & CONSTRUCTION FINANCED FROM MANPOWER TRAINING FUNDS INSTEAD OF CONTRACTORS' FUNDS; HOUSING DEVELOPMENT CORPORATIONS TO ARRANGE FINANCING & REDUCE MORTGAGE COSTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions 35 External Functions	DEVELOPMENT & PERFECTION OF HOUSING DEVELOPMENT CORPORATIONS TO DESIGN & OPERATE INTEGRATED HOUSING PROJECTS. PROGRAM ACTIVITIES IN SAN ANTONIO, DENVER & LOS ANGELES
GENERAL	
40 Codes	HOUSING DEVELOPMENT CORPORATIONS TO WORK WITH LOCAL CODE GROUPS

R. A. Nack

PROPOSER

R. A. Nack and Associates, Inc., Carbondale, Illinois

AFFILIATES

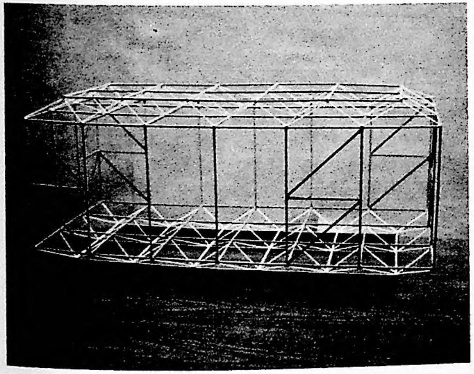
School of Technology, Southern Illinois University; Bureau of Business Research, Southern Illinois University

Development of self-supporting box modules is proposed, built around steel pipe supporting members (or structural tubing), and utilizing sandwich panels for attachment to this frame in a factory operation.

Units would be suitable for trucking to a site from a central factory, since width would be held to 12 feet; principal purpose would be for assembly into single-family, and multifamily low-rise structures. Factory production could utilize semiskilled workers; site work would require little skilled labor.

Several types of sandwich panels are under consideration, including panels that can act as structural units or structural members with sheathing attached to act as walls. With either these components or others, maximum freedom would be permitted to occupants as to decoration and final finish. The box modules formed around the structural frame would have a uniform 12-ft. width, and would vary in length from 24 ft. to 60 ft. Plywood or metal decking would provide a base for roofing; exterior siding could be of many materials. No special foundation conditions would be required.

The system, with accompanying production facilities, is in the design stage at the present time, thus requiring further research and construction of a prototype for full scale testing.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
3 Topography	ADAPTABLE TO ALL NORMAL SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTI-FAMILY LOWRISE
14 State of Development	PRODUCTION PLANT & BUILDING SYSTEM IN DESIGN STAGE REQUIRING FURTHER RESEARCH & PROTOTYPE CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure	MODULE OF STEEL PIPE FRAME; SANDWICH WALL PANELS; PLYWOOD OR METAL ROOF DECKING
17 Exterior Elements	REINFORCED EXTERIOR SIDING
18 Interior Elements	RIGID FOAM INSULATION; GYPSUM BOARD OR WOOD PANELING
PRODUCTION	
24 Offsite Production	STRUCTURAL STEEL TUBING; WALL PANELS
26 Onsite Construction and Erection	ERECTION OF STEEL FRAME & SANDWICH PANELS
27 Labor	UNSKILLED AT FACTORY; MINIMUM SKILLED ON SITE
28 Labor Training Programs	INDIGENOUS WORKERS TO BE TRAINED IN THE MANUFACTURING PROCESS
29 Community Involvement	SELF-HELP LABOR
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF DESIGN, INTERIOR WORK, METHOD OF TRANSPORTATION, & SITE REQUIREMENTS
GENERAL	
39 Major Innovative Concepts	TUBULAR STEEL FRAME BUILDING SYSTEM; PANEL DEVELOPMENT

Nashua Fiberglass

PROPOSER

Nashua Fiberglass Company, Inc., Nashua, New Hampshire.

Design and development of the equipment and molds by which could be produced almost every element of a panelized, fiberglass, one story single family home is proposed by this manufacturer. Applying experience in the production of custom-molded fiberglass products for such industries as electronics, spacecraft, and automotive, the proposer would arrive at rationalized factory processes capable of turning out load-bearing walls, non-bearing or filler panels, roof trusses, roof panels, and unitized bathroom, kitchen and closet components.

Both interior and exterior wall surfaces could be customized to suit individual or market preferences by use of special mold inserts which could simulate exteriors (for example, board-and-batten clapboard, shingle, or stone) with a wide range of color and texture treatments being available through impregnation of the plastic mix.

A wall panel locking system would be developed consisting of matching grooves formed in the sides of the panels, these grooves to be injected with a special adhesive which would bond the panels into a structural entity. Other joint fittings in the respective components (joining, for example, top plate to walls, trusses to top plate, and roof panels to trusses) would effect a combination mechanical/adhesive bond between elements and add structural rigidity to the entire structure.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
4 Climate	ADAPTABLE TO ALL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
14 State of Development	DESIGN STAGE; FURTHER DEVELOPMENT & PROTOTYPE UNIT REQUIRED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	DESIGN & DEVELOPMENT OF: FIRE RETARDANT FIBERGLASS LOAD-BEARING WALL PANELS, TRUSSED RAFTERS & ROOF COMPONENTS; NON-LOAD BEARING WALL PANELS; FIBERGLASS MOLDS FOR CASTING CONCRETE; SPECIAL CONNECTIONS FOR COMPONENT SECTIONS
20 Comfort Systems	FACTORY INSTALLED HEATING PLANT
21 Plumbing	CAST UNITIZED BATHS & KITCHENS
PRODUCTION	
24 Offsite Production	FIBERGLASS PANELS & COMPONENTS; UNITIZED KITCHEN BATH
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF PANELS; PLACING OF KITCHEN & BATHROOM UNITS
27 Labor	UNSKILLED LABOR FOR FABRICATION
28 Labor Training Programs	AVAILABLE AT NASHUA PLANT
ECONOMICS	
30 Construction Costs	$9,774 PER 960 SQ. FT. UNIT EXCLUDING TRANSPORTATION & LAND ($10.15 PER SQ. FT.)
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	COMPLETE DESIGN & DEVELOPMENT OF FIBERGLASS PANEL METHODS; PROTOTYPE HOUSE
35 External Functions	EVENTUAL FRANCHISE/LICENSE OF PLANT OPERATIONS
36 Market Area	NATIONWIDE; 300 MILE RADIUS OF PLANTS
37 Delivery Rate	1 HOUSE PER DAY PER PLANT

NAHB Research Foundation, Inc.

PROPOSER

National Association of Home Builders Research Foundation, Inc., Rockville, Maryland.

Development of plans and specifications for low-cost, minimum-area housing, using conventional materials and saving 15 to 20 percent in construction costs, is the aim of this proposal. Referred to as "least cost engineered," the process can be adapted to any of three construction methods depending upon type and volume of the market: (1) Three-dimensional modules or unitized components, constructed in a factory and delivered by reusable trailer to the site; (2) Components built in shop facilities; (3) Advanced construction methods onsite, with alternate use of special jigs and fixtures to facilitate use of indigenous, unskilled labor. The least cost engineering approach, plus architectural and scientific analytical methods and efficient production management will bring about the projected cost saving.

Least cost engineering involves the application of laboratory and field tested cost-reducing practices, involving such items as design, materials, products, and standards. The proposer has been studying and building research houses since 1955, developing and incorporating many innovations. Those found to be mutually compatible will be incorporated in a single integrated system. User needs and full utilization of all conventional material capabilities are primary considerations in the concept. Each element of the dwelling unit will be studied in the light of cost reduction through engineering and innovation.

An important factor is the use of currently available materials, shops and labor; no factories will be constructed, no new production machinery designed, and no training programs structured to accommodate the system. Self-help labor will be used in finish painting, landscaping, and some of the actual construction work. Documented cost-reducing innovations will be developed and integrated into the system for most dwelling unit elements: footings, slabs, floors, walls, roofs, closets, electrical, plumbing and heating subsystems, trim, and siding.

The proposed system will be adaptable to construction of unitized components or modules in a factory, use of an offsite factory or shop, or for onsite construction depending on market need. Code and union problems are acknowledged, but these are felt to be less serious in a system using conventional materials and labor skills than in totally innovative approaches.

As proposed, the plan would involve development of basic systems and alternatives suitable for houses with a minimum square footage, providing units adequate to serve the space needs of conventional households of two adults and two, three or possibly four young children. Housing types would include single-family detached and attached and multifamily low-rise.

SITE SYSTEM	
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOIL
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
13 Design Selection	DEVELOPMENT OF PLANS AND SPECIFICATIONS THROUGH LEAST COST ENGINEERING PROCESS
14 State of Development	LEAST COST ENGINEERING PROCESS HAS BEEN PROVEN ON EXPERIMENTAL HOUSES
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations 20 Comfort Systems 21 Plumbing 22 Electrical 23 Furnishings	DEVELOPMENT OF LEAST COST ENGINEERING PROCESS APPLIED TO (1) FACTORY-BUILT VOLUMETRIC COMPONENTS OR MODULES, (2) OFFSITE SHOPBUILT COMPONENTS, (3) ADVANCED SITE CONSTRUCTION METHODS
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection	THE PROPOSED SYSTEM ADAPTABLE TO CONSTRUCTION OF UNITIZED COMPONENTS OR MODULES IN A FACTORY, TO USE OF OFFSITE FACTORY OR SHOP FOR BUILDING COMPONENTS, OR TO ONSITE CONSTRUCTION, DEPENDING ON MARKET NEED
29 Community Involvement	SELF-HELP LABOR IN CONSTRUCTION & FINISHING
ECONOMICS	
30 Construction Costs	LEAST COST ENGINEERED PROCESS TO FIND LEAST COST SYSTEM; ESTIMATED COST REDUCTION OF 15 TO 20%
MANAGEMENT	
33 Proposer Organization	RESEARCH FOUNDATION
34 Internal Functions	RESEARCH & DEVELOP PLANS & SPECIFICATIONS FOR LEAST COST ENGINEERED, CONVENTIONAL MATERIALS, BUILDING SYSTEM

NAHB Research Foundation, Inc.

PROPOSER

National Association of Home Builders Research Foundation, Inc., Rockville, Maryland.

Proposed here is a production control system useful in lowering costs, increasing productivity, and stimulating new industrialized building concepts, all within the framework of current home construction processes. It would look toward the introduction of production control on the housing site, similar to that applied in the machine-tool manufacturing industry, and would proceed from the collection of detailed labor data and materials-use information. This would be compiled on specified jobs and transmitted to a central point for computer processing. This would furnish unit labor times for each job and operation studied. Jobs would be categorized by house type and characteristics.

When the information is collected and computerized, it would be analyzed for high-cost areas, cost variations, and low-cost areas among the participating builders. Through a feed-back process, these builders would benefit from the new knowledge on methods and materials brought to them through the production control system. Initially, the project would involve three builders relying mainly on their own labor forces, who construct 50 to 100 units per year. Cost to the builder would be determined from the proposed research. Ultimately, this charge would drop to a point where net labor and materials cost savings would be realized.

PRODUCTION	
25 **Onsite Production**	PRODUCTION CONTROL SYSTEM WILL PROMOTE INDUSTRIALIZED SITE BUILDING
26 **Onsite Construction and Erection**	
27 **Labor**	CONTROL OF LABOR OPERATIONS & INVENTORY ITEMS BY PRODUCTION CONTROL SYSTEM
ECONOMICS	
30 **Construction Costs**	PRODUCTION CONTROL SYSTEM TO LOWER COSTS OF LABOR & MATERIALS
MANAGEMENT	
33 **Proposer Organization**	RESEARCH INSTITUTE
34 **Internal Functions**	DEVELOP INDUSTRIALIZED PRODUCTION CONTROL SYSTEM FOR THE CONVENTIONAL HOME BUILDING PROCESS
35 **External Functions**	INITIALLY THREE BUILDERS TO CONSTRUCT 50 TO 100 UNITS PER YEAR & CONTRIBUTE INPUTS TO THE SYSTEM
37 **Delivery Rate**	PRODUCTION CONTROL TO INCREASE PRODUCTION

NAHB Research Foundation, Inc.

PROPOSER

NAHB Research Foundation, Inc., Rockville, Maryland.

An industrial engineering study of rehabilitation of dwelling units to better identify problems and solutions in this area forms the basis of this proposal. Methods for reducing in-place costs for labor and materials will be developed, and the studies are expected to lead to new products, materials, and equipment that can be designed specifically for rehabilitation work. Another objective is to identify ways by which so-called unemployables can engage in certain rehabilitation tasks. The supply of labor and subcontractors for work of this nature would be expanded.

The proposal calls for the rehabilitation of three similar or, if possible, identical structures with a labor and materials profile charted on the first and third. The first project would be done with conventional methods and materials, with new methods and opportunities for cost reductions for both labor and materials noted. New methods found to be worthy would be adopted in the rehabilitation of the second dwelling unit. Finally, methods proven in the second practice unit would be adopted for the third. The before-and-after data would identify new methods for reducing labor and material costs and would identify new products, materials, tools, and equipment.

An important product of these demonstration projects would be an abbreviated report for builders outlining the program findings. This publication would be given wide distribution, providing builders having little or no previous rehabilitation experience with information that could reduce their risks in entering the rehabiliation market. A builder well established in rehabilitation work would be selected to conduct the experimental projects.

SITE SYSTEM	
1 Site Situation	URBAN RENEWAL
PRODUCTION	
26 Onsite Construction and Erection	STUDY OF REHABILITATION REQUIREMENTS FOR ONSITE SPOT DECISIONS & INCREASED SUPERVISION REQUIRED; MATERIALS LOGISTICS
27 Labor	STUDY OF HIGH LABOR TIME PROBLEM FOR REHABILITATION; EXPERIENCED & SKILLED WORKMEN REQUIRED
ECONOMICS	
30 Construction Costs	STUDY IS TO IDENTIFY COST-SAVING PRINCIPLES FOR REHABILITATION
MANAGEMENT	
33 Proposer Organization	RESEARCH INSTITUTE
34 Internal Functions	CONDUCT ONSITE INDUSTRIAL ENGINEERING STUDIES OF REHABILITATION; TO IDENTIFY & SOLVE PROBLEMS
35 External Functions	REHABILITATION WORK BY A PARTICIPATING BUILDER

National Loss Control Service

PROPOSER

National Loss Control Service Corporation, (Subsidiary of Kemperco), Chicago, Illinois

This proposal addresses itself to providing consulting services in two phases of fire protection. Phase I would encompass the development of fire protection design performance criteria; while in phase II, comprehensive fire protection evaluations of various proposed housing systems would be provided. The proposer would provide the necessary staff, engineering support and assistance to develop and present data supporting possible necessary variance in model and local code requirements.

Each projected housing system would be analyzed for all pertinent fire protection design parameters such as materials, system components, service systems, layouts, critical detection-alarm items, and escape facilities. Occupant safety, fire spread, and public fire department needs would be essential considerations.

Paramount objective is to provide means for negating time and effort expended on system designs with serious and/or insurmountable fire protection problems which generally defy economical solution.

BUILDING SYSTEMS	
11 Housing Types 12 Unit Variations 13 Design Selection 14 State of Development 15 Community Involvement	DEVELOPMENT OF FIRE PROTECTION DESIGN PERFORMANCE CRITERIA. ANALYSIS OF BUILDING MATERIALS, SYSTEMS COMPONENTS, UTILITY SERVICE SYSTEMS, INTERIOR LAYOUTS, CRITICAL DETECTION & ALARM SYSTEMS, EXPRESS FACILITIES, & SITE CONFIGURATIONS TO OBTAIN FIRE PROTECTION DATA.
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations 20 Comfort Systems	
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOP FIRE PROTECTION DESIGN PERFORMANCE CRITERIA & EVALUATION OF SYSTEMS
GENERAL	
40 Codes	RESULTS OF STUDY MAY SUPPORT VARIANCES IN MODEL & LOCAL CODE STANDARDS IN FIRE PROTECTION

Newark College of Engineering

PROPOSER

Newark College of Engineering, Newark, New Jersey.

The postulation set forth in this proposal is that no major industry in the United States is as deficient in systematic research as is the housing industry, the most prominent deficiency being the lack of adequate marketing data. The proposed program is for statistical sampling and analysis of findings related to consumer wants and local environment.

A series of control groups, comprising 300 families, will be questioned concerning designs, needs, likes, and desires; the goal being to discover which housing and environment types will be acceptable to low-middle income groups. Results of the question-and-answer surveys will be translated to a series of innovative experimental designs which will be presented to a subcontrol group to determine acceptability.

The end result would be a preference ranking of existing and experimental designs leading to a costing out of such housing developments. Expansion of the sample households to a representative universe would then yield a marketability and feasibility study of each housing design and development. The factors would then be related to current conditions and extrapolated to a forecast of requirements for the future in five-year increments.

SITE SYSTEM	
8 Site Planning Services	THROUGH THE USE OF QUESTIONNAIRES & GRAPHICS
9 Community Involvement	STUDY TO ASCERTAIN THE DESIRES OF SURVEY GROUP WITH RESPECT TO LOCAL ENVIRONMENT
BUILDING SYSTEMS	
11 Housing Types 12 Unit Variations 13 Design Selection	DEVELOPMENT OF REPRESENTATIVE DESIGNS BASED ON SURVEY RESULTS
14 State of Development	PROPOSED STUDY
15 Community Involvement	STUDY TO ASCERTAIN USER NEEDS THROUGH THE USE OF QUESTIONNAIRES & PICTURES. STUDY THE SOCIAL, ECONOMIC, & OTHER CHARACTERISTICS OF SURVEY GROUP
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	CONDUCT USER-NEEDS STUDY TO DETERMINE MARKETABILITY OF HOUSING SYSTEMS; DEVELOPMENT OF REPRESENTATIVE DESIGNS

Newark College of Engineering

PROPOSER

Newark College of Engineering, Newark, New Jersey.

This proposal embraces an investigative program relative to current building construction requirements and a study of unique and innovative construction methods. The proposer intends to research design load factors, which appear to be overly conservative, and to apply resultant findings to a program of general building code revisions.

A second part of the study would be devoted to an investigation of new techniques in component manufacture, as well as overall construction, with the intent of demonstrating how building costs may be substantially reduced.

The latter program would deal specifically with foundation techniques having a wide range of physical properties and accommodating a variety of topographies, modular panels for walls and floors, prestressing of main bearing members, construction techniques allowing efficient redistribution of load patterns, bonding techniques for joining members at main joints, and synthetic continuous core construction in sandwich panels.

The end product would be a report which could serve as the basis for altering and updating construction standards throughout the homebuilding industry.

BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	REVIEW OF EXISTING STANDARDS CONCERNED WITH LOADING DEFINITIONS & PATTERNS; MODULAR CONSTRUCTION; PRESTRESSING TIMBER; BONDING; SYNTHETIC CONTINUOUS CORE CONSTRUCTION; LOAD REDISTRIBUTION
19 Foundations	INVESTIGATION OF TECHNIQUES & NEW SYSTEMS; POSSIBLE ELIMINATION OF BASEMENTS & FROST WALLS BY USE OF PIERS & BEAMS/FLOOR PANELS
ECONOMICS	
30 Construction Costs	PROPOSED REVISION OF CONSTRUCTION STANDARDS TO REDUCE CONSTRUCTION COSTS
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	CONDUCT STUDIES OF CURRENT STANDARDS & INNOVATIONS TO REDUCE LOADING REQUIREMENTS & SUBSEQUENT COSTS
GENERAL	
39 Major Innovative Concepts	INVESTIGATION OF INNOVATION IN BUILDING TECHNIQUES
40 Codes	STUDY TO RECOMMEND REVISIONS TO OVERLY CONSERVATIVE OR OUTDATED ENGINEERING CODES

Nolen, Swinburne & Associates

PROPOSER

Nolen, Swinburne & Associates, Architects, Philadelphia, Pennsylvania

This proposal offers an interdisciplinary research program which will establish criteria for a complex to be known as the new city, with housing as an important subsystem. The proposal includes creation of a model wherein the matrix of variable, interlocking criteria may be tested and alternatives considered by planners and architects of future cities of varying sizes and locations.

Postulations are advanced as a basis for definition of the project by activity subsystems such as living, learning, talking, playing, caring, (the relevant needs of the people).

The technical approach separates into four major disciplines of investigation: geo-physical, private, public, and growth and change sectors. The framework for development of criteria would be constructed on sectors of the city, needs of the city, dynamics of the city, and realities of the city. Each discipline would be studied singly, and in conference with each subgroup, and in meeting with all groups present.

After development and determination of the basic needs in each discipline and its subfunction, the ultimate goal would be to produce a universal model for use by planners and architects in immediate and long-range city planning.

SITE SYSTEM
1 **Site Situation**
2 **Density Range**
3 **Topography**
4 **Climate**
5 **Planning Concepts**
6 **Nonresidential Functions**
7 **Circulation**
8 **Site Planning Services**
9 **Community Involvement**
10 **Utilities**

INTERDISCIPLINARY RESEARCH PROGRAM TO ESTABLISH CRITERIA FOR THE NEW CITY AS A COMPLETE SYSTEM WITH HOUSING AS A SUBSYSTEM; PERFORMANCE REQUIREMENTS FOR THE NEW CITY WILL BE DETERMINED FROM THE GEO-PHYSICAL SECTOR, PRIVATE SECTOR, PUBLIC SECTOR, AND GROWTH & CHANGE. CONCEPTUAL MODELS WILL BE USED TO TEST ALTERNATE PLANNING & ARCHITECTURAL CONCEPTS. USER NEEDS STUDIES & SURVEYS WILL ALSO BE CONDUCTED.

BUILDING SYSTEMS
11 **Housing Types**
12 **Unit Variations**
13 **Design Selection**
14 **State of Development**
15 **Community Involvement**

MANAGEMENT
33 **Proposer Organization** — PROFESSIONAL
34 **Internal Functions** — CONDUCT OF INTERDISCIPLINARY STUDY OF THE NEW CITY WITH HOUSING AS A SUBSYSTEM.

Old Dominion University

PROPOSER

Old Dominion University, Civil Engineering Department, Norfolk, Virginia

An experimental apartment structure, with its units made up of fiberglass-reinforced elements and suspended (actually, cantilevered) from central service and stairwell cores, is proposed.

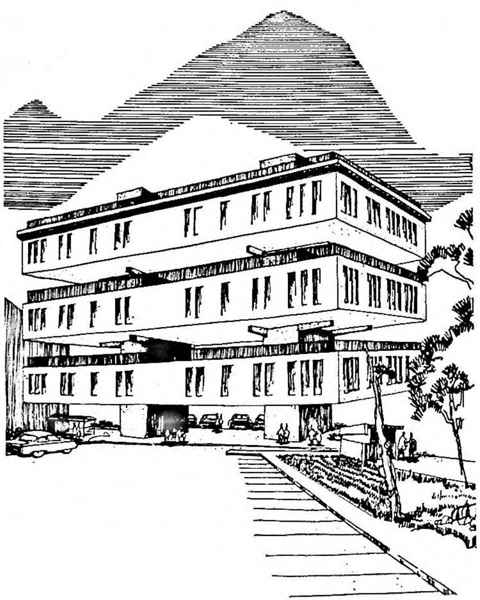
Analytical and experimental research on the structural behavior of the building components is described. The proposed research also will include study of architectural and utility requirements, to the extent that the resulting structural system will be economically and structurally feasible.

The building system would be composed of a number of prefabricated fiberglass reinforced plastic units, strengthened by an integral wood frame, and mounted on and supported by two reinforced concrete stairwell cores. Stairwell cores can be either precast and post-tensioned, or cast-in-place at the site. The plastic units themselves are to be made up in two sections, by the open-mold spray-up process with a polyester resin with continuous roving and a mat or fabric reinforcement as required at points of stress. After sections are removed from molds, a reinforcing wood frame would be inserted, and bonded to the plastic wall material by a sprayed layer of resin and chopped fiberglass.

Advantages of the proposed system include the excellent insulating and weatherproof characteristics of the plastic itself and noise reduction between apartments, since vertical separation is planned and horizontal points of contact will be reduced to only two short common walls.

A further advantage is that the finished unit—standing, to all appearances, on stilts formed by the stairwell cores—will have no rigid building line to inhibit landscaping and maintenance and can provide covered parking space.

Foundations may be of two types, spread or pile foundations, depending on soil conditions at the site. In either case, foundations would extend outward in a direction parallel to the short axis of the building a sufficient distance to provide stability against lateral wind loading (in addition to providing required bearing capacity for vertical loading).



SITE SYSTEM

1 Site Situation	URBAN; URBAN RENEWAL; SUBURBAN; RURAL
2 Density Range	32 TO 48 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
6 Nonresidential Functions	BETWEEN-STORY PATIOS WITH PROVISIONS FOR SEATING, GAMES, OUTDOOR COOKING

BUILDING SYSTEMS

11 Housing Types	MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 3 BEDROOMS
14 State of Development	BUILDING SYSTEM REQUIRES DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING

BUILDING SUBSYSTEMS

16 Structure	WOOD FRAME FIBERGLASS & PLASTIC VOLUMETRIC MODULES; SUSPENDED FROM CONCRETE CORES
17 Exterior Elements	FIBERGLASS & PLASTIC CORROSION-FREE WALL SURFACES
18 Interior Elements	CONVENTIONAL CEILING, WALL & FLOORING MATERIALS ATTACHED TO MODULE WOOD FRAME
19 Foundations	CONVENTIONALLY DESIGNED; SPREAD FOOTINGS OR PILES
20 Comfort Systems	OPTIONAL ELECTRIC PANEL OR HOT WATER HEATING
21 Plumbing	SERVICE CHASE INTEGRATED IN STAIRWELL CORES
22 Electrical	

PRODUCTION

24 Offsite Production	VOLUMETRIC MODULES; OPTIONAL PRECAST STAIRWELL CORE SECTIONS
26 Onsite Construction and Erection	FOUNDATIONS, OPTIONAL SLIP FORMING OF STAIRWELL CORES

MANAGEMENT

33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	ANALYTICAL & EXPERIMENTAL RESEARCH OF STRUCTURAL SYSTEM; CONSIDERATION OF ARCHITECTURAL & UTILITY REQUIREMENTS & MASS PRODUCTION FEASIBILITY

GENERAL

40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Omnia Franchise Corporation

PROPOSER

Omnia Franchise Corporation, Easton, Maryland

Substantial reduction in the cost of reinforced concrete structural framework for low- and high-rise housing is projected for this modularized system of construction. The concept is based on a combination of site-cast concrete and factory-cast thin concrete panels, which incorporate prelocated, three-dimensional reinforcement assemblies—these panels acting as formwork for shear walls—and one-way reinforced concrete floor slabs. The cost reduction stems from the retionalized, high-volume, low-cost factory manufacture of the modular units and the fact that, although they act as formwork, they become monolithic with the site-cast concrete to produce an overall structural entity, to which they contribute their design strength. The net effect is that the cost of formwork and of form stripping has been eliminated.

There are two types of modular components in the system. The wallform component consists of two identically made, 2-in.-thick panels, 4 in. apart, spaced by stirrups protruding from panels (and tied to #2 bars embedded in the panels). These stirrups form a lattice of reinforcement on 2-ft. centers vertically. These double-walled, shear-wall form components typically are 4 ft. wide and of room height.

The other component, the floor slab form, consists of a single, 2-in-thick concrete panel, with stirrups protruding from the panels and tied to the reinforcement within the panel, forming a lattice-girder system 2 ft. on center. Site-placed temperature steel and continuity reinforcement over the shear walls are supported by this girder system for reinforcement of the site-placed concrete which, when added to the 2-in. concrete panel, makes up the required floor thickness. The floor elements typically are 4 ft. wide, and in lengths up to 30 ft. clear span.

Since the manufactured components come from the factory with a smooth finish, for both walls and underside of the floor slab for ceilings, they are ready for painting or texture spraying. Preformed holes in both wall and floor units are provided for lateral and vertical runs of ducting, plumbing, and electrical conduit, thus affording additional construction savings. Finally, because the structural framework consists only of load-bearing shear walls along the length of the building and floor slabs, the ends remain open, providing easy access for installation of mechanical services and finishing operations, with these ends eventually being weather-sealed by nonbearing infill panels.

The structure which results from use of the modular concrete form units, in combination with *in-situ* concrete is equivalent in all aspects to a completely cast-in-place reinforced concrete frame and complies with all codes in place.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	FLEXIBLE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS & EARTHQUAKE AREAS
4 Climate	ADAPTABLE TO ALL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	FLEXIBLE
13 Design Selection	FLEXIBLE
14 State of Development	FLOOR SYSTEM DEVELOPED & MARKETED; WALL SYSTEM REQUIRES FINAL DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure	PRECAST REINFORCED CONCRETE SHEAR WALLS & FLOOR SLABS SERVING AS FORMS INTO WHICH CONCRETE IS CAST IN PLACE
17 Exterior Elements	NONBEARING EXTERIOR CURTAIN WALLS; BALCONIES
18 Interior Elements	REINFORCED CONCRETE FLOOR SLABS; PRECAST STAIRS
19 Foundations	CONVENTIONAL; STRIP FOUNDATIONS OR CAST CONCRETE SLAB, DESIGNED FOR SITE
20 Comfort Systems 21 Plumbing 22 Electrical	PROVISION FOR DUCTING, PLUMBING, & ELECTRICAL CONDUITS INCLUDED DURING MANUFACTURE AND/OR ERECTION
PRODUCTION	
24 Offsite Production	REINFORCED CONCRETE SHEAR WALLS & FLOOR SLABS; CURTAIN WALLS
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF WALLS & FLOORS; WITH CAST CONCRETE; FINISHES
27 Labor	PRIMARILY UNSKILLED OR SEMISKILLED
29 Community Involvement	SELF-HELP COMPLETION AND ALTERATIONS POSSIBLE
ECONOMICS	
30 Construction Costs	$2.24 TO $2.80 PER SQ. FT. (EXCLUDING FOUNDATIONS)
31 Financing Methods	PROPOSER SUPPLIED
32 Useful Life	PRACTICALLY UNLIMITED
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	PRODUCE AND MARKET BUILDING SYSTEM
35 External Functions	FRANCHISES
36 Market Area	ATLANTA, BOSTON, FREDERICKSBURG (VA.), GLENDORA (CAL.) AREAS
GENERAL	
39 Major Innovative Concepts	
40 Codes	CONFORMS TO ALL MODEL CODES

Optimum Systems

PROPOSER

Optimum Systems Inc., Systems Analysts, Palo Alto, California

AFFILIATES

Consultants Computation Bureau; Marquis & Stoller, Architects; Forrell/Elsesser, Structural Engineers; Wilsey & Ham, Civil Engineers; Kasin, Guttman & Co., Mechanical Engineers; Mel Cammisa, Electrical Engineer

The proposed program is for a management information system designed to develop a working prototype which will establish a system of related computer programs to create, maintain, analyze, and query a data base of major quantifiable factors pertaining to any large-scale construction project, and produce selected graphic displays. The goal of the program is to reduce housing costs by reducing to a bare minimum the time consuming activities relative to site selections, manual preplanning, endless preliminary design drawings and conferences, and analysis studies classically encountered in multistructure development.

The system will contain the following capabilities: Common compatible form of element and system representation for all design disciplines; Classification and storage of building and process design data; High-level interactive command language for data input and query of data base; Ability for trial modification to any part of the system; Graphic display of building plans, sections and elevations on cathode ray tube devices and X-Y plotters; Site plan display in countour and isometric form; Search for physical interferences through command language; Enumeration of specified items, computation of lengths, areas, volumes and weights; Direct access by professional groups to all design data and modifications.

SITE SYSTEM	
8 **Site Planning Services**	DEVELOPMENT OF A COMPUTERIZED INFORMATION SYSTEM TO ASSIST IN PLANNING OF LARGE SCALE PROJECTS
BUILDING SYSTEMS	
13 **Design Selection**	DEVELOPMENT OF COMPUTERIZED INFORMATION SYSTEM TO ASSIST IN BUILDING DESIGN
14 **State of Development**	CONCEPTUAL STAGE
ECONOMICS	
30 **Construction Costs**	PROPOSED SYSTEM ESTIMATED TO HAVE POTENTIAL TO DOUBLE OUTPUT OF EACH USING ARCHITECT & ENGINEER
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH & DEVELOPMENT OF PROTOTYPE COMPUTER INFORMATION SYSTEM FOR INTEGRATED SITE & BUILDING ARCHITECTURAL & ENGINEERING DESIGN
36 **Market Area**	4 COMPUTER CENTER OUTLETS—ONE EACH IN SOUTHEASTERN, NORTHEASTERN, MIDDLEWEST & WESTERN STATES
GENERAL	
39 **Major Innovative Groups**	SINGLE NETWORK PRESENTATION OF COMBINED FUNCTIONAL, TOPOLOGICAL, AND GEOMETRIC RELATIONSHIPS

Philip J. Ostendorf

PROPOSER

Philip J. Ostendorf, Architect and Engineer, Dayton, Ohio

The production of volumetric modules from wood and steel, capable of being stacked in multifamily high-rise configurations, is proposed. The manufacturing process would follow closely the current concepts of mobile home manufacturing to take advantage of labor supply and factory techniques. The basic modules would be plant produced, but stairwells, elevator shafts, and a number of different types of accessory buildings would be constructed onsite. Stacking to a six-story limit is proposed.

The structural system called for involves the use of steel sidewall frames, partially triangulated to reduce deflection. Studs would be of wood and interior application would be gypsum board with conventional finishes. Exterior covering would be textured plywood or gypsum board finished with cement asbestos board. The modules would measure 33 ft. x 12 ft. for 1-bedroom units; 45 ft. x 12 ft. for 3-bedroom units. All would be 9 ft. vertically.

Any type of topography can accommodate the proposed construction and various foundation types are specified, depending upon site conditions. Because of a lighter unit weight, the foundation work could represent some cost savings. Floors, ceilings, and mechanical systems would follow conventional trends.

SITE SYSTEM	
1 **Site Situation**	URBAN
3 **Topography**	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 **Climate**	ADAPTABLE TO ALL NATIONAL CLIMATES
6 **Nonresidential Functions**	RECREATIONAL FACILITIES; SWIMMING POOL
BUILDING SYSTEMS	
11 **Housing Types**	MULTIFAMILY HIGH-RISE
12 **Unit Variations**	1 TO 3 BEDROOMS
13 **Design Selection**	STANDARD PLANS WITH OPTIONS
14 **State of Development**	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
BUILDING SUBSYSTEMS	
16 **Structure**	MODULES OF STEEL FRAME & WOOD STUDDING
17 **Exterior Elements**	TEXTURED PLYWOOD OR GYPSUM BOARD AND ASBESTOS CEMENT SIDING
18 **Interior Elements**	PREFABRICATED PARTITIONS
PRODUCTION	
24 **Offsite Production**	VOLUMETRIC MODULES
26 **Onsite Construction and Erection**	FOUNDATIONS; PLACING OF MODULES; UTILITY HOOKUP
27 **Labor**	SEMISKILLED; MOBILE HOME CRAFTSMEN
ECONOMICS	
30 **Construction Costs**	\$11,788.00 (\$6.25 PER SQ. FT.), 890 DWELLING UNITS PER YEAR (BEST RATE)
MANAGEMENT	
33 **Proposer Organization**	PROFESSIONAL
34 **Internal Functions**	CENTRAL CONTROL
37 **Delivery Rate**	890 UNITS PER YEAR
GENERAL	
40 **Codes**	ADAPTABLE TO ALL NATIONAL CODES

Owen, Kelleher & Walsh

MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions 35 External Factors 36 Market Area	APPLICATION OF COMPUTERIZED SYSTEMS APPROACH TO OPTIMIZE RESOURCE ALLOCATION AMONG VARIOUS CONSIDERATIONS SUCH AS COSTS, TIME FACTORS, VOLUME, SOCIAL ASPECTS FOR BREAKTHROUGH PROPOSALS; DEVELOPMENT OF MODEL OR SIMULATION TECHNIQUES WHERE APPLICABLE

PROPOSERS

Owen, Kelleher & Walsh, Operations Research, Management Science and Economics, Dallas, Texas

Proposed here is the development of a systems approach from the standpoint of both operations research and economics, using a computerized model for estimating costs. Alternative measures of merit in the program would be measured and traded off, one against the other. Such measures would involve costs, time factors, volume and other economic factors such as social welfare and increased gross regional product. Program managers would be supplied with analyses of inter-industry flows (buying-selling) involved in the housing industry. Once developed, the input-output models would produce economic multipliers for use in maximizing, per unit of expenditure, such goals as employment, payrolls, value added, or total output.

The system could be applied, as well, to efficient allocation of funds. Suggested as part of this proposal are costing and simulation models, development of scheduling and inventory control theory, computerized design and manufacturing. In addition, development of a full range of statistical methods for application to Operation Breakthrough is proposed.

Owens-Corning

PROPOSER

Owens-Corning Fiberglas Corporation, Granville, Ohio.

AFFILIATE

Simpson, Gumpertz and Heger, Inc., Selection System.

Development of a computer-assisted system for selecting and optimizing combinations of surface and core materials for prefabricated modular wall panels is proposed. The system will be designed to satisfy only the performance requirements of exterior, nonbearing walls. These limits have been established because these particular elements offer the greatest potential for volume production, whereas, load-bearing panels, due to their variety and complexity of design, do not. Because the exterior, non-bearing wall must be so designed to take into account the most extreme of conditions (exclusive of loading), such as exterior-interior considerations, thermal insulation, and environmental requirements, the basic approach to their design and optimization may one day be expanded to all other wall types, including load bearing and interior partitions.

The proposed program will be in two parts. First, the computer-assisted system will be developed and used for generating optimized wall panel cross sections. Basically the input will consist of: (1) a list of facing materials, preevaluated by screening against design requirements such as aesthetics, environmental resistance, durability, use and abuse resistance, flamability, sound control, and maintenance considerations; and (2) a selected list of core materials tabulated with appropriate physical properties and costs.

Output will be selection of optimum composite structures of core and facing materials to provide a range of performance satisfying a variety of end-use applications and a ranking of the generated panel cross sections according to cost-performance values.

The second part of the study will consist of fabrication and testing of panels of several different optimum cross sections. Cost and performance data derived from these tests will be used to test the validity of the computer-assisted system. A survey of potential customers will be made and a plan for incorporating these wall panels into their modular wall systems will be developed.

BUILDING SUBSYSTEMS	
17 Exterior Elements	DEVELOPMENT OF A COMPUTER-ASSISTED SYSTEM FOR SELECTING & OPTIMIZING COMBINATIONS OF SURFACE & CORE MATERIALS FOR EXTERIOR, NON-BEARING WALL PANELS
18 Interior Elements	SELECTION SYSTEM CAN BE EXPANDED TO INCLUDE LOAD BEARING & INTERIOR WALL PANELS
PRODUCTION	
24 Offsite Production	PREFABRICATED MODULAR WALL PANELS
ECONOMICS	
30 Construction Costs	CRITERIA OF SELECTION WILL BE MAXIMUM COST/PERFORMANCE
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOP SYSTEM FOR SELECTING COMBINATIONS OF MATERIALS FOR EXTERIOR NONBEARING WALL PANELS
35 External Functions	SUBCONTRACTOR TO DEVELOP BASIC SYSTEM

Owens-Corning

PROPOSER

Owens-Corning Fiberglas Corporation, Granville, Ohio.

AFFILIATE

NAHB Research Foundation, Inc.

A completely self-contained service capsule embodying kitchen and bathroom facilities and most mechanical equipment, and amenable to mass production for high-volume-produced housing units, would be the end product of this proposed study. In addition to actual equipment, fixtures, and appliances, any such unitized, modular concept necessarily would include the high-performance interior surfaces associated with such subsystems such as bathroom tiling.

The mechanical subsystems to be studied for potential incorporation in the design are as follows: air treatment (including heating/air conditioning, humidity and dust/odor control); air distribution; heating (if other than forced air is required, such as electric baseboard); lighting; communications (telephone and intercom); and energy supply (gas and electricity).

The proposed program of design and evaluation will consist of 11 tasks. (1) Development of design planning requirements; (2) Development of essential engineering requirements; (3) Identification and evaluation of constraints; (4) Establishment of cost for functionally equivalent conventional construction; (5) Conceptual design; (6) Preliminary engineering study; (7) Preliminary cost analysis; (8) Survey of potential customers; (9) Final design and engineering; (10) Plan of prototype fabrication and testing; and (11) Program control and reporting.

BUILDING SUBSYSTEMS	
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	DESIGN & EVALUATION OF SELF-CONTAINED SERVICE CAPSULE; SYSTEM WILL INCLUDE AIR TREATMENT (HEATING, AIR CONDITIONING, HUMIDITY & DUST/ODOR CONTROL), COMMUNICATIONS, BATHROOM & KITCHEN FACILITIES, LIGHTING, & ENERGY SUPPLY (GAS, ELECTRICITY)
ECONOMICS	
30 **Construction Costs**	COST COMPARISON WITH FUNCTIONALLY EQUIVALENT CONVENTIONAL CONSTRUCTION
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DESIGN & EVALUATION OF SELF-CONTAINED SERVICE CAPSULE EMBODYING KITCHEN, BATHROOM & MECHANICAL EQUIPMENT FOR MASS PRODUCTION
35 **External Functions**	SUBCONTRACTED STUDIES BY NAHB RESEARCH FOUNDATION
36 **Market Area**	NATIONWIDE; TO BE USED WITH INDUSTRIALIZED HOUSING SYSTEMS

P&W Engineers

PROPOSER

P & W Engineers, Inc., Chicago, Illinois.

AFFILIATES

ISD Incorporated, Interior Space Design; The Perkins & Will Corporation, Architects and Urban Planners.

Research, evaluation, and development of both hardware and software concepts for a complete packaged waste handling system, suitable for use by local authorities (community or municipal) or contract operators, is proposed by this engineering firm. With each member of society generating nearly 5 lbs. of waste per day, equalled by the wastes produced by construction, demolition, commerce, and industry, and with a 40 percent overall rise in waste generation expected by 1980, the dimensions of the problem urge a solution.

The engineering concepts expected to emerge from the proposed study should encompass: (1) Basic flow diagram utilizing all process possibilities from refuse generation—separation, recovery for reuse, storage, collection, transport, and disposal; (2) Application of systems analysis techniques formulating linear program model for flow disposal handling of domestic waste, from mixed urban housing or from new community, analyzing alternates to finally obtain optional process use and most suitable waste disposal plan; and (3) Consideration of cost, location, labor, and efficiency requirements.

Although the ultimate goal in waste disposal will be to seek full recycling of all salvageable waste materials, the proposed study will seek to improve processes of the present systems. This will be accomplished by (1) obtaining information and classifications on refuse characteristics, (2) determining precisely the rate of present and expected waste generation, and (3) identifying and selecting the best processes (both domestic and foreign) for reduction, collection, and disposal.

SITE SYSTEM	
3 **Topography**	STUDY OF ADAPTABILITY OF SANITARY LAND FILL TO TOPOGRAPHY & GEOLOGICAL CONDITIONS
10 **Utilities**	STUDY OF PACKAGED WASTE HANDLING SYSTEMS SUITABLE FOR LOCAL AUTHORITIES & CONTRACT OPERATORS, INCLUDING PACKAGING, COLLECTION & DISPOSAL TECHNIQUES
BUILDING SYSTEMS	
14 **State of Development**	RESEARCH EFFORT IS IN DESIGN STAGE; STUDY OF COMMERCIALLY AVAILABLE PROCESSES
ECONOMICS	
30 **Construction Costs**	GOAL OF REDUCING COST OF WASTE COLLECTION WHICH ACCOUNTS FOR 75% OF MUNICIPAL WASTE HANDLING EXPENDITURES
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH, EVALUATE, & DEVELOP HARDWARE & SOFTWARE CONCEPTS FOR COMPLETE PACKAGE WASTE HANDLING SYSTEMS
GENERAL	
40 **Codes**	NO CODE RESTRICTIONS AGAINST WASTE PACKAGE SYSTEM

PIP Modular Housing

PROPOSERS

PIP Modular Housing Corporation, New York, New York
Conklin & Rossant, Architects, New York, New York
Construction Technology, Inc., New York, New York

A brick-and-mortar concept of high-rise housing construction is proposed: the bricks are dwelling-sized volumetric modules; the mortar is infill; cast-in-place concrete serves a dual function of fireproofing and structural framework for the building.

The modules, which derive from advanced design and manufacturing concepts of the mobile-home industry, are presently of two types: one of paper-honeycomb, plywood stressed-skin wall and ceiling panel construction, with a plywood and wood-joist floor system; the other of wood-framed construction, also plywood-faced on the interior and exterior. The ceiling system of each type is structurally designed and built to withstand the weight of the infill concrete which will be placed over it to form the subfloor of the next placed module.

Erection sequence of the system is relatively simple. (1) Placement of foundations, floor slab, and site utility lines; (2) Placement of first story of modular units; (3) Hook-up of mechanical services and plumbing, with stubs protruding from the top for connection to the next level of modules; (4) Placement of reinforcement for floor slabs and placing of concrete for walls (the side walls of adjacent modules acting as formwork) and floor slab; and repetition of cycle.

Similar to mobile homes, the living modules will be delivered to the site completely finished on the inside, ready for occupancy. Because all hook-up connections will be external to the units, no craftsmen need enter the module, and the seal with which the living space will be closed at the factory need not be broken until the first occupant takes possession.

The brick-and-mortar concept, while borrowing on the proved economies of mobile home manufacture, at the same time delivers dwellings of considerably greater solidity, quality, and durability. The system is capable of being built up to 12 stories without reinforcement in the concrete bearing walls formed between modules, and with reinforcement may go higher.

SITE SYSTEM	
1 Site Situation	URBAN; URBAN RENEWAL
2 Density Range	38 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	LINEAR CLUSTERS, CONTINUOUS OR INTERRUPTED LINKAGES
6 Nonresidential Functions	DAY CARE & FAMILY PLANNING CENTERS; HEALTH CLINICS; RECREATION FACILITIES
7 Circulation	LINEAR ACCESS SPINE
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	FLEXIBLE DEPENDING OF NUMBER OF MODULES USED
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM DEVELOPED; FURTHER DESIGN REQUIRED
BUILDING SUBSYSTEMS	
16 Structure	WOOD-FRAME, PLYWOOD-HONEYCOMB, OR REINFORCED-PLASTIC PANEL MODULES JOINED BY CAST-IN-PLACE CONCRETE INFILL
18 Interior Elements	SKIP STOP ELEVATOR CORE; WOOD OR METAL STUD GYPSUM BOARD PARTITIONS
19 Foundations	WALL FOOTINGS; PIERS; SPREAD FOOTINGS; SHALLOW BEAMS; DESIGNED FOR SITE CONDITIONS
20 Comfort Systems	ELECTRIC HEATING & COOLING INTEGRATED IN MODULE
21 Plumbing	INTEGRATED IN MODULES
22 Electrical	INTEGRATED IN MODULE WALL SECTIONS
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES
26 Onsite Construction and Erection	FOUNDATION; PLACING OF MODULE & CONCRETE INFILL; UTILITY HOOKUP
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN; MANAGEMENT
35 External Functions	PRODUCTION; LAND PLANNING; MECHANICAL & STRUCTURAL ENGINEERING

Panelframe Associates

PROPOSER CONSORTIUM

Panelframe Associates, Middlesex, Pennsylvania
William C. Campbell, President, Shenago Steel Buildings, Inc.
Herold Bradley, AIA
Emil Koledin, President, Hermitage Square Building Corporation
Fred Ratowsky, President, Consolidated Cleaning Enterprises, Inc.

Basis of this proposed system is use of a single, standard, metal-framed panel to produce walls, floors, ceilings and roofs of single-family and multifamily dwellings that would simplify construction, yet provide adequate architectural variety.

The panels—to be fabricated around a frame of 14-gage galvanized steel or aluminum of equal strength—would be covered with a skin of metal or other material, and enclose a rigid insulating core. They would form the entire structural frame of the building, in addition to providing actual walls, ceilings, and roof. The same panels would also be used to form interior partitions.

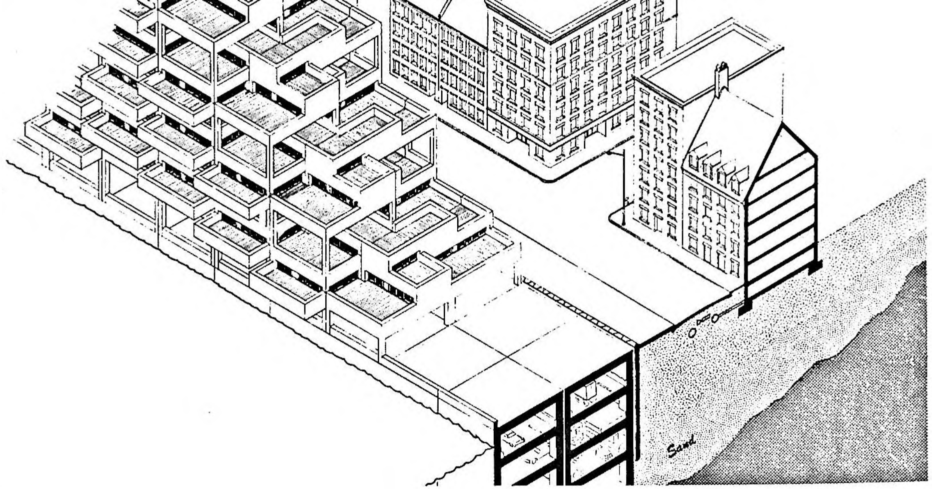
Also included in the proposed system is a considerable amount of built-in furniture, to reduce ultimate cost to the consumer, and to permit rapid erection. Sections of wall requiring windows, doors, or other openings, would also be prefabricated on the same 4-ft. module, using wood or metal sash as desired or dictated by economic considerations.

Panels of this type would be light in weight; homes built with them could easily be expanded or contracted by simple addition or removal of panels; they would require little interior finishing and could easily be completely demounted and moved to another location for other use, as desired. The resulting homes would be designed for forced warm-air heating (with provisions for air conditioning) and would make use of standard plumbing and mechanical systems.

It is contemplated that regional plants could be set up to manufacture the basic panels, thus cutting down shipping time and costs.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
BUILDING SUBSYSTEMS	
16 Structure	METAL-FRAMED PANEL SYSTEM
17 Exterior Elements	METAL PANELS
18 Interior Elements	METAL PANELS—INTERIOR PARTITIONS
20 Comfort Systems	FORCED WARM AIR HEAT; PROVISIONS FOR COOLING
23 Furnishings	SOME BUILT-IN
PRODUCTION	
24 Offsite Production	MANUFACTURE OF PANELS
26 Onsite Construction and Erection	ERECTION OF PANELS
27 Labor	UNSKILLED
MANAGEMENT	
33 Proposer Organization	COMPANY
34 Internal Functions	DEVELOPMENT OF METAL PANEL SYSTEM

Parsons, Brinckerhoff, Quade and Douglas, Inc.



PROPOSER

Parsons, Brinckerhoff, Quade & Douglas, Inc., Engineers-Architects-Planners, New York, New York

Proposed is research on the use of rapidly-deteriorating urban waterfront areas for housing and similar development. Central to the proposed study is the assumption that major economies may be achieved by better use of deteriorating waterfront areas in urban centers; and further economies may be achieved by using either under-used or abandoned shipyards for production of housing components. Components could then be shipped by water to waterfront housing sites, thus eliminating restrictions on size and weight. The study would develop engineering and economic criteria for such uses.

SITE SYSTEM	
1 Site Situation	URBAN & SUBURBAN WATERFRONTS
2 Density Range	MEDIUM TO HIGH
5 Planning Concepts	USE OF WATERFRONT SITES FOR PLANTS & HOUSING SITES; CRITERIA FOR WATERFRONT SITES TO BE ESTABLISHED
8 Site Planning Services	PROPOSER SUPPLIED
BUILDING SUBSYSTEMS	
16 Structure	COMPLETE VOLUMETRIC MODULES
19 Foundations	HYDROSPACE PREFABRICATED, FLOAT-IN BASEMENT-FOUNDATION ELEMENTS, INTEGRATED TRANSPORTATION UTILITY RIGHTS-OF-WAY
PRODUCTION	
24 Offsite Production	STUDY OF OBSOLETE OR UNDERUTILIZED RAIL & WATERFRONT SHIPPING FA-
25 Onsite Production	CILITIES TO MINIMIZE MATERIAL SHIPPING COST TO PLANT; ONSITE HANDLING
26 Onsite Construction and Erection	OF OVERSIZED PREFABRICATED UNITS ABOVE GROUND; CONSTRUCTION OF HYDROSPACE TRANSPORT SUBSTRUCTURES, HOUSING SUPERSTRUCTURES
27 Labor	SEMISKILLED & UNSKILLED IN PLANT OPERATIONS
28 Labor Training Programs	ESTABLISH PROGRAM FOR UNSKILLED
29 Community Involvement	IDENTIFICATION OF PROXIMITY BETWEEN UNDEREMPLOYED & USABLE OBSOLETE WATERFRONT SHIPPING FACILITIES
ECONOMICS	
30 Construction Costs	EXPECTED ECONOMIES OF SCALE THROUGH REGIONAL CENTRALIZATION OF PRODUCTION
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN SYSTEM TO USE WATERWAYS FOR THE TRANSPORT OF MAXIMUM-
35 External Functions	SIZE UNITS FROM WATERFRONT PLANT TO WATERFRONT SITES
36 Market Area	NEW YORK CITY; GENERALLY APPLICABLE TO OTHER URBAN WATERFRONT AREAS
GENERAL	
39 Major Innovative Concepts	USE OF WATERWAYS FOR DELIVERY OF HOUSING
40 Codes	PROBLEMS ANTICIPATED WITH BUILDING REGULATIONS, ZONING, & NAVIGATION

Parsons, Brinckerhoff, Quade & Douglas

PROPOSER

Parsons, Brinckerhoff, Quate & Douglas, Inc., Engineers, New York, New York

AFFILIATES

PDQ & D, Inc.; Parsons, Brinckerhoff-Hirota Associates

A patented composite concrete building component is proposed for study. The study is concerned with research into properties and uses of what the proposer calls a variation of concrete—a composite material made of high-strength (preferably prestressed) and low-strength cellular concrete. It is a relatively soft material that can be sawed with a wood saw, can be drilled, and can be bonded to regular concrete. The composite material is made by embedding strips of the cellular material into the concrete of high compressive strength; thus, the cellular material serves for connection purposes, and the high-strength compressive concrete carries the load.

It is suggested that the new material can be designed as lightweight members, can be handled on a dolly or cart because of lighter weight, and thus could serve as flues, joists, beams, partitions, or floor slabs in housing construction. Uses in prepackaged housing for such elements as foundations walls are also suggested. Developed under the study would be means of connecting, standards for strengths and spans, and other information for use by architects and engineers.

BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE; DESIGN, RESEARCH AND DEVELOPMENT TO FOLLOW
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundation	STUDY OF COMPOSITE CONCRETE BUILDING COMPONENTS MADE BY EMBEDDING STRIPS OF LOW-STRENGTH CELLULAR MATERIAL INTO CONCRETE OF HIGH COMPRESSIVE STRENGTHS; SUITABLE FOR FLUES, JOISTS, BEAMS, PARTITIONS, WALLS, FOUNDATIONS, OR FLOOR SLABS; DEVELOPMENT OF STANDARDS FOR CONNECTIONS & DESIGN CRITERIA
PRODUCTION	
24 Offsite Production	STUDY OF: COMPOSITE CONCRETE BUILDING COMPONENT FOR PREPACKAGED HOUSING SYSTEMS; ECONOMY, PRODUCTION & MARKETABILITY
27 Labor	UNSKILLED FOR MANUFACTURE & CONSTRUCTION
ECONOMICS	
30 Construction Costs	COMPOSITE CONCRETE BUILDING COMPONENT TO REDUCE UNIT COSTS
32 Useful Life	EQUIVALENT TO REGULAR CONCRETE
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & DEVELOPMENT OF COMPOSITE CONCRETE BUILDING COMPONENTS, ARCHITECTURAL & STRUCTURAL PLANS FOR PREPACKAGED HOUSING
GENERAL	
39 Major Innovative Concepts	LIGHTWEIGHT CONCRETE BUILDING COMPONENT WITH COMPRESSIVE STRENGTH OF REGULAR CONCRETE, EASILY INTERCONNECTED WITH OTHER MATERIALS

Peat, Marwick, Mitchell

PROPOSER CONSORTIUM

Peat, Marwick, Mitchell & Company, Public Accounting-Tax-Management Consultants, Los Angeles, California
Social Engineering Technology, Design of Mechanisms and Institutions for Social Change, Los Angeles, California
California Institute of the Arts, Concepts in Education for the Arts, Los Angeles, California

A housing delivery system, consisting of three primary factory-produced elements augmented by site-supplied elements with considerable self-help potential, is proposed for development. Three primary elements embody the system's structural concept: steel or concrete columns or bearing walls, supporting 9-ft.-deep, sheet-steel box beams spaced out in a variety of arrangements both horizontally and vertically (in low- or high-rise construction), and in turn supporting a flooring system, which spans the space between the box beams.

Key to the proposed system is the box beam which takes on some of the characteristics (both in manufacture and in structural rigidity) of the automobile body. It is designed in sheet steel to take advantage of the production capabilities of the automobile industry, and is a monocoque structure which incorporates all the costly mechanical facilities which are highly compatible with rationalized manufacture and assembly on a production line basis. The box-beam component, typically 6 ft. wide capable of spanning up to 60 ft., would include kitchen, bathroom, stairway, entryway, and all mechanical functions, including chases for utilities, formed by corrugations in the beam, thus increasing its rigidity.

The flooring planks, which span the space between the box beams and form living space for the dwelling units, may be delivered to the site in any length and must be capable of spanning up to 15 ft. These planks may be steel-edged gypsum, extruded concrete, formed steel, stressed-skin plywood, or joists and sheathing.

The exterior in-fill walls, interior partitions, windows and doors may be of any feasible material, may be supplied in configurations to suit the occupant's taste, and may even be supplied and installed by the owner himself. Within structural design considerations, there is no limit to the height of an apartment structure based on the proposed system, because the box-beam elements are not load bearing and, therefore, are not subjected to increasing loads as the building rises.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	1 TO 150 UNITS PER ACRE
4 Climate	ADAPTABLE TO ALL NORMAL CLIMATES
5 Planning Concepts	RELOCATABLE HOUSING; EMPHASIS ON TOTAL LIVING ENVIRONMENT
9 Community Involvement	SITE CONSIDERATIONS TO RESPOND TO CHANGING USER NEEDS & USER LIFE STYLES
10 Utilities	ALL UTILITY CONNECTIONS ACCOMPLISHED AT A SINGLE POINT ON THE EXTERIOR OF THE UNIT
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	CONCEPTUAL STAGE; RESEARCH & DEVELOPMENT REQUIRED
15 Community Involvement	BUILDING SYSTEMS TO RESPOND TO CHANGING USER LIFE STYLES
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE OR STEEL BEARING COLUMNS OR BEARING WALLS; ALUMINUM TRUSS ROOF SYSTEM
17 Exterior Elements	EXTERIOR WALLS; ROOF ELEMENTS
18 Interior Elements	UTILITY CORE BOX BEAM; INTERIOR WALLS; PLANK FLOORING
19 Foundations	BOX BEAM
20 Comfort Systems 21 Plumbing 22 Electrical	INTEGRATED IN UTILITY-CORE-BOX-BEAM; PLUMBING NETWORKS FABRICATED AS CIRCUITS LAMINATED BETWEEN TWO WALL SURFACES
23 Furnishings	BARE CHASSIS APPLIANCES IN ENCLOSURE BUILT INTO MAJOR STRUCTURAL SYSTEM
PRODUCTION	
24 Offsite Production	STRUCTURAL & NON-STRUCTURAL COMPONENTS; CORE UNITS
26 Onsite Construction and Erection	FOUNDATION; ERECTION; UTILITY HOOK-UPS; FINISHES
27 Labor	PRIMARILY UNSKILLED
29 Community Involvement	SELF-HELP FOR INTERIOR LAYOUT
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DEVELOP LINC HOUSING DELIVERY SYSTEM USING INDUSTRIALIZED PRODUCTION ELEMENTS
GENERAL	
39 Major Innovative Concepts	UTILITY CORE BOX-BEAM SUBSYSTEM

Pennsylvania State University

PROPOSER

Pennsylvania State University, University Park, Pennsylvania

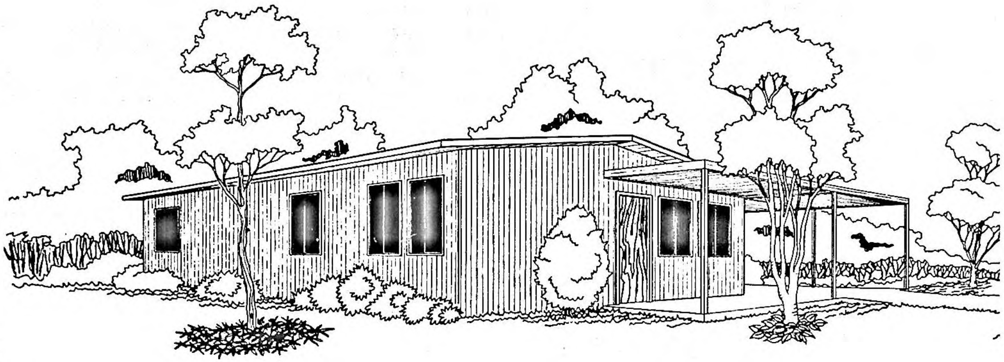
Development of a prototype, computer-aided design system that can be used by building designers to cope with the rising numbers of construction projects and the new era of componentization and modularization is proposed by this engineering college. The proposed system would permit building schemes or concepts to be entered into a computer via a drawing device and would permit the designer certain manipulations such as moving modules, rooms, walks, and partitions through the use of a light pen and a cathode-ray-tube design console.

Beyond these basic design changes, the system, on command, could stimulate perspective views of the building under study and simulate placement of construction materials and components. Output of the system initially would be for room areas, volumes, room schedules, air-conditioning demand and operating costs, acoustical analysis, and structural analysis. Output would be accomplished automatically through a plotter and would consist of plans and elevations showing the assembly procedures for units of construction such as prefabricated modules, walls, partitions, or other building systems.

Other output would consist of material and module quantities, to be used for cost estimation. Ultimately, the system as envisioned could be used for automatic selection of prefabricated building modules and other building materials through the use of a major data bank, containing a catalog of these building units, on a nationwide basis. The present study, to be carried out over a two year period, however, will result in a workable prototype from which might emerge the format for further and future development.

BUILDING SYSTEMS	
13 Design Selection	DEVELOPMENT OF COMPUTER-AIDED SYSTEM VIA DRAWING DEVICE—LIGHT PEN & CATHODE-RAY-TUBE DESIGN CONSOLE
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	PROPOSED SYSTEM COULD ULTIMATELY BE USED FOR AUTOMATIC SELECTION OF PREFABRICATED BUILDING MODULES & OTHER BUILDING MATERIALS THROUGH USE OF A MAJOR DATA BANK
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	DEVELOPMENT OF PROTOTYPE, COMPUTER-AIDED DESIGN SYSTEM; BUILDING CONCEPTS ENTERED INTO A COMPUTER VIA A DRAWING DEVICE; WOULD PERMIT THE DESIGNER TO MAKE CERTAIN MANIPULATIONS IN THE DESIGN STAGE, SUCH AS MOVING MODULES, ROOMS, WALKS, & PARTITIONS, THROUGH THE USE OF A LIGHT PEN & CATHODE-RAY-TUBE DESIGN CONSOLE

Phelps Dodge



PROPOSER

Phelps Dodge Cable and Wire Company, Building Systems Division, Yonkers, New York.

Production of aluminum-faced, insulated sandwich panels is proposed for modularized onsite assembly of single-family, one-story homes and low-rise apartment structures, and for use as infill panels in high-rise construction. By using this panel system in a building-block sense—for walls, partitions, floor and roof—the architect has complete flexibility and freedom to design to suit the market of eventual owner, without producing a home of stereotyped appearance.

Exterior and interior aluminum facings of the sandwich panel are attached to aluminum stud framing with a vertical wire chase being fitted at the mid-thickness of the panel, between front and back studs. The void between panels is filled with a rigid polyurethane core for high insulation value, thus also eliminating any potential nesting place for insects or vermin. The panels are joined onsite by sliding a specially fitted cross member into the vertical recesses of adjoining panels. The cavity at the joint, thus mechanically locked, is then filled with urethane foam to effect a continuous, monolithic wall.

The panels are prefinished at the factory with a plastisol coating over the aluminum facing, with repainting not being required for at least 15 years. Other advantages claimed for the panelized system are superior insulation value, no air infiltration, very low moisture vapor transmission, high sound isolating value, complete thermal break (preventing inside condensation), and independent grounding of each metal face.

Manufacturing facilities to produce the panels are capable of being set up in 45 days almost anywhere in the country, using unskilled, local labor.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	ADAPTABLE TO SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	ALUMINUM FACED, ALUMINUM STUDDED PANELS WITH POLYURETHANE CORE TO BE USED FOR WALLS, PARTITIONS, FLOOR & ROOF; PANELS CAN BE USED AS INFILL PANELS IN HIGH-RISE CONSTRUCTION; PANELS HAVE EXTERIOR FINISH OF PLASTISOL SO REPAINTING WILL NOT BE REQUIRED FOR AT LEAST 15 YEARS
PRODUCTION	
24 Offsite Production	MANUFACTURING OF PANELS
26 Onsite Construction and Erection	PANELS ARE JOINED BY SLIDING FITTED CROSS MEMBER INTO VERTICAL RECESS OF ADJOINING PANEL
27 Labor	UNSKILLED USE OF LABOR AT FACTORY
29 Community Involvement	USE OF LOCAL LABOR
ECONOMICS	
30 Construction Costs	$9.00 PER SQ. FT., 6 DWELLING UNITS PER DAY
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL; COORDINATION
36 Market Area	MANUFACTURING FACILITIES FOR PRODUCTION OF PANELS CAN BE SET UP IN APPROXIMATELY 45 DAYS ALMOST ANYWHERE IN THE COUNTRY
37 Delivery Rate	6 DWELLING UNITS PER DAY

Philadelphia 1976 Bicentennial Corporation

PROPOSER

Philadelphia 1976 Bicentennial Corporation, Philadelphia, Pennsylvania.

AFFILIATES

Mitchell/Giurgola Associates, Architects; Stull Associates, Inc., Architects; Roger Glasgow, AIA, Architect; William Mann, AIA, Architect; Forest Adams, Community Development; Augustus Baxter, AIA, Community Development; Harold Haskins, Community Development; David M. Walker, Associates, Planner; William Phillips, Planner; Edouard Fiset, Architect; James Lowry, Community Development; Ralph Iredale, Building Systems; Raymond Firmin, Cost Estimating; Kenneth Marshall, Community Development.

Offered is a proposal to join the Federal government as a management partner: (1) In evaluation of systems produced by "Breakthrough" contract recipients; (2) In development of techniques for market aggregation; and (3) In demonstration aspects of integrating housing, community facilities, and transportation.

The proposer points out that, at present in its area, there is no existing system of land control or assembly based on regional goals or to improve development patterns, and proposes to provide this control or assembly of land at the proper time—in quantity and strategic locations—to bring about substantial reductions in unit costs of dwellings, as well as in community facility and transportation costs. Land costs could be reduced by encouraging satellite and in-city development. Under the proposal, the corporation would make a demonstration management study to discover and develop land assembly schemes that could result in better housing, better community development, and higher quality, more efficient transportation and community facilities.

SITE SYSTEM	
6 Nonresidential Functions 7 Circulation 8 Site Planning Services	MANAGEMENT STUDY & DESIGN OF LAND ASSEMBLY SCHEMES TO IMPROVE TRANSPORTATION & COMMUNITY FACILITIES
9 Community Involvement	INTERVIEWS WITH LOCAL REALTORS, DEVELOPERS & BUILDERS

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions 35 External Functions 36 Market Area	MANAGEMENT PARTNER TO EVALUATE SYSTEMS PRODUCED BY OPERATION BREAKTHROUGH CONTRACTS; DEVELOPMENT OF TECHNIQUES FOR MARKET AGGREGATION; DEMONSTRATION ASPECTS OF INTEGRATING HOUSING, COMMUNITY FACILITIES & TRANSPORTATION; MANAGEMENT STUDY TO DISCOVER & DESIGN LAND ASSEMBLY SCHEMES.

Phoenix Housing Development Corporation

PROPOSER

Phoenix Housing Development Corporation, Great Falls, Virginia.

AFFILIATE

Felix R. R. Drury, AIA, Architect; Roy Littlejohn Associates; Systan, Inc.; Covington & Burling, Legal Counsel; Albert Dietz, Building Construction Consultant.

Analysis of the low-income family housing crisis, identification of the fundamental objectives of our national housing program, and utilization of systems analysis in achieving a workable solution comprise the program proposed. Implementation of the solution expected to emerge from the proposed program would be through nationwide establishment of a relatively simple and highly adaptable production-managerial system, with heavy dependence upon the typical, small building contractor.

General objectives of the systems analysis approach to the housing crisis include: enhancement of home ownership; meaningful consideration and integration of community needs and desires; employment of human resources in ghetto areas; reduction of existing market distortions and impediments; and simplicity and adaptability of architectural design, building technology, and computer methods.

In seeking also to arrive at the physical solutions to the problem, the following areas are expected to merit particular study and possibly offer substantial promise: plastic foam as a stiffening and bonding agent between exposed surfaces; factory-formed modular shells or skins for exterior or interior surfaces; high-density, plastic foam foundations; inflatable, plastic foam roof forms; factory-produced mechanical systems with foam infilling; factory-produced bathroom, kitchen and utility cores; evaluation of metal frame, concrete frame, and box systems; and identification of variables based on site conditions. Emphasis also will be placed on a study of legal and financial roadblocks to low-income family housing production in order to devise new legal and financial instruments, based on innovations in building design and technologies, to overcome these obstacles.

SITE SYSTEM	
5 **Planning Concepts**	SPATIAL & TECHNOLOGICAL HOUSING CONCEPTS BASED ON IDENTIFICATION OF SOCIAL, FINANCIAL & LEGAL CONSTRAINTS
9 **Community Involvement**	DETERMINATION OF USER NEEDS AS TO SITE REQUIREMENTS
BUILDING SYSTEMS	
15 **Community Involvement**	DETERMINATION OF USER NEEDS IN BUILDING SYSTEMS
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements** 19 **Foundations**	STUDY OF DESIGN & BUILDING TECHNOLOGY WITH EMPHASIS ON SIMPLICITY & ADAPTABILITY; STUDY OF INFLATABLE PLASTIC FOAM ROOF FORMS; PREFABRICATED MODULAR COMPONENTS FOR EXTERIOR & INTERIOR SURFACES, & HIGH-DENSITY PLASTIC FOAM FOUNDATIONS
PRODUCTION	
24 **Offsite Production**	STUDY OF MODULAR SHELLS, MECHANICAL SYSTEMS, & CORE UNITS
27 **Labor**	STUDY OF UTILIZATION OF AVERAGE-SIZE CONTRACTORS & USE OF UNSKILLED LABOR WHERE FEASIBLE
ECONOMICS	
31 **Financing Methods**	STUDY NEW FINANCIAL INSTRUMENTS BASED ON INNOVATIVE DESIGN & TECHNOLOGIES
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	ANALYSIS OF LOW-INCOME HOUSING CRISIS; IDENTIFICATION OF FUNDAMENTAL NATIONAL HOUSING OBJECTIVES; UTILIZATION OF SYSTEMS ANALYSIS
35 **External Functions**	LEGAL; COMPUTER SYSTEM
36 **Market Area**	NATIONWIDE APPLICATION; EMPHASIS ON REDUCTION OF EXISTING MARKET DISTORTIONS & IMPEDIMENTS
38 **Consumer Protection**	CONSUMER PREFERENCE EVALUATION

Poly Innovatex, Inc.

PROPOSER

Poly Innovatex, Inc., Market Research, Eugene, Oregon.

A broad range study of life styles and preferences of citizen groups, housing systems needs and preferences, and functional relationships among principal activities of each group is proposed.

It is believed that such a formal analysis can develop the general outline of housing needs, preference criteria, and the basis for design criteria for housing systems. This general outline could then be applied regionally or locally, as a basis for decisions as to the type and design of individual housing projects. In effect, the result would be a market analysis, defining the housing systems acceptable to each component segment of the United States population, the housing needs of which are not now being met.

A second part of the proposed study would include: analysis of the degree of resistance and reasons for resistance to change by zoning authorities and financial institutions; feasibility of modification of production techniques in the type of small business enterprise normally engaged in housing construction; and feasibility of modification of distribution systems for housing.

BUILDING SYSTEMS	
15 Community Involvement	DETERMINATION OF USER NEEDS & PREFERENCES FOR SELECTION OF TYPE & DESIGN OF HOUSING
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions 35 External Functions	MARKET ANALYSIS ON SIZE, CHARACTERISTICS & LOCATION OF POPULATION NOW RESIDING IN INADEQUATE HOUSING; DEFINITION OF A HOUSING SYSTEM & ANALYSIS OF ITS FEASIBILITY

Portland Cement Association

PROPOSER

Portland Cement Association, Skokie, Illinois

AFFILIATE

Peter J. Verna, Jr., Consultant

The basic concept of this proposed system centers around a mobile factory, precasting concrete panels for housing, adaptable to a variety of sizes and designs. The system can be used for single-family detached and attached and multifamily low-rise housing. It is adaptable to high-rise construction but some of the advantages of the mobile factory technique are lost in this application.

The system consists of a series of trailers which are concrete molds in themselves. Trailers are ganged together adjacent to the site and pulled forward as the job progresses. Production rate is estimated at two houses per day with a single factory assembly unit.

Economies expected are from assembly line techniques, no stationary factory overhead, no transportation or delivery cost, no double handling, minimum capital investment, and use of local labor substantially at an unskilled level.

The method is most applicable to warmer climates although alterations in methods and materials make it feasible for more rigorous climates. Construction is practicable on all but highly expansive soils, and is adaptable to all topographies other than very steep slopes.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHIES & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT TESTED
BUILDING SUBSYSTEMS	
16 Structure	CONCRETE ROOF, CEILING, & FLOOR PANELS
17 Exterior Elements	WOOD SIDING; ALUMINUM SIDING, BRICK PANELS
19 Foundations	CONVENTIONAL; DESIGNED FOR SPECIFIC SITE CONDITIONS
PRODUCTION	
25 Onsite Production 26 Onsite Construction and Erection	MOBILE FACTORY CONSISTING OF A SERIES OF TRAILERS WHICH ARE CONCRETE MOLDS; TRAILERS ARE GANGED TOGETHER AT JOB SITE & PULLED FORWARD AS THE JOB PROGRESSES
27 Labor	UNSKILLED
29 Community Involvement	USE OF LOCAL LABOR
ECONOMICS	
30 Construction Costs	$3,000 PER UNIT, 500 UNITS PER YEAR (BEST RATE)
32 Useful Life	DWELLING UNIT—40 YEARS
MANAGEMENT	
33 Proposer Organization	CORPORATION (TRADE ASSOCIATION)
34 Internal Functions	CENTRAL CONTROL
37 Delivery Rate	2 HOUSES PER DAY PER ASSEMBLY UNIT; 500 DWELLING UNITS PER YEAR (BEST RATE)

The Prometheus Company

PROPOSER

The Prometheus Company, Shelby, North Carolina

AFFILIATES

Marley Carroll, Architect; Tom G. Weathers, Sr., Builder; John McClurd, Architect; George A. Watson

The triangle as a basic module for housing—using a system of connecting triangles at angles to form both sidewalls and roof—plus a plan for a circular arrangement of urban conveniences would be studied under the proposal submitted.

The basic concept for consideration is a system the proposer has called a tetra-triangular building system. This would be an assembly of triangular panels, in any basic sizes that may be required, assembled by connection devices to form buildings suitable for single-family or multifamily dwelling units. The panels could be assembled to form structures of relatively unusual appearance by making the triangular shape a dominant feature or, by using smaller panels, could be given a nearly conventional appearance.

Panels could be manufactured either as skeletal structures, to be finished onsite with suitable coverings (which could be metal, plywood, gypsum board or many other materials); or could be made up completely at a central plant. Wiring, utilities, and insulation could be included in the panels, if desired, or could be added onsite if the suggested skeltal-type panels were used. Framing materials for the panels would be conventional wood or metal. Foundations would be minimal, located only where the points of wall-forming triangles would bear. The panels would provide the entire structural frame.

The idea of a circular city, also suggested, calls for housing, shopping, offices, and other structures arranged in a circular pattern that would facilitate an internal local transit system. In addition, studies would be made of market acceptability and to develop more complete engineering data.

SITE SYSTEM	
1 Site Situation	SUBURBAN
3 Topography	ADAPTABLE TO NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PLANNED COMMUNITY; CIRCULAR CITY PLANNED AROUND TRANSPORTATION FACILITIES
7 Circulation	NO THROUGH VEHICULAR TRAFFIC
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; SINGLE-FAMILY DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	2 & 4 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION, & TESTING
BUILDING SUBSYSTEMS	
16 Structure	PRESTRESSED POLYURETHANE OR POLYSTYRENE FOAM PANELS ASSEMBLED INTO SELF-SUPPORTING TRIANGLES; PRESTRESSING ELEMENTS WOULD BE STRETCHED FILAMENTS OF POLYESTERS OF POLYAMIDES
17 Exterior Elements 18 Interior Elements	
19 Foundations 20 Comfort Systems	CONVENTIONAL; DESIGNED FOR SITE CONDITIONS; OPTIONAL GROUND ANCHOR MODULE
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
PRODUCTION	
24 Offsite Production	PANELS
26 Onsite Construction and Erection	FOUNDATIONS; ASSEMBLY OF PANELS INTO TRIANGULAR UNITS; UTILITY HOOKUP
ECONOMICS	
30 Construction Costs	$5.00 TO $7.00 PER SQ. FT.
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	RESEARCH, DESIGN, TESTING OF BUILDING SYSTEM

RMA Corporation

PROPOSER

RMA Corporation, East Detroit, Michigan.

Use of an innovative, proprietary type of concrete block for construction of low-cost housing is proposed. The block differs from conventional products in that the concrete ribs which join together the two faces of the conventional unit are replaced by a pair of steel frames of no. 18 gauge galvanized wire across the ends of the units.

The result is a completely new building product subsystem—two small concrete slabs, typically 2 in. x 8 in. x 16 in. When laid up in the exterior wall structure they form inner and outer surfaces along with other units, the steel framework across the ends of the units keeping these slabs apart. The void between faces of the unit creates a dead air, insulating gap between outer and inner wall, which may be filled with insulation material for even greater effectiveness.

The absence of ribs between inner and outer surfaces of the block eliminates one channel for possible moisture migration. This permits application of interior plastering or paneling, directly to the inner surface, without furring; exterior finish may be stucco, with integral color. The new units weigh about one third less than the conventional block.

Block manufacturers would be licensed to produce the units with delivery to the site of the shaped steel frames and the inner and outer concrete faces strapped together in cubicles. The builder would insert the faces into the frames and then lay up the blocks in the conventional manner.

SITE SYSTEM	
1 **Site Situation**	URBAN; SUBURBAN
BUILDING SUBSYSTEMS	
16 **Structure**	CONCRETE BLOCKS UTILIZING GALVANIZED-WIRE STEEL FRAMES IN LIEU OF CONCRETE CORE RIBS
17 **Exterior Elements**	STUCCO FINISH
18 **Interior Elements**	UNFURRED PLASTER FINISH; PANELING
PRODUCTION	
24 **Offsite Production**	MANUFACTURE OF CONCRETE BLOCKS & STEEL FRAME
26 **Onsite Construction and Erection**	PLACING OF WIRE FRAME IN BLOCKS; CONVENTIONAL LAYING OF BLOCKS
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	LICENSING OF BLOCK PRODUCERS
35 **External Functions**	PRODUCTION OF CONCRETE BLOCKS & STEEL FRAMES

Reditruss Int'l

PROPOSER

Reditruss International, Inc., Miami, Florida

Further research and development is proposed of a patented system of joining wood members by grooving their ends. The general intent of the proposal is to develop the joining concept originally applied in the manufacture of roof trusses, so that all levels of home building may use it to reduce costs in roof, wall and floor systems.

Fabrication of the joint is accomplished by machine dadoing the ends of pieces of lumber in the form of matching sets of wood teeth. When fit together, the teeth interlock and act in shear to develop the required joint load-carrying capacity without the need for expensive connection devices. The joint thus becomes part of the assembly (typically a truss) and achieves maximum strength. The savings claimed for the system result from elimination of steel gusset plates or other connection devices and through reduced transportation costs. For example, 400 knocked-down trusses can be shipped on a single truck, as opposed to 50 or 60 factory-assembled trusses which could be shipped on the same truck.

Onsite assembly of trusses made with the grooved joint is possible because no assembly tables or skilled labor are required. Fitting the teeth together, fitting bolts in prebored holes, and attaching steel tension members assure that the component will be correctly assembled with the proper camber.

Other uses for the grooved joint which the proposed research and development is expected to explore include: "lumber stretching", the combining of cheaper, short lengths of lumber into a single length; fabrication of flat floor truss systems to eliminate interior foundation elements; fabrication of interlocking wall panel components; making of adjustable shoring and forming for concrete work; and fabrication of larger, multi-member truss systems.

No code conflict is expected in development of the grooved-end jointing system.

BUILDING SYSTEMS	
14 State of Development	INITIAL TESTING OF JOINTS & TRUSS COMPLETED; FURTHER RESEARCH, DEVELOPMENT & TESTING PROPOSED; PRODUCTION FACILITIES IN THE DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	DEVELOPMENT OF WOOD-TEETH JOINT SYSTEMS FOR WOOD COMPONENTS & ELEMENTS; TRUSSES, JOISTS, WALL PANELS & FOR INTERLOCKING PANELS; STEEL TENSION MEMBERS IN TRUSSES
PRODUCTION	
24 Offsite Production	TRUSS COMPONENTS; OPTIONAL ASSEMBLY OF TRUSSES
25 Onsite Production	OPTIONAL ASSEMBLY OF TRUSSES
26 Onsite Construction and Erection	OPTIONAL ASSEMBLY OF TRUSSES; TRUSS ERECTION; JOINT SYSTEM ADAPTABLE FOR ADJUSTABLE FORMING & SHORING FOR CONCRETE CONSTRUCTION
27 Labor	SEMISKILLED LABOR WITH SKILLED EQUIPMENT SUPERVISION FOR PRODUCTION
ECONOMICS	
30 Construction Costs	MINIMUM COST SAVING OF 20% COMPARED TO SMALLEST COMMON RESIDENTIAL TRUSS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DESIGN; DEVELOPMENT; TESTING; PRODUCTION
35 External Functions	PROPOSER WILLING TO JOIN WITH OTHERS TO FORM A CONSORTIUM
37 Delivery Rate	UP TO 2,400 TRUSS CHORD MEMBERS (FOR 25 RESIDENTIAL UNITS) PER DAY PER PATIENT
GENERAL	
39 Major Innovative Concepts	WOOD COMPONENT JOINING SYSTEM; TRUSS JOINT SYSTEM PERMITS JOINING SHORT LENGTHS OF LUMBER
40 Codes	ADAPTABLE TO NATIONAL BUILDING CODES

Reliable Electric

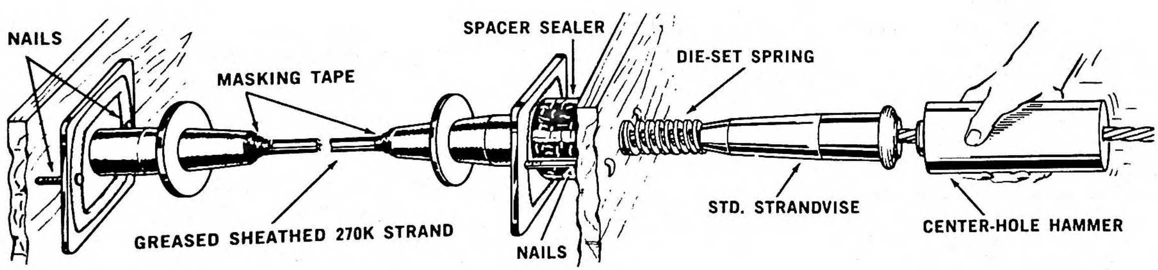
PROPOSER

Reliable Electric Company, Franklin Park, Illinois

Proposed is the use of a proprietary post-tensioning system for anchoring seven-wire stranded cables in unbonded post-tensioned concrete construction.

The anchors consist of a cold-forged and heat-treated steel case which is tapered to receive a cluster of tapered forged steel jaws. The jaws are held together by a retainer ring to form a chuck and are secured in position within the anchor case by means of a spring. One end of the anchor when used at the dead end contains a pilot cup to guide the tendon and hold the chuck open until the tendon is properly secured. The opposite end of the anchor has an encased chuck and spring, held in place by a cap with a plastic window at the end of the anchor. The cup, cap and spring are removed when the anchor is used at the jacking end. The anchor case is inserted into primary and secondary thrust plates which bear against the concrete.

BUILDING SUBSYSTEMS	
16 Structure 19 Foundations	POST-TENSIONING SYSTEM FOR ANCHORING SEVEN-WIRE STRANDED CABLES IN UNBONDED POST-TENSIONED CEMENT CONSTRUCTION
PRODUCTION	
24 Offsite Production	POST-TENSIONING ANCHORS
26 Onsite Construction and Erection	INSTALLATION OF ANCHORS & POST-TENSIONING
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	PRODUCTION OF ANCHORS



Research Triangle Institute

PROPOSER

Research Triangle Institute, Research Triangle Park, North Carolina.

The design, construction and computer implementation of a cost effectiveness model for the evaluation of consumer preferences for alternative housing system components and configurations is proposed by this research organization. The purpose of the proposed work is to arrive at a methodology for such evaluation, with surveys of inner city residents in two metropolitan cities expected to provide the raw information required for the model. The data thus collected would be stored, processed, and analyzed within an information system to be designed specifically for the proposed work.

The onsite surveys would be accomplished by mobile vans, thus bringing the interview to the consumer. The field staff would be recruited from responsible organizations whose work and programs are related to and identified with the inner city, thus reducing any potential communication gap to a minimum. Three-dimensional models, with removable and adjustable components, slides, charts, and other visual aids would be employed to assist in drawing out the respondents and in arriving at their preferences.

Two principal constraints would be imposed upon the respondents during the interview—total costs and basic minimum standards required by law or code. The interviewer, aided by the computer, would advise as preferences expressed exceeded these constraints, and would suggest alternative solutions (again, aided by the computer). The entire record of choices, those feasible as well as those rejected, would be fed into the program in arriving at a preference profile.

SITE SYSTEM	
9 **Community Involvement**	SURVEY OF USER NEEDS
BUILDING SYSTEMS	
15 **Community Involvement**	SURVEY OF USER NEEDS
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements**	COMPUTER IMPLEMENTATION OF COST-EFFECTIVENESS MODEL FOR EVALUATING ALTERNATIVE BUILDING SYSTEM COMPONENTS
ECONOMICS	
30 **Construction Costs**	DESIGN OF CONSTRUCTION OF COST EFFECTIVE MODELS FOR EVALUATING ALTERNATIVE BUILDING COMPONENTS
MANAGEMENT	
33 **Proposer Organization**	PRIVATE COMPANY
34 **Internal Functions** 35 **External Functions**	DESIGN, CONSTRUCTION & COMPUTER IMPLEMENTATION OF A COST-EFFECTIVENESS MODEL FOR EVALUATING ALTERNATIVE HOUSING COMPONENTS & CONFIGURATIONS; DATA COLLECTED IN SURVEY TO BE STORED, PROCESSED & ANALYZED WITHIN AN INFORMATION SYSTEM TO BE DESIGNED SPECIFICALLY FOR PROJECT

Reynolds Metals Company

PROPOSER CONSORTIUM

Reynolds Metals Company, Management, Richmond, Virginia
City Investing Company, Planning, Marketing, Financing, New York, New York.

This is a structural system designed on a modular grid using aluminum as the basic material. It is a new system, proposing a family of parts from which single-family attached and detached, and multifamily low-rise units can be constructed by selecting from stock items including panels, posts, beams, doors, windows, storage units, utility cores, heating, ventilating and air conditioning subelements. This approach offers a wide variety of architectural choices: styles and floor and site plans. Development of a complete building system based on a fixed module that provides wide flexibility in arrangement of individual units is proposed.

The proposer indicates that a total integration of architectural, structural, and mechanical subsystems is necessary for optimum efficiency in production and assembly. Also, a complete systems analysis will be necessary to determine the full effect of the shift of onsite skilled labor to unskilled plant workers. The probable effect of labor patterns is realized and the prospect of 12-months employment each year is expected to be a significant factor in making factory production more attractive to the trades.

One of the design concepts offered incorporates post and beam techniques to form space frames which are filled in with wall panels and other components. Floor, wall, ceiling and roof areas consist of aluminum-framed sandwich panels with a special continuous fastening device at the panel edges. Floor panels are 2 ft. or 4 ft. wide and factory produced in lengths of 2-ft. multiples. Mechanical and electrical lines are inserted in raceways in the panel edges and in the hollow posts. The continuous fasteners provide structural integrity greater than is achieved by nailing or bolting.

In erection, door and window extrusion kits are fitted into openings where wall panels have been omitted. These parts snap into place on adjacent fasteners. Gable-end infill panels are factory glazed. Flat roof and floor panels also snap into place at the site. For sloping roofs, a 2-in.-thick aluminum-framed sandwich panel is applied in 2-ft. or 4-ft. widths. Roof finishes can be hypalon films bonded to the panels in plant or prefinished aluminum skin. Interior partitions are of the same modular panel manufacture as the exterior elements, with cabinet, closet, and shelf units available as stock items. Mechanical cores are planned which would be mated with vent posts carrying discharges through a weatherproofed roof stack.

SITE SYSTEM	
3 **Topography**	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 **Climate**	ADAPTABLE TO ALL NATIONAL CLIMATES
9 **Community Involvement**	CIVIL GROUPS MEETINGS TO EXPLAIN PLANS & OBJECTIVES OF MAJOR PROJECTS
BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12 **Unit Variations**	1 TO 5 BEDROOMS
13 **Design Selection**	FLEXIBLE OPEN PLANNING VARIATIONS
14 **State of Development**	PRODUCTION PLANT & BUILDING SYSTEM IN DESIGN STAGE
16 **Structure**	ALUMINUM FLOOR, WALL & ROOF PANELS; UNIVERSAL POST & CONTINUOUS BEAM SPACE FRAME; SNAP-FIT INTERLOCKING SPLINE FASTENER
18 **Interior Elements**	ALUMINUM-FRAME SANDWICH PANEL PARTITIONS
19 **Foundations**	CONVENTIONAL
20 **Comfort Systems**	CONVENTIONAL; CENTRAL SYSTEM INTEGRATED MECHANICAL CORE BUILDING SUBSYSTEM
21 **Plumbing**	CONVENTIONAL; INTEGRATED WITH BUILDING SUBSYSTEM
22 **Electrical**	CONVENTIONAL; INTEGRATED CONDUIT SYSTEM
PRODUCTION	
24 **Offsite Production**	PANELS AND FRAME COMPONENTS
26 **Onsite Construction and Erection**	FOUNDATIONS; ERECTION OF FRAME & PANELS
28 **Labor Training Programs**	ASSIST STATE EMPLOYMENT AGENCIES IN SETTING UP JOB TRAINING CLASSES
MANAGEMENT	
33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	MANAGEMENT; FINANCING; PRODUCTION; MARKETING; DEVELOPMENT
GENERAL	
40 **Codes**	RECOGNIZED POSSIBLE PROBLEMS WITH BUILDING CODES

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., City of Industry, California

This proposal covers an installation system for cushion-back carpeting, and involves both adhesives and moldings. Four types of adhesive are available: for outdoor and indoor installation; for indoor installation only; for indoor vinyl-foam installation only; and for peel-up indoor installation. Moldings are manufactured in both metal and vinyl types. Further studies are proposed for developing double-faced pinless metal for joining two carpeted areas and additional colors for vinyl inserts and new fastening methods for base metals.

The proposer recommends self-help installation of areas of 12' x 12' or less. Small jobs can be accomplished by do-it-yourself methods. Professional installers are required only for the larger areas.

BUILDING SYSTEMS	
14 State of Development	PRODUCTION PLANT OPERATIONAL; SYSTEM BEING MARKETED
BUILDING SUBSYSTEMS	
18 Interior Elements	INSTALLATION SYSTEM FOR CUSHION-BACK CARPETING; COMPLETE LINE OF MOLDINGS; FURTHER DEVELOPMENT OF ADHESIVES & INSTALLATION TECHNIQUES
PRODUCTION	
24 Offsite Production	CARPET ADHESIVES & INSTALLATION ACCESSORIES
26 Onsite Construction and Erection	LATEX ADHESIVE IS TROWEL APPLIED
29 Community Involvement	SELF-HELP LABOR
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL
36 Market Area	NATIONALLY & INTERNATIONALLY
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., City of Industry, California

This proposal describes a prefinished (painted) steel bifold door, usually installed in prefinished wall openings. It is factory produced from 24-gauge cold-rolled steel and has FHA approval. The unit can be installed by one man in less than 20 minutes by means of mounting screws; the door elements run in top and bottom tracks. The system is adaptable to all housing types and to all climates. Replacement is a simple and easy process, requiring approximately the same time as the original installation. Self-help completion is recommended. The product has been marketed for over 11 years and faces no code or labor constraints.

BUILDING SYSTEMS	
14 State of Development	COMPLETELY DEVELOPED & CURRENTLY BEING MARKETED
BUILDING SUBSYSTEMS	
18 Interior Elements	PREFINISHED, PREPAINTED BIFOLD DOOR OF 24-GAUGE, COLD-ROLLED STEEL
PRODUCTION	
24 Offsite Production	BIFOLD STEEL DOOR
26 Onsite Construction and Erection	USUALLY INSTALLED IN PREFINISHED WALL OPENING; ONE MAN CAN INSTALL IN LESS THAN 20 MINUTES
29 Community Involvement	SELF-HELP INSTALLATION OF DOOR
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL
36 Market Area	MARKET ACCEPTANCE IN ALL AREAS OF WESTERN & MIDWESTERN UNITED STATES
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., City of Industry, California

This proposal pertains to vinyl-clad, sliding (bypass) wardrobe doors usually installed in prefinished wall openings. The doors are formed from hardboard panels and finished with anodized aluminum top and bottom track and trim. They are top hung, suspended from nylon wheels rolling in the top track; nylon guides ride in the bottom track. The product is FHA-approved and market acceptance has been established. A feature of the system is simplicity and ease of installation. All elements are prefit and prefinished, and doors are preassembled. Hardware is packaged with each set. Track and doors can be installed in 15 minutes by one person.

BUILDING SYSTEMS	
14 State of Development	DOOR HAS BEEN SUCCESSFULLY MARKETED FOR 3 YEARS
BUILDING SUBSYSTEMS	
18 Interior Elements	VINYL-CLAD HARDBOARD SLIDING WARDROBE DOORS USUALLY INSTALLED IN PREFINISHED WALL OPENINGS WITH ALUMINUM TOP & BOTTOM TRACKS
PRODUCTION	
24 Offsite Production	MANUFACTURE & ASSEMBLY OF DOOR PANELS & FITTINGS
26 Onsite Construction and Erection	INSTALLED BY ONE PERSON IN 15 MINUTES
27 Labor	UNSKILLED FOR INSTALLATION
29 Community Involvement	SELF-HELP INSTALLATION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., City of Industry, California

Simplicity and ease of installation mark the prefinished metal door frame system offered in this proposal. The product is sleeved to wall openings and attached by nails or screws. Trim moulding is snapped into place over the frame, covering nails or screws. The frame is used with finished or unfinished walls. Special corner-backing pieces and adjustable strike plates are patented features. The proposed system lends itself to owner completion because the product is installed after the wall is constructed. No special tools or skills are required for installation. Each set of frames is individually cartoned with parts, trim and illustrated instructions.

BUILDING SYSTEM	
14 State of Development	DOOR FRAME COMPLETELY DEVELOPED & MARKETED
BUILDING SUBSYSTEMS	
18 Interior Elements	A PREFINISHED METAL DOOR FRAME SLEEVED TO WALL OPENINGS & ATTACHED BY NAILS OR SCREWS; TRIM MOULDING IS SNAPPED INTO PLACE OVER THE FRAME COVERING NAILS OR SCREWS
PRODUCTION	
24 Offsite Production	METAL DOOR FRAME
26 Onsite Construction and Erection	TRIM MOULDING IS SNAPPED INTO PLACE OVER THE FRAME COVERING NAILS OR SCREWS
27 Labor	NO SPECIAL SKILLS NECESSARY FOR INSTALLATION
29 Community Involvement	SELF-HELP COMPLETION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., Monrovia, California

Application of a fully developed, complete line of adhesives, sealants and coatings for factory prefabrication of housing modules or panels is proposed. Onsite installation and self-help completion is discussed also.

A wide range of products presently is available for almost every stage of housing production. In connection with construction of the house structure, or shell itself, these applications are provided for: (1) Elastomeric systems applied as free-flowing liquids for roofing and decking; (2) Sealants for walls, roofs, joints, and windows; (3) Insulation adhesives including those used for laminating fiberglass mat to foil, vinyl, and paper and for installation of insulation materials; (4) Adhesives for laminating wood, metals, and reinforced plastics to plastic foams, honeycomb, and other core materials for nonbearing walls; and (5) Adhesives for laminating materials to the wood or metal framing members of load-bearing panels. Interior applications include adhesives for partitions, paneling, cabinetry, flooring, ceiling and built-in furniture, and sealants and caulking for use around kitchen and bathroom cabinets, bathtubs, and shower stalls.

The self-help potential for the products is high; many may be used without training or special skills. Once the basic structure is completed, owners can install kitchen cabinets, wall paneling, floor tile, and carpet, with the adhesive products being available in convenient sizes and in kit form.

BUILDING SYSTEMS	
14 State of Development	PRODUCTION OPERATIONAL; SYSTEM & MARKETING CHANNELS DEVELOPED
BUILDING SUBSYSTEMS	
18 Interior Elements	FURTHER DEVELOPMENT OF TACKLESS STRIP METHOD FOR INSTALLING CONVENTIONAL WALL-TO-WALL CARPETING
PRODUCTION	
24 Offsite Production	TACKLESS STRIP FOR CARPETING INSTALLATION
26 Onsite Construction and Erection	STRIP FASTENED TO A FLOOR
29 Community Involvement	NOT RECOMMENDED FOR SELF-HELP
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT AND PRODUCTION OF TACKLESS STRIP FOR CARPET INSTALLATION
37 Delivery Rate	IN EXCESS OF 1 MILLION FEET OF TACKLESS STRIP PER DAY
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., City of Industry, California

The system here proposed is for securing and finishing carpeting and exposed edges of carpeting. It uses an aluminum base component, in either a pin-type (for stretched conventional carpet) or a pinless type for adhesive-installed carpet (conventional or cushion-back), and a colored vinyl insert which fits into the base component and bridges varying levels of floor covering. The installation is adaptable to any type of structure or climate and is recommended for self-help completion. No special skills or tools are required for initial installation or replacement of the molding. Additional system elements to be researched and developed include: (1) an added flat section for use as abutment molding; (2) additional colors for inserts; and (3) new fastening methods for the base metal.

BUILDING SYSTEMS	
14 State of Development	SYSTEM DEVELOPED & IN USE BY PROFESSIONAL CARPET INSTALLERS
BUILDING SUBSYSTEMS	
18 Interior Elements	SYSTEM FOR SECURING & FINISHING CARPETING & EXPOSED EDGES OF CARPETING, USING ALUMINUM BASE COMPONENT & VINYL INSERTS
PRODUCTION	
24 Offsite Production	ALUMINUM BASE COMPONENT
26 Onsite Construction and Erection	CARPET INSTALLATION
27 Labor	NO SPECIAL SKILLS OR TOOLS NECESSARY
29 Community Involvement	SELF-HELP COMPLETION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL; RESEARCH & DEVELOPMENT; ADDITIONAL INSTALLATION COMPONENTS

Roberts Consolidated

PROPOSER

Roberts Consolidated Industries, Inc., City of Industry, California

Further development of the conventional tackless strip method of installing wall-to-wall carpeting is proposed as a means of speeding the laying of carpeting in homes. The basic product is a 48 in. long strip of plywood with at least two rows of sharp pins projecting from the top surface and tilted toward the wall at a 60 degree angle. The strip serves to hold the carpeting under constant tension.

The development work proposed would entail study of materials (the tackless strip, adhesives, moldings, tapes and nails) and various tools involved with cutting, fastening and stretching the carpet.

The method proposed is presently well advanced. The proposer now is capable of producing over 1 million feet of tackless strip per day. Market acceptance is assured. Self-help for installation is not recommended.

BUILDING SYSTEMS	
14 State of Development	PRODUCTION FACILITIES OPERATIONAL; ADHESIVES BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	COMPLETE LINE OF ADHESIVES FOR USE IN FABRICATION OR INSTALLATION OF HOUSING MODULES OR PANELS, ROOFING, WALLS, FLOORING, PANELING
PRODUCTION	
24 Offsite Production	ADHESIVES
29 Community Involvement	SELF-HELP APPLICATION OF ADHESIVE FOR WALL PANELING, CABINETS & CARPETS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	CENTRAL CONTROL
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES

Richard Allen Rose

PROPOSER

Richard Allen Rose, Architect, Miami Beach, Florida
Creative Structures, Inc., Miami Beach, Florida

AFFILIATES

Joseph M. Rose, Financial Consultant

A thin-shell, free-standing monolithic, reinforced concrete structure (comprising roof and walls) is the principal component of the housing system proposed. Developed as a refinement of earlier formless, thin-shell techniques of the 1950's, and subsequently patented by the proposer, the system is stated as offering substantial potential for self-help.

In erection of a typical 1200-sq.-ft. one-story home, for example, the owner himself will assemble the steel space frame. This frame both outlines the shape of the roof and serves as reinforcement for the concrete. The space frame is assembled in a simple sequence with the possibility for mistakes being minimal. Doors and windows also can be set in place by the owner on their foundations under the structure. A professional concrete spraying crew is necessary to apply concrete to the space frame (which has been covered with metal lath). The owner can place the prefabricated utility wall and a bathroom-kitchen core unit. Prefabricated, movable built-in furniture walls (on rollers) are provided, and the owner can complete the perimeter enclosure of the house with jalousie wall sections. Plug-in base molding and duplex receptacles are provided for electrical fixtures and appliances.

The thin-shell roof structure may be finished on the exterior with white cement and varicoloured aggregates and does not require repainting or maintenance. Other advantages claimed for the concept are: (1) Being formless, the structure suffers none of the damaging secondary stresses which occur when falsework is removed from concrete; (2) The shell can be water-cured from both sides (in the absence of formwork) resulting in higher strength and better quality; (3) Spray application of concrete affords better control of the water/cement ratio for a denser, stronger structure; and (4) Absence of formwork saves construction money and time.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
3 Topography	ADAPTABLE TO ALL TOPOGRAPHY
4 Climate	ADAPTABLE TO SOUTHERN & NORTHERN CLIMATES; ADAPTABLE TO ALL SOILS
6 Nonresidential Functions	DAY CARE CENTERS; SHOPPING CENTERS; AIRPORTS; CHURCHES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
13 Design Selection	FLEXIBLE
14 State of Development	CONSTRUCTION METHOD DEVELOPED; PROTOTYPE DESIGNS COMPLETE
BUILDING SUBSYSTEMS	
16 Structure	MONOLITHIC THIN-SHELL STEEL SPACE FRAME; PNEUMATICALLY SPRAYED WITH CONCRETE
17 Exterior Elements	WINDOW & JALOUSIE WALLS; UTILITY WALL
18 Interior Elements	CEILING; FLOOR; INTERNAL PARTITIONS; STAIR TREADS
19 Foundations	CONVENTIONAL; DESIGNED FOR EXISTING SOIL CONDITIONS
20 Comfort Systems	ELECTRIC SPACE HEATING CONTAINED IN UTILITY WALL; AIR CONDITIONING OPTIONAL
21 Plumbing	PREFABRICATED BATHROOM & KITCHEN; PREFABRICATED UTILITY WALL
22 Electrical	CONDUIT IN PREFABRICATED UTILITY WALL; DUPLEX OUTLETS IN BASE MOLDING
23 Furnishings	PREFABRICATED, MOVABLE BUILT-IN FURNITURE
PRODUCTION	
24 Offsite Production	STEEL SPACE FRAME COMPONENTS; CORE UNITS
26 Onsite Construction and Erection	ERECTION OF SPACE FRAME; SPRAYING OF CONCRETE; PLACING OF CORE UNITS
27 Labor	UNSKILLED LABOR
29 Community Involvement	CONSIDERABLE SELF-HELP POSSIBLE
ECONOMICS	
30 Construction Costs	$3,000 TO $15,000 PER UNIT ($5.65 PER SQ. FT.); 1,000 UNITS PER YEAR
31 Financing Methods	MONTHLY MORTGAGE PAYMENTS: $61.00 ON $6,500 HOUSE INCLUDES UTILITIES & TAXES
32 Useful Life	50 TO 200 YEARS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & DIRECT CONSTRUCTION OF THIN-SHELL CONCRETE HOUSING SYSTEM
36 Market Area	NATIONWIDE; PRIMARILY THE SOUTH
37 Delivery Rate	2 DWELLING UNIT DOMES PER DAY PER RIG; COMPLETE UNIT ERECTED IN 2 TO 3 DAYS
GENERAL	
39 Major Innovative Concepts	DOMED THIN-SHELL CONCRETE STRUCTURE

Ross, Hardies, O'Keefe, Babcock, McDugald & Parsons

PROPOSER

Ross, Hardies, O'Keefe, Babcock, McDugald & Parsons, Attorneys, Chicago, Illinois

This proposal would undertake the preparation of a manual to better equip HUD and developers under Operation Breakthrough to respond to legal and administrative barriers encountered in the application of technical innovations at the local level. It would include model legislation as a guide to states and cover existing state codes, zoning restrictions, and land-use controls. Further than this, the document would outline strategies for avoiding or responding to local resistance to construction of low- and moderate-income family housing.

The proposer would research and write in some depth on the following subjects as they bear on opposition to the placement of housing for lower income families in suburban areas:

- Criteria for making grants and loans as a basis for judgment as to community responsibility in its decisions on admitting low cost housing;
- State legislation redefining responsibility for location of moderate-low-income family housing;
- State legislation giving local governments assurance that relaxation of codes to permit some housing of this type where it now is barred can be beneficial to the community;
- Preparation of prototype sections for use in model codes to balance the objectives of adequate safety and increased availability of low-cost housing;
- Examination of areas of bargaining power available to cities in their contractual relationships with the suburbs to be accomplished in a commercial-legal context;
- A study of policies of metropolitan planning agencies on the distribution of housing with respect to their role in persuading local communities to accept a share of the low-cost housing market;
- Preparation of a lawyer's brief challenging restrictive code barriers on constitutional grounds.

This proposal assumes that the restrictive barriers to the construction of low- and moderate-income family housing in many suburban areas must be removed, in part, if volume housing of that type is to be erected in required quantities.

SITE SYSTEM 8 Site Planning Services	PREPARATION OF A LAWYER'S BRIEF CHALLENGING RESTRICTIVE CODE BARRIERS ON CONSTITUTIONAL GROUNDS; MODEL LEGISLATION ON ZONING & LAND-USE CONTROLS
ECONOMICS 31 Financing Methods	STUDY OF CRITERIA FOR MAKING GRANTS & LOANS AS A BASIS FOR COMMUNITY DECISIONS ON LOW COST HOUSING
MANAGEMENT 33 Proposer Organization	PROFESSIONAL LAWYERS
34 Internal Functions	PREPARATION OF A MANUAL TO BETTER EQUIP HUD & DEVELOPERS UNDER OPERATION BREAKTHROUGH TO RESPOND TO LEGAL AND ADMINISTRATIVE BARRIERS ENCOUNTERED IN APPLYING TECHNICAL INNOVATIONS AT THE LOCAL LEVEL. IT WOULD INCLUDE MODEL LEGISLATION & COVER ZONING RESTRICTIONS & LAND-USE CONTROLS; WOULD OUTLINE STRATEGIES FOR AVOIDING LOCAL RESISTANCE TO LOW-INCOME HOUSING
GENERAL 40 Codes	PREPARATION OF A LAWYERS BRIEF TO BE USED IN CHALLENGING RESTRICTIVE CODE BARRIERS ON CONSTITUTIONAL GROUNDS

Herman D. Ruth

PROPOSER

Herman D. Ruth & Associates, City and Regional Planning Consultants, Berkeley, California.

AFFILIATES

Associated Home Builders of the Greater East Bay; Professor Ira Michael Heyman, Legal Analysis; Professor Paul Wendt, Market & Fiscal Analysis; Professor John W. Dyckman, Design Analysis.

Identifying housing construction potential and obstacles to volume construction and setting up an action program to overcome institutional and other restraints is the goal of this proposed program. Although the program applies specifically to the San Francisco Bay area, the results and conclusions expected to emerge from the study generally should have applicability for urban areas anywhere in the United States.

Achieving what is designated as the housing element is paramount in the proposal. The housing element would serve as a guide to both public officials and private entrepreneurs and should be the link between the objectives of a community and the plan for attaining them. Further, the housing element should provide guides for construction of new housing and for the continued upgrading and preservation of the city's housing stock; and finally, it may become the first legal guide for solving social problems within the framework of a larger, overall area plan.

The methodology through which the housing element and an action program are to be developed includes: (1) Review of existing housing programs; (2) Review of legislation; (3) Review of governmental regulations and codes; (4) Interviews with developers, mortgage lenders and labor organizations; (5) Analysis of data obtained; (6) Identification of items relevant to housing; (7) Organization of technical advisory committee; and (8) Seminars to seek information from, and to inform, planning commissions and city councils.

PRODUCTION	
28 Labor Training Program	"HOUSING ELEMENT ACTION PROGRAM" WILL INFORM & EDUCATE ADMINISTRATORS, LABOR UNIONS, DEVELOPERS, PRODUCERS, & OTHERS CONCERNED WITH HOUSING
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions 35 External Functions	PREPARATION OF A "HOUSING ELEMENT ACTION PROGRAM" FOR THE SAN FRANCISCO BAY AREA TO FACILITATE VOLUME PRODUCTION, & PROVIDE A GUIDE FOR CONSTRUCTION OF NEW HOUSING & UPGRADING & PRESERVATION OF HOUSING STOCK; THE HOUSING ELEMENT OF THE GENERAL PLAN WILL BE A FUNCTION OF HOUSING NEEDS, LEGISLATION, POLICIES, & PLANNING, ETC., AS INTERPRETED BY PROPOSERS.
36 Market Area	SAN FRANCISCO BAY AREA; GENERAL APPLICABILITY FOR OTHER URBAN AREAS IN THE UNITED STATES.
GENERAL	
40 Codes	CONSIDERATION OF EXISTING CODES, STATUTES, & LEGISLATIVE POLICIES WILL BE A MAJOR INPUT IN PREPARATION OF THE "HOUSING ELEMENT ACTION PROGRAM."

Herman D. Ruth

PROPOSER

Herman D. Ruth & Associates, City and Regional Planning Consultants, Berkeley, California.

AFFILIATE

Associated Home Builders of the Greater East Bay.

Planned unit developments (PUD) in California cities and counties would be the subject of review and evaluation in the study proposed. It is stated that the knowledge gained through such a study would produce a model which could be used by other states throughout the nation.

Objectives of the proposed work are to assess PUD procedures and processing techniques, to seek understanding of the causes of delay in processing, to record and detail successful applications of PUD, and to recommend means of facilitating rapid processing of PUD by builders and developers.

Methodology in achieving these objectives includes review and evaluation of data, development of a model PUD processing technique, and interviews with builders and developers who have submitted proposals for PUD.

SITE SYSTEM	
2 Density Range 5 Planning Concepts 8 Site Planning Services	STUDY OF PLANNED UNIT DEVELOPMENTS & DEVELOPMENT OF MODEL PROCESSING TECHNIQUES
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	STUDY & EVALUATION OF PLANNED UNIT DEVELOPMENT PROCESSING IN SELECTED MUNICIPALITIES IN CALIFORNIA
GENERAL	
40 Codes	PROPOSER WILL SUGGEST STATUTES, ORDINANCES, RULES, STANDARDS, PROCESSING PROCEDURES, & COORDINATION DEVICES TO EXPEDITE PROCESSING OF PLANNED UNIT DEVELOPMENT BY BUILDERS & DEVELOPERS

Seed Consortium

PROPOSER

SEED Consortium, Structural, Esthetic and Environmental Design, Oklahoma City, Oklahoma

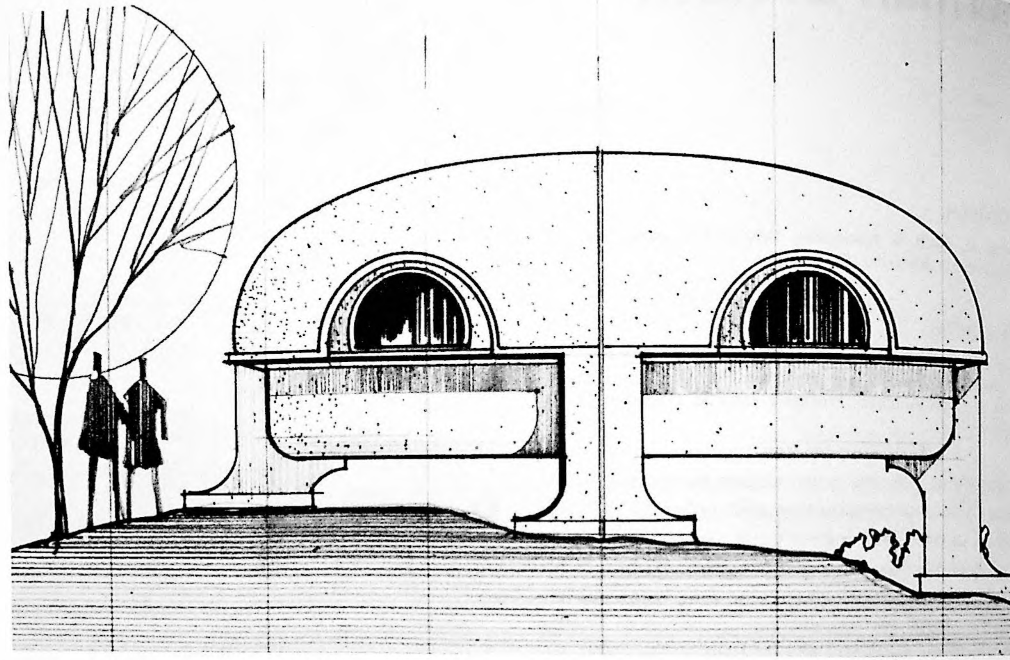
Feasibility of an all-molded, fiberglass home, built in a series of four partial modules complete to furniture and bed-bases, would be studied under this proposal.

Shells would be formed with reinforced fiberglass exterior and interior structural skins, with a urethane foam core for stability and insulation. The basic module would be manufactured in four sections—two half-sections for roof and upper wall and two half-sections for lower wall and floor—for ease in shipment and erection, and minimum number of joints that must be weatherproofed. These sections can be joined to form the module structure either at the plant or onsite.

It is contemplated that this basic module can be brought to the site complete with all electrical-mechanical and other subsystems, requiring only site placement and connection to foundation and utility services. The planned basic structural shell would provide 720 sq. ft. of interior space, providing two bedrooms, one bath, living and dining area, kitchen, and storage space. This module could then be divided to make a duplex dwelling with 320 sq. ft. of living space in each apartment. By the same token, it can be expanded to almost any desired amount of space.

Kitchen and bathroom would be completely molded fiberglass modules, with floors, walls and ceilings in a preplumbed and prewired package. In addition, built-in furniture would be provided, including seats, tables, and bed-base.

The proponents point out that the molded plastic material can eliminate any sharp corners or edges, practically eliminates maintenance—the whole interior could actually be hosed down without any damage to the materials. Exterior and interior treatment could be varied to produce almost any desired effect.



SITE SYSTEM	
4 Climate	ADAPTABLE TO ALL CLIMATES, INCLUDING SEVERE CONDITIONS OF HEAT & COLD
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED
13 Design Selection	SELECTED FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULE OF REINFORCED FIBERGLASS EXTERIOR AND INTERIOR STRUCTURAL SKINS WITH A URETHANE FOAM CORE; MONO-UNIT SYSTEM
20 Comfort Systems	CONVENTIONAL FORCED AIR GAS OR ELECTRIC HEATING-COOLING
21 Plumbing	PREWIRED, PREPLUMBED UNITIZED MOLDED FIBERGLASS KITCHEN & BATHROOM MODULES
22 Electrical	
23 Furnishings	BUILT-IN FURNITURE INCLUDING SEATS, TABLES, AND BED BASE
PRODUCTION	
24 Offsite Production	FOUR STANDARD COMPONENTS JOINED EITHER AT PLANT OR ONSITE
26 Onsite Construction and Erection	FOUNDATION; PLACEMENT OF MODULE OR COMPONENT CONNECTION; UTILITY HOOKUPS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DEVELOPMENT OF MONO-UNIT HOUSING SYSTEMS
35 External Functions	CONSULTANT WORK

SMS Partnership

PROPOSER

The SMS Partnership, Architects-Management, Stamford, Connecticut.

AFFILIATES

Ford, Bacon & Davis, Inc., Construction; Gerard Van Duyn & Associates, Industrial Design.

BUILDING SYSTEMS	
14 State of Development	BUILDING SYSTEM REQUIRES FURTHER RESEARCH
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF MODULE OR STRUCTURAL PANELS TO FORM MODULES
20 Comfort Systems	FORCED AIR, ELECTRIC OR GAS UNIT OR CENTRAL HYDRONIC OIL, GAS, OR ELECTRIC SYSTEM
21 Plumbing 22 Electrical	RESEARCH AND DEVELOPMENT OF PREFABRICATED KITCHEN, LAUNDRY, BATHROOM CORE UNITS, NONBEARING PANELS
PRODUCTION	
24 Offsite Production	MODULES OR PANELS; FIXTURES AND APPLIANCES
27 Labor	UNSKILLED ONSITE
29 Community Involvement	LOCAL CONTRACTORS AND SUBCONTRACTORS; SELF-HELP
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	MANAGEMENT
35 External Functions	DESIGN
GENERAL	
40 Codes	TO BE ADAPTABLE TO ALL NATIONAL CODES

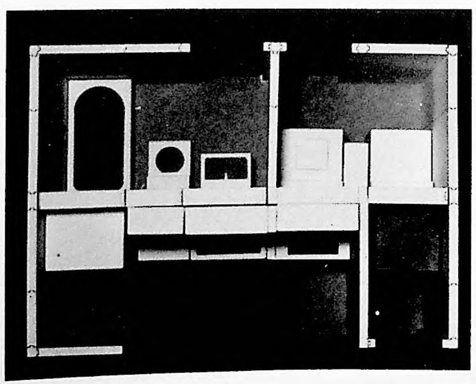
Research and development of a prefabricated, panelized, and integrated system of providing all service and utility core facilities for dwelling units, whether in new construction or for rehabilitation, is proposed. The central objective of the proposed work is to develop panels that will plug together to form a continuing matrix of enclosing surfaces, with integrally contained services such as all piping, wiring, and ductwork incorporated in wall and ceiling panels during fabrication, these services being readily linked between panels at the time of assembly.

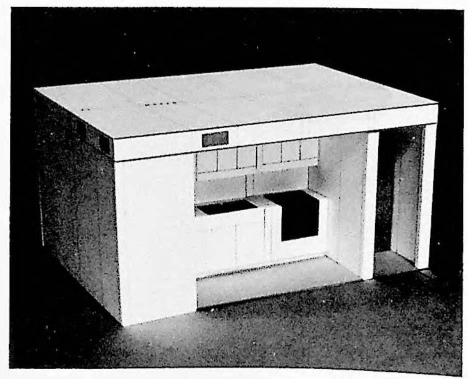
The basic wall panels would be horizontal and vertical, with corner panels, door panels, and other panel types necessary for adaptation of the system to a variety of floor plans. Ceiling panels would fit together to form a distribution system for heating and air conditioning, supplying the entire living unit. Panels would be lightweight, capable of being carried by two men, and small enough to fit through a conventional, residential doorway.

The panelized system would be designed so that its overall height would permit it to fit within the 8-ft. 1/2-in. floor-to-ceiling dimension of most residential construction. The inside faces of the panels would have integral finishes as required for the space they enclose, but the exterior surfaces would be designed to accept whatever finish was called for in the rooms adjacent to the core—bedrooms, dining room, or entryway. The panels would be so designed that they could be abutted to exterior walls, with openings provided for insertion of clip-on window frames, adjustable to the exterior wall thickness.

As presently viewed, the core units would be shipped knocked-down for both new construction and rehabilitation application. Sequential loading and unloading would be provided, so that the panels would come from the truck or stock pile exactly as needed. The connections would be such that no special tools, skill, or training would be required to produce a completed, working assembly.

Among the advantages claimed for the panelized core concept are: use in new construction or rehabilitation; application in a variety of combinations and in any type of dwelling; amenable to production at a substantially lower cost than conventional installation; easy replacement of obsolescent or worn out elements; and elimination of practically all mechanical, electrical, and plumbing work external to it, with only one site connection per service being required.





Saxon Enterprises

PROPOSER

Saxon Enterprises, Inc., Business and Management Consultant Services, Beaver Falls, Pennsylvania.

Value engineering is put forward by this proposer for its potential in helping to solve the nation's housing problems. Applied either to development of a complete housing system for the retired and elderly, or to development of new products and new materials, value engineering is offered as being able to both organize and channel creative effort and to coordinate and counsel with others already engaged in on-going programs.

Moving new concepts, products, and materials from the laboratories into practical application would be one of the main thrusts of value engineering as applied to housing, with an eventual goal of designing, developing, manufacturing, and marketing modern homes at reduced costs, thus effectively serving the low- and moderate-income markets.

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	PERFORM VALUE ENGINEERING ANALYSIS ON ANY PROJECT OF BREAK-THROUGH OR FOR A COMPLETE HOUSING SYSTEM

Sentra Corporation

PROPOSER

Sentra Corporation, Concrete Products, La Grange, Illinois

Feasibility of precasting sheets of prestressed concrete—in thicknesses of 1 in., 2 in. or more and on a mass basis in casting beds—for assembly of low-cost housing units, would be the subject of the suggested study.

The sheets, which could be cast in large increments and then cut to suit the design module of a building, would constitute both the weather envelope and the structural frame of the building, joined at edges through steel plates cast into the edges and welded. Similar sheets could be used for roofs.

The proposer suggests that outer walls could be built by erecting two sheets side by side, with a proper space between to accommodate insulation, wiring, plumbing and heating-air conditioning ducts.

It is pointed out that such concrete sheets could be manufactured with a variety of textures and treatments for architectural effect and could be treated on the interior with a variety of paints, plastics, and other finishes to suit the decorating desires of the tenant or owner.

Because of their inherent strength and tightness, the sheets could serve as roof and exterior walls and could be extended to project from the walls to form sun and weather shelters, balconies, and other enhancements.

BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
14 State of Development	SINGLE-FAMILY MODEL CONSTRUCTED
BUILDING SUBSYSTEMS	
16 Structure **17 Exterior Elements**	ALL-WEATHER PRESTRESSED LOAD-BEARING CONCRETE SHELL; CONCRETE SHEETS JOINED BY STEEL PLATES CAST INTO THE EDGES AND WELDED; ROOF; EXTERIOR WALLS; BALCONIES; SUN AND WEATHER SHELTERS
20 Comfort Systems **21 Plumbing** **22 Electrical**	MECHANICAL AND ELECTRICAL SUBSYSTEMS CONTAINED BETWEEN THE TWO CONCRETE SHEETS OF WALL COMPONENT
PRODUCTION	
24 Offsite Production	PRESTRESSED CONCRETE SHEETS FOR OFF-SITE CONSTRUCTION OF MODULE OR DELIVERY TO SITE
27 Labor	PRIMARILY UNSKILLED
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOP ALL-WEATHER HOUSING SHELL SYSTEM UTILIZING PRESTRESSED CONCRETE SHEETS

Lloyd A. Severn

PROPOSER

Lloyd A. Severn and Others, Madison Wisconsin.

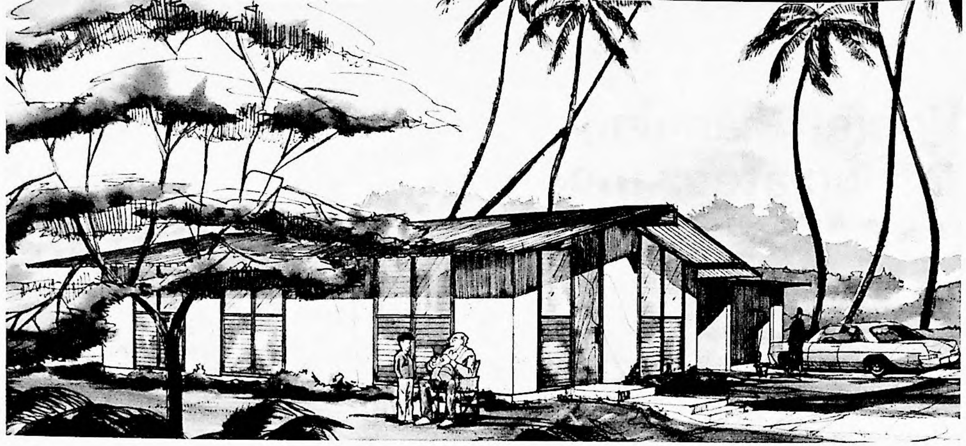
Development of a new type of housing unit, to be suspended on a structural frame to provide medium- or high-rise apartments, is the subject of the suggested study.

The living units or apartments would be completely factory- or site-fabricated modules, containing heating-cooling and mechanical services to be connected to an outside source—or the power unit could also be "snapped on" to the living unit. The modules would then be suspended in a multistory structure from a conventionally built frame of any suitable material. Modules may be of any height, though the proposer suggests a 9-ft. measure.

Also to be studied under the proposal would be consumer acceptance of the concept.

SITE SYSTEM	
4 Climate	ADAPTABLE TO ALL CLIMATES
6 Nonresidential Functions	SCHOOL; DAY CARE UNITS PROPOSED
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY; MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULES SUSPENDED FROM A STRUCTURAL FRAME
20 Comfort Systems	INTEGRATED WITH TOTAL ENERGY SYSTEM
22 Electrical	TOTAL ENERGY POWER SYSTEM PROPOSED
PRODUCTION	
24 Offsite Production	FACTORY- OR SITE-FABRICATED MODULES
25 Onsite Production	
26 Onsite Construction and Erection	
27 Labor	SEMISKILLED LABOR
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DEVELOPMENT OF BUILDING SYSTEM

Ken Smith Haiku Corporation



PROPOSER

Ken Smith Enterprises, Ltd., Honolulu, Hawaii

AFFILIATES

Lemmon, Freeth, Haines & Jones, Architects; Hawaii United Internation, Real Estate Brokers; AMFAC, Manufacturer

Further study and development is proposed of a housing system that utilizes cast-in-place floor slab and foundations, gunited (sprayed concrete) sidewalls, and conventional wood-frame interior partitions.

The concept, already under construction in a prototype in Hawaii, includes a complete plan for plumbing, wiring, and other appurtenances. The proposer expects that single-family detached or multifamily attached structures can be produced at extremely low costs in the United States mainland market.

The foundation is cast in mobile, steel channel forms which include a master vibrator system to assure a smooth, dense, and level surface. Sidewalls consist of gunited metal-frame sections, 2 1/2 in. thick, in areas where no windows or doors are planned, or wood, steel or aluminum panels which incorporate windows, doors and other openings. These prefabricated frame units are installed in a slot cast into the foundation slab perimeter to insure accurate, quick erection. The roof is supported on exterior and interior center bearing plates formed by the prefabricated wall units and a ridgepole. The system includes a number of developments such as matched male-and-female connections between wall panels and roof panel sections.

Use of the gunite technique of spraying concrete eliminates the need for many forms, permits easy installation of utility wires and piping, and makes possible use of semiskilled labor in construction.

SITE SYSTEM

2 Density Range	10 TO 15 DWELLING UNITS PER ACRE
3 Topography	SUITABLE TO LEVEL AND UNDULATING SITE; UNSUITABLE TO POORLY DRAINED AREAS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
6 Nonresidential Functions	RECREATION FACILITIES
7 Circulation	SEPARATE VEHICULAR CIRCULATION

BUILDING SYSTEMS

11 Housing Types	SINGLE-FAMILY DETACHED; MULTIFAMILY LOW-RISE
14. State of Development	PRODUCTION PLANT DESIGN STAGE; BUILDING SYSTEM DEVELOPED

BUILDING SUBSYSTEMS

16 Structure	METAL-PANEL WALL FRAMES WITH REINFORCING CONDUITS IN PLACE, GUNITE SPRAYED
18 Interior Elements	PREFABRICATED PARTITIONS, OPTIONAL MATERIALS
19 Foundations	CONCRETE SLAB
21 Plumbing	PLUMBING TREE; INTEGRATED IN BUILDING SYSTEM
22 Electrical	CONVENTIONAL; INTEGRATED IN BUILDING SYSTEM
23 Furnishings	

PRODUCTION

24 Offsite Production	PARTITIONS; PLUMBING TREES; ELECTRICAL; PANEL FRAMES
26 Onsite Construction and Erection	FOUNDATION; ASSEMBLY OF WALL PANELS; GUNITING OF WALLS & ROOFS
27 Labor	SKILLED, SEMISKILLED, UNSKILLED FOR SITE CONSTRUCTION
28 Labor Training Programs	UNSKILLED TRAINED TO DO SEMISKILLED TASKS
29 Community Involvement	LIMITED SELF-HELP

ECONOMICS

30 Construction Costs	$9,160 PER DWELLING UNIT
31 Financing Methods	
32 Useful Life	OVERALL, 35 YEARS

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	GENERAL PROJECT CONTROL
35 External Functions	REAL ESTATE; MANUFACTURING OF COMPONENTS
36 Market Area	HAWAIIAN ISLANDS
37 Delivery Rate	200 TO 400 UNITS PER YEAR

Social Planning Associates, Inc.

PROPOSER

Social Planning Associates, Inc., Chicago, Illinois.

A critical, comparative analysis of state housing legislation, is proposed from which would emerge recommendations for reshaping legislation as a spur to greater housing productivity. The objective of such a program is to furnish the federal government with a means of encouraging greater participation by the states in housing development.

The basic premise of the proposal is that the state governments have a vital role to play in encouraging increased housing production. But statewide market aggregation and waiver of building codes (as under Operation Breakthrough) are insufficient alone to stimulate output. Needed are incentive programs and the administrative machinery to run them. With few notable exceptions, state legislation does not support this kind of increased activity. State-by-state analysis of both legislation and housing production would be expected to produce guidelines for states desirous of amending their legislation. Furthermore, the analysis would identify existing constraints which are impeding volume production of low- and moderate-income housing and would indicate the extent to which individual states can assume greater responsibility in administering housing programs.

In addition to the analysis itself, the proposed study should reveal such factors as the extent to which state-sponsored incentives have, in fact, resulted in increased production; machinery which impedes and machinery which encourages development; and effective innovative approaches. An overview of the project will review the capacity of existing structures to respond to demands for low- and moderate-income housing and the trends developing in legislation and administration to respond to current needs.

MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	COMPARATIVE ANALYSIS OF STATE HOUSING LEGISLATION; RECOMMENDATIONS FOR RESHAPING LEGISLATION AS A SPUR TO GREATER HOUSING PRODUCTIVITY; PROVIDE FEDERAL GOVERNMENT WITH MEANS OF ENCOURAGING GREATER STATE PARTICIPATION IN HOUSING DEVELOPMENT; REVIEW OF CAPACITY OF PRESENT INSTRUMENTS TO MEET THE NEEDS OF LOW- & MODERATE-INCOME HOUSING; ANALYSIS OF INSTRUMENTS WHICH ENCOURAGE & DISCOURAGE DEVELOPMENT

GENERAL	
40 Codes	ANALYSIS OF STATE LEGISLATION WHICH ENCOURAGES & DISCOURAGES HOUSING PRODUCTION

Social Planning Associates

PROPOSER

Social Planning Associates, Inc., Chicago, Illinois.

Analysis of legislation and administration of programs which relate to housing in rural areas and examination of the interrelationships of programs of different agencies in the field are the basic activities proposed by this planning organization, with the final result to be summed up in a handbook for use by rural housing sponsors.

Four assumptions motivate this proposal: (1) Rural needs differ from urban needs; (2) Development of rural housing must be seen in the total context of the area; (3) Public or private groups which have produced rural housing can underscore the strengths and weaknesses of current programs; and (4) Potential sponsors of such housing need guidance.

The approach used to carry out the proposed project would combine legislative analysis with field work to test the conclusions that emerge. The final production, including the handbook, as well as technical analysis and recommendations, should reflect both theory and practice and should assist builders in the implementation of housing in rural areas.

The handbook to be produced would be divided into the following sections: public agencies, nonprofit sponsors, limited-dividend corporations, for-profit corporations, and development by owner-occupiers. The latter section would be concerned with the individual who wishes to construct, rehabilitate, or improve his own home, or participate in a cooperative development, or provide housing for migratory workers. This portion of the manual might be produced in such a way that it could be distributed independently (from the major portion of the handbook) to persons eligible for assistance.

SITE SYSTEM	
1 Site Situation	RESEARCH ON RURAL NEEDS
8 Site Planning Services	SELECTION OF AT LEAST 4 REPRESENTATIVE AREAS FOR FIELD WORK
PRODUCTION	
29 Community Involvement	PARTICIPATION OF LOCAL CONTRACTORS AND SUBCONTRACTORS
ECONOMICS	
31 Financing Methods	STUDY OF FINANCING METHODS; CONVENTIONAL; REVOLVING FUND
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions 35 External Functions	ANALYSIS OF LEGISLATION AND ADMINISTRATION OF PROGRAMS RELATING TO HOUSING IN RURAL AREAS AND EXAMINATION OF INTER-RELATIONSHIPS OF PROGRAMS OF DIFFERENT AGENCIES; USE OF QUESTIONNAIRES; PREPARATION OF A HANDBOOK FOR USE BY RURAL HOUSING SPONSORS, INCLUDING SECTIONS DIRECTED TO FOR-PROFIT CORPORATIONS, NOT-FOR-PROFIT SPONSORS, LIMITED-DIVIDEND CORPORATIONS, PUBLIC AGENCIES, AND OWNER/OCCUPIERS

Southwest Forest Industries

PROPOSER

Southwest Forest Industries, Wood Products Group, Phoenix, Arizona

A product-integrated shelter system, heavily oriented toward the use of wood and wood products, would result from implementation of this proposal. It involves a prototype testing procedure making use of most of the current housing program operations; it would cover the movement of wood from stumpage to finished housing unit. A corporate system is now in operation.

The objectives of such an integrated shelter development system are: (1) To increase interdependency of existing housing components and to provide component assembly plants; (2) To reduce the number of business transactions now required to produce a completed housing unit; (3) To design a wood modular dwelling system adaptable to the mass-production building components of the proposer; (4) To use the proposer's existing real estate holdings for residential development; and (5) To use these holdings for land exchanges with the Bureau of Land Management and the Forest Service of the federal government. The use of public domain lands in the western states for new city sites is proposed as part of the land exchange suggestion.

The structural design aspect of this proposal would answer and document three unknowns: What design or combination of existing modular designs is best suited for mass production of a basic wood dwelling unit or units? What design best matches the proposer's capabilities for integrated housing development? What is the best method of mass producing the structure or strucures?

The proposer presently uses several production techniques to develop housing-component fabrication and partial factory assembly, standard site assembly and many combinations of it. The planned research would produce a unified production technique or techniques incorporating all corporate or noncorporate inputs to the final product.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	LOW TO MEDIUM DENSITY
5 Planning Concepts	EXCHANGE OF COMPANY-HELD FOREST LANDS FOR FEDERAL LANDS IN SOUTHWEST FOR NEW TOWNS
8 Site Planning Services	SITE PLANNING THROUGH CORPORATION REAL ESTATE & PLANNING GROUP
BUILDING SYSTEMS	
13 Design Selection	DEVELOPMENT OF OPTIMUM DESIGN FOR MODULAR WOOD FRAME SYSTEMS
14 State of Development	CORPORATE SYSTEM PRESENTLY OPERATIONAL; AGGREGATION OF NONCORPORATE COMPONENTS OF BUILDING SYSTEM REMAINS
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF OPTIMUM INDUSTRIALIZED WOOD FRAME SYSTEMS & COMPONENTS
PRODUCTION	
24 Offsite Production	WOOD SYSTEM COMPONENTS
ECONOMICS	
31 Financing Methods	FHA SECTION 235 AND 235 PROGRAMS; OTHER.
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ESTABLISH A PRODUCT-INTEGRATED SHELTER SYSTEM TO REDUCE NUMBER OF BUSINESS TRANSACTIONS REQUIRED TO PRODUCE WOOD COMPONENT HOUSING SYSTEMS
35 External Functions	NONWOOD MATERIALS & PRODUCTS; MECHANICAL & ELECTRICAL WORK; FINANCING; LEGAL; SALES
36 Market Area	ARIZONA; CALIFORNIA; COLORADO; GEORGIA; ILLINOIS; NEW MEXICO; SOUTH CAROLINA; TEXAS; UTAH; NEVADA

Spaceshell

PROPOSER

Spaceshell, Inc., Oakland, California.

This proposal centers around 18 double-ended, pie-shaped modular components of laminated plastic which are joined together to form a pumpkin-shaped structural shell for a single-family house assembly. The self-supporting, relocatable structure (its modular panels may be disassembled and reused) is 39 ft. in diameter at floor level, is 13 ft. high at its center, and offers 1,200 sq. ft. of floor space.

The resultant structure is unconventional in appearance and unconventional in manufacture and assembly. The 18 exterior segments, which form outside wall and roof surfaces, and inside wall and ceiling surfaces, are joined together at the apex by a flat tension ring which surrounds a skylight. The sections are built up from fiberglass-reinforced polyester resin, with a polyurethane polyether core, resulting in a total 3-in. thickness. Impervious to elements or time, the segments require no painting, are readily hosed down with water, but may be painted on the interior for decorative effect.

Interior partitions are modular, rectangular panels, 13 ft. high (maximum), and being nonbearing may be arranged to conform to a wide variety of floor plans, with the available space being suitable for three- and four-bedroom configurations. The home is shipped to the site as a knockdown modular package, consisting of the outside segments, acrylic windows, one exterior door and hardware, and an optional number of interior partition panels. Erection of the pumpkin-shaped, scalloped shell, takes approximately 30 man hours. The heaviest component, the exterior segment, weighs only 400 lbs. and is readily handled by two men.

The unusually shaped structure is said to offer significant structural advantages compared to conventional structures. A volume rate of 2,000 units per year per plant is predicted, utilizing franchised production plants.

SITE SYSTEM	
1 **Site Situation**	SUBURBAN
3 **Topography**	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 **Climate**	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY DETACHED
12 **Unit Variations**	3 TO 4 BEDROOMS
13 **Design Selection**	FLEXIBLE OPEN PLANNING VARIATIONS
14 **State of Development**	PROTOTYPE UNDER CONTRACT
BUILDING SUBSYSTEMS	
16 **Structure**	RELOCATED PIE-SHAPED LAMINATED SANDWICH PANELS, FIBERGLASS
17 **Exterior Elements**	REINFORCED POLYESTER RESIN WITH A POLYURETHANE POLYETHER
18 **Interior Elements**	SANDWICH CORE; RECTANGULAR NONLOAD BEARING PARTITIONS
PRODUCTION	
24 **Offsite Production**	PIE-SHAPED PANELS, WINDOW COMPONENTS & PARTITIONS
26 **Onsite Construction and Erection**	FOUNDATION; ERECTION OF PANELS; UTILITY HOOKUP
ECONOMICS	
30 **Construction Costs**	$10.00 TO $12.00 PER SQ. FT., $12,000 TO $15,000 PER UNIT, 2000 UNITS PER YEAR
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	RESEARCH & DEVELOPMENT OF BUILDING SYSTEM
35 **External Functions**	FRANCHISED PRODUCTION PLANTS
37 **Delivery Date**	2,000 UNITS PER YEAR, PER PLANT
GENERAL	
39 **Major Innovative Concepts**	PUMPKIN-SHAPED FIBERGLASS-REINFORCED PLASTIC PANEL BUILDING SYSTEM

Stanford University

PROPOSER

Stanford University, Palo Alto, California.

A detailed investigation of problems in the specific area of self-help housing is proposed. Results of the proposed investigation are expected to furnish insight into these problems as they appear in the general context of industrialized housing production. The ultimate aim of the work would be to establish fundamental criteria for design, production, and implementation of industrially produced housing.

Self-help housing, for the purposes of the study, would include any specific housing system composed of factory-produced components which may be assembled and erected onsite by community service groups, ghetto enterprises, private individuals, or commercial construction concerns using low-skill labor.

The proposed study would consist of eight separate tasks: (1) Community systems design—investigation of patterns of land use, circulation, and urban design, and research into an integrated buildings system suitable for assembly by unskilled labor. (2) Materials research—comprehensive study of materials for mass production of housing units or elements which can be readily joined together by unskilled labor. (3) Contributions of computer science to industrialized housing—examination of the applicability of computer technology to the solution of low-cost housing problems. (4) Geologic siting of self-help housing—investigation of methods for prevention of problems due to siting on geologically faulty sites. (5) Design and development of an industrially-produced system for urban self-help housing. (6) Community decisions and low-cost housing technology—arriving at more effective community decision making procedures. (7) Sociological research problems related to low-cost housing. (8) A study of the creative development of human values through the esthetic component of low-cost housing.

SITE SYSTEM	
3 Topography	STUDY OF METHODS FOR SELECTING APPROPRIATE SITES
7 Circulation 8 Site Planning Services	INVESTIGATION OF PATTERNS OF LAND USE, CIRCULATION, AND URBAN DESIGN
9 Community Involvement	DEVELOPMENT OF MORE EFFECTIVE DECISION MAKING PROCEDURES; SOCIOLOGICAL RESEARCH PROBLEMS RELATED TO LOW-COST HOUSING; A STUDY OF THE CREATIVE DEVELOPMENT OF HUMAN VALUES THROUGH THE ESTHETIC COMPONENT OF LOW-COST HOUSING
BUILDING SYSTEMS	
11 Housing Types	STUDY OF SELF-HELP HOUSING TO DETERMINE DESIGN CRITERIA ADAPTABLE TO INDUSTRIALIZED HOUSING; COMPREHENSIVE RESEARCH OF BUILDING MATERIALS
PRODUCTION	
24 Offsite Production 25 Onsite Production 26 Onsite Construction and Erection 27 Labor 28 Labor Training Programs 29 Community Involvement	STUDY OF INDUSTRIALIZED HOUSING PRODUCTION; RESEARCH INTO A BUILDING SYSTEM THAT CAN BE ASSEMBLED BY UNSKILLED LABOR, ASSEMBLY OF FACTORY-PRODUCED COMPONENTS, BUILDING SYSTEM ADAPTABLE TO UNSKILLED LABOR; DETAILED INVESTIGATION OF SELF-HELP HOUSING TO ESTABLISH CRITERIA ADAPTABLE TO INDUSTRIALIZED PRODUCTION PARTICIPATION OF COMMUNITY SERVICE GROUPS, PRIVATE INDIVIDUALS, GHETTO ENTREPRENEURS, OR COMMERCIAL CONSTRUCTION COMPANIES
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	CONDUCT OF STUDY & STUDY OF COMPUTER TECHNOLOGY AS APPLIED TO INDUSTRIALIZED HOUSING

Stanwick Corporation

PROPOSER

Stanwick Corporation, Arlington, Virginia

AFFILIATES

Dewberry, Nealon and Davis, Engineers

The long range goal of the development work proposed is the formation of voluntary cooperative construction corporations, through which the efficiencies of production inherent in large scale operation and maximum utilization of scarce resources are attained, while at the same time individual enterprise is preserved and encouraged. That there is an urgent need for rapid construction of new housing without the luxury of diseconomies stimulates the proposed program.

The functions which a voluntary construction cooperative might provide include: (1) Land acquisition and management participation in large area development by individual, smaller firms; (2) Development of new methods for design and construction utilizing contemporary advances in the art; (3) Liaison between producers and consumers; (4) Reduced-cost purchasing of materials and equipment in quantities; (5) Assuring a labor supply; (6) Managerial assistance through fiscal control; and (7) Planning for compatible communities with improved environments reflecting benefits not only to builder, but to the home buyer as well.

Development and implementation of a plan by which such cooperatives might be established is viewed as a two-phased program. Phase I would consist of a review of small contractors and builders and their practices and economic characteristics, development of the requirements for cooperative organization of such builders, study and development of the concepts to be embodied in such an organization, and development of a management plan in which would be included every phase of the housing development process. Phase II would consist of implementation of the program developed in Phase I, by application of the concepts to a pilot housing project, with evaluation of the work accomplished concluding the program.

0509

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
8 Site Planning Services	ESTABLISHMENT OF VOLUNTARY COOPERATIVE CONSTRUCTION CORPORATIONS FOR LAND ACQUISITION & MANAGEMENT IN LARGE AREA DEVELOPMENT BY INDIVIDUAL, SMALLER FIRMS; PLANNING FOR COMPATIBLE COMMUNITIES WITH IMPROVED ENVIRONMENTS
BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure	DEVELOPMENT OF NEW METHODS FOR DESIGN & CONSTRUCTION
PRODUCTION	
26 Onsite Construction and Erection	DEVELOPMENT OF NEW METHODS FOR DESIGN & CONSTRUCTION
29 Community Involvement	FORMATION OF VOLUNTARY COOPERATIVE CONSTRUCTION CORPORATIONS THROUGH WHICH THE EFFICIENCIES OF LARGE-SCALE PRODUCTION CAN BE ATTAINED
MANAGEMENT	
33 Proposer Organization 34 Internal Functions 35 External Functions	ESTABLISHMENT OF VOLUNTARY COOPERATIVE CONSTRUCTION CORPORATIONS TO TAKE ADVANTAGE OF QUANTITY PURCHASING; MANAGERIAL ASSISTANCE THROUGH FISCAL CONTROL; STUDY OF CHARACTERISTICS & NEEDS OF SMALL BUILDERS; DEVELOPMENT OF NECESSARY CONCEPTS ORGANIZATION & MANAGEMENT OF COOPERATIVES; IMPLEMENTATION OF CONCEPTS WITH A PILOT HOUSING PROJECT

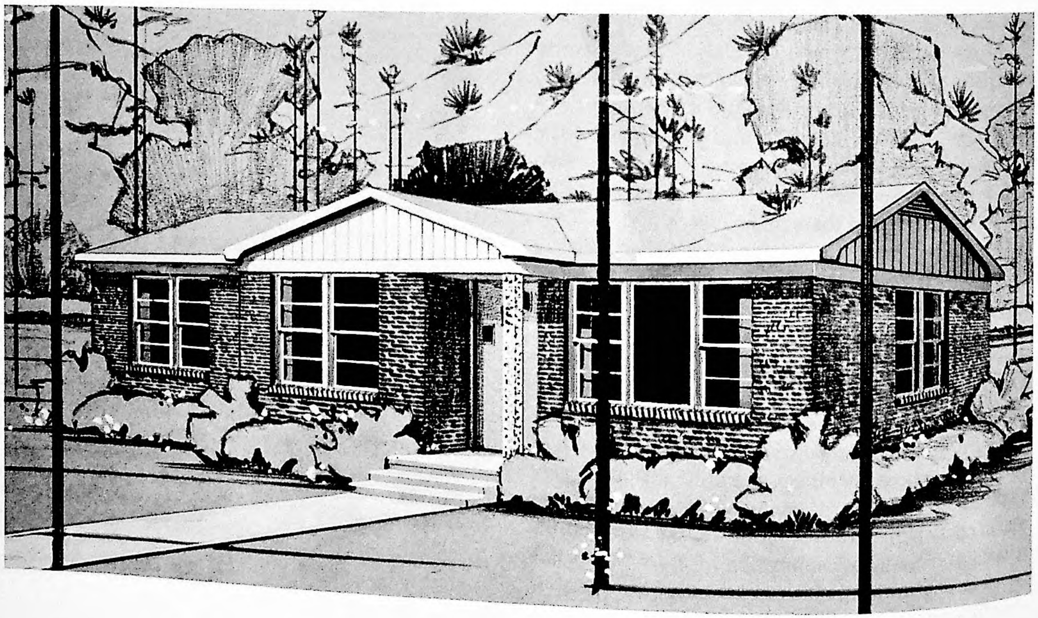
S. S. Steele & Company, Inc.

SITE SYSTEM	
1 Site Situation	SUBURBAN
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
12 Unit Variations	3 TO 4 BEDROOMS
14 State of Development	DEVELOPED & BEING MARKETED; FURTHER DEVELOPMENT PROPOSED
BUILDING SUBSYSTEMS	
16 Structure	WOOD FRAME
17 Exterior Elements	BRICK VENEER; CONVENTIONAL FINISH
18 Interior Elements	GYPSUM WALLBOARD; CONVENTIONAL FINISH; VINYL TILE FLOOR
19 Foundations	CONVENTIONAL; CONCRETE BLOCK PIERS
20 Comfort Systems	CONVENTIONAL
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	WOOD TRUSSES, GABLE ENDS; INTERIOR & EXTERIOR WALL SECTIONS
26 Onsite Construction and Erection	FOUNDATION; CONVENTIONAL CONSTRUCTION; UTILITY HOOKUP
ECONOMICS	
30 Construction Costs	$12,500 FOR 1298 SQ. FT.
31 Financing Methods	CONVENTIONAL; F.H.A.
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN; MANAGEMENT; CONSTRUCTION

PROPOSER CONSORTIUM

S.S. Steele & Company, Inc., Mobile, Alabama
Victor W. Glazner, Architect, Mobile, Alabama

Research is proposed for a low-cost housing system for production of single-family, wood-framed, brick-veneered dwellings. The proposers state that the system they have been employing and intend to develop further is capable of producing homes within the price range of low-income families. The housing system utilizes prefabricated wood roof trusses and prefinished gable ends, with all exterior trim painted. Interior walls and ceilings are surfaced with 1/2-in. gypsum board. The roof is finished with 15 lb. felt and 235 lb. asphalt shingles.



E. George Stern

PROPOSER

E. George Stern, Architect, Blacksburg, Virginia.

Guidelines for storm-resistant construction of houses are to be prepared under this proposal to form the basis for improved building standards, which can be embraced all over the United States, being adaptable to specific conditions encountered regionally, locally, or for a particular building. Failure of buildings has too often resulted from failure of joints or individual building elements and components, and from failure of unsatisfactory anchorage or lack of anchorage of any part or the whole structure. Publication of such guidelines can draw attention of those involved to the feasibility of preventing unwarranted, direct storm and flood damage and indirect damage from debris of storm ravaged buildings.

SITE SYSTEM	
1 Site Situation	ALL SITE CONDITIONS COMMONLY ENCOUNTERED TO BE CONSIDERED
BUILDING SYSTEMS	
11 Housing Types	ALL CONSTRUCTION SYSTEMS ENCOUNTERED
14 State of Development	GUIDELINES TO BE DEVELOPED ON BASIS OF GENERALLY ACCEPTED KNOWLEDGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	DEVELOPMENT OF GUIDELINES FOR BALANCED CONSTRUCTION THROUGHOUT BUILDING; BUILDING ANCHORAGE THROUGH FOUNDATION STRUCTURE TO GROUND
PRODUCTION	
26 Onsite Construction and Erection	CONSTRUCTION OF BALANCED ANCHORAGE SYSTEM THROUGHOUT BUILDING
ECONOMICS	
30 Construction Costs	NEGLIGIBLE INCREASE, IF ANY, IN CONSTRUCTION COST
32 Useful Life	POTENTIALLY INCREASED USEFUL LIFE WITH STRONGER & SAFER BUILDING
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DEVELOPMENT OF GUIDELINES FOR STORM-RESISTANT BALANCED ANCHORAGE SYSTEM
36 Market Area	ALL OVER UNITED STATES
GENERAL	
40 Codes	ACCEPTANCE OF PROPOSED GUIDELINES BY CODE AGENCIES ANTICIPATED

Structural Systems, Inc.

PROPOSER

Structural Systems, Inc., McKeesport, Pennsylvania

Only eight standardized, basic parts, consisting of a lightweight, structural steel framework and panels which snap in place, are required for the weather envelope of this single-family housing system for which further research and development is proposed. The patented framing system may be readily assembled without tools. The panels, for both external and internal applications slip into place speedily and are secured and sealed by concealed modular frames. Erection is so simple that two unskilled workers can complete a three-bedroom structure in just 4 hours.

The narrow, continuous space formed between the inner and outer panels, which are applicable for wall, floor, ceiling and roof systems, acts as an integral dead air cavity and creates a thermos-bottle insulative effect.

Unitized kitchen-bathroom modules are planned for the houses, with a double, modular wall serving as a common back-up for the appliances and fixtures, this double wall being furnished, however, in three equal widths for design freedom in placement of the various facilities.

An unusual design feature for the flat-roof models of the proposed system is provision for interconnected series of pools on the roof, the resultant wide areas of water thus dampening the noise of rain drops.

BUILDING SYSTEMS

11 **Housing Types**	SINGLE-FAMILY DETACHED
12 **Unit Variations**	3 BEDROOM
13 **Design Selection**	STANDARD PLANS WITH OPTIONS
14 **State of Development**	BUILDING SYSTEM REQUIRES FURTHER RESEARCH FOR DESIGN & CONSTRUCTION

BUILDING SUBSYSTEMS

16 **Structure**	STRUCTURAL STEEL FRAME; INTERIOR & EXTERIOR WALL PANELS; FLAT & SLOPED ROOF PANELS
18 **Interior Elements**	KITCHEN AND BATHROOM MODULES; CEILING PANELS
19 **Foundations**	CONVENTIONAL
21 **Plumbing**	KITCHEN & BATH MODULES

PRODUCTION

24 **Offsite Production**	MANUFACTURE OF PANELS
26 **Onsite Construction and Erection**	FRAMING SYSTEM ASSEMBLED WITHOUT TOOLS; PANELS SNAP ON TO FRAME
27 **Labor**	2 UNSKILLED LABORERS CAN COMPLETE A 3-BEDROOM STRUCTURE

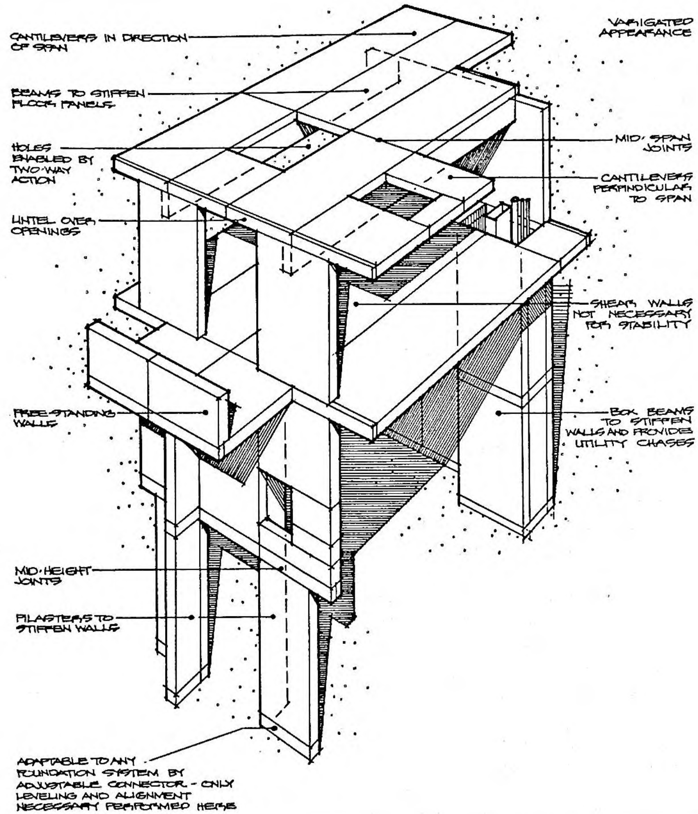
ECONOMICS

30 **Construction Costs**	$5,009 PER 480-SQ.-FT. DWELLING UNIT, INCLUDING CARPORT

MANAGEMENT

33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEVELOPMENT OF PANEL HOUSING SYSTEM

John H. Suhr



PROPOSER

John H. Suhr, Architect, Birmingham, Michigan

Proposed for development and testing is a self-locking joint which can be used to snap together, on-site, building components of many types and in many sizes and configurations. The proposer supports the need for such a device by arguing that the greatest potential for economy and volume production of housing lies with panelized systems rather than with factory-assembled modules. Further, he points out that the most efficient panel system must consist of panels as large as possible to reduce handling, but not so large as to require special erection equipment, and that they must be capable of being joined in the field without special skills and equipment, and in a minimum of time.

Other criteria established for self-locking joints are that they be self-operating, be self-aligning, be fully concealed (after the components have been joined), be capable of being disengaged, removed, and reassembled for use elsewhere, be load-bearing on placement, be completely mechanical, be capable of bearing tension (and thus moment) as well as compression and shear stresses, be resistant to air, water, sound, light and vermin, and that the resultant joint be as strong as the components it joins—and ultimately, that it render the assembled panels or parts monolithic with each other.

Other uses suggested for the self-locking joint include their application to interior, nonbearing partitions, with the device's reusable feature permitting easy rearrangement later by the owner. Even prefabricated staircases could be assembled with the self-locking devices, the risers and treads being connected to each other through concealed joints in the stringer, the balusters then snapping into the steps, and the modular rail snapping to the balusters.

BUILDING SYSTEMS	
14 **State of Development**	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
16 **Structure** 17 **Exterior Elements** 18 **Interior Elements**	DEVELOPMENT & TESTING OF A SELF-LOCKING JOINT WHICH CAN BE USED TO SNAP TOGETHER BUILDING COMPONENTS OF DIFFERENT SIZES. USING THIS JOINT, STRESSED PANELS COULD BE JOINED WITH A REINFORCED, CONCRETE FRAME OR PRECAST PANELS TO A FIBERGLASS SANDWICH PANELS; PREFABRICATED STAIRCASE COMPONENTS ALSO COULD BE SNAPPED TOGETHER
MANAGEMENT	
33 **Proposer Organization**	PROFESSIONAL
34 **Internal Functions**	DEVELOPMENT OF SELF-LOCKING JOINT FOR PREFABRICATED COMPONENTS
35 **External Functions**	TESTING

Sunshine, Jaeger, Kupritz & Associates

PROPOSER

Sunshine, Jaeger, Kupritz and Associates, Architects, Park Ridge, Illinois.

Proposed is development of a series of strategies for the site organization of housing, ranging from high to low density, and analysis of the predicted communities resulting from each strategy. The proposer points out that while assembly-line manufacture of self-contained living units, ready for placement and immediate occupancy, is making a substantial contribution toward solving the housing crisis from a production standpoint, the manner in which those units are placed or organized on the site will, in a large measure, determine the resultant community environment.

The contemplated study would consist of three phases: (1) Compilation and evaluation of existing applicable site organizational strategies; (2) Development of extensive additional, alternative strategies for large-scale site organization, specifically suited to manufactured dwelling units; and (3) Development of all selected methods of large-scale site organization and evaluation and analysis of the predicted resultant environment.

The information would be developed from case studies made in specifically selected, existing housing projects, with particular attention to differing human interaction in both high- and low-density living environments. For example, interior and exterior spaces first would be physically described, and then socially described in terms of frequency and length of time of use, the nature and quality of interaction, and their correlation to income level and social characteristics.

SITE SYSTEM 8 Site Planning Services 9 Community Involvement	COMPILATION & EVALUATION OF EXISTING APPLICABLE SITE ORGANIZATIONAL STRATEGIES; DEVELOPMENT OF EXTENSIVE ADDITIONAL ALTERNATIVE STRATEGIES FOR LARGE-SCALE SITE ORGANIZATION, SPECIFICALLY SUITED TO FACTORY-BUILT DWELLING UNITS; EVALUATION & ANALYSIS OF PREDICTED RESULTANT ENVIRONMENT OF LARGE-SCALE SITE ORGANIZATION; CASE STUDIES OF SELECTED EXISTING HOUSING PROJECTS WITH PARTICULAR ATTENTION TO HUMAN INTERACTION
MANAGEMENT 33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DEVELOPMENT & ANALYSIS OF SITE STRATEGIES

TELG System

PROPOSER CONSORTIUM

Wallace-Murray Corporation, New York, New York
The Tappan Company, Cleveland, Ohio
Lennox Industries, Inc., Marshalltown, Iowa
Genova Products, Detroit, Michigan

Development is proposed of the techniques for assembly and marketing of a unitized, package core unit which would incorporate kitchen, bathroom and laundry facilities (including all appliances and fixtures), plumbing, drain, venting, electrical distribution and other services, and heating and air conditioning.

Much of the proposed development would extrapolate on currently available systems and technology and, by combining them into one readily handled, installed, and serviced unit, achieve for the package, minimum cost, maximum performance, high volume production and rapid onsite installation.

Depending upon the elimination of code and other constraints, certain innovative, or, until now, relatively unexploited, concepts would be investigated for inclusion in the package. Among these are: use of rigid vinyl pipe for drain, waste, water and venting lines; use of single vent system; factory instead of site testing of the total system, with subsequent sitework being only a test for utilization and safety; use of quick connections for water, gas, drain, and electric services; use of fiberglass reinforced polyester (or equivalent) for bathrooms; use of preplumbed fixtures; and recirculation and treatment of air in multifamily units.

Another concept to be explored would permit the occupant to bring in 100% outside air at night, to purge the apartment dwelling unit and to lower temperatures to a more desirable level.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
BUILDING SYSTEMS	
11 Housing Types	ADAPTABLE TO SINGLE-FAMILY ATTACHED & DETACHED, MULTIFAMILY LOW- & HIGH-RISE
14 State of Development	BUILDING SUBSYSTEMS DEVELOPED & CURRENTLY MARKETED
BUILDING SUBSYSTEMS	
20 Comfort Systems 21 Plumbing 22 Electrical	DEVELOPMENT OF THE TECHNIQUES FOR ASSEMBLY & MARKETING OF A UNITIZED PACKAGE CORE UNIT INCORPORATING KITCHEN, BATHROOM & LAUNDRY FACILITIES, INCLUDING PLUMBING, DRAIN, VENTING, ELECTRICAL DISTRIBUTION, HEATING & AIR CONDITIONING; USE OF PLASTIC PIPING WHERE APPROPRIATE
PRODUCTION	
24 Offsite Production	HIGH VOLUME OFFSITE PRODUCTION OF UTILITY CORE; FACTORY TESTING OF SYSTEM; DEVELOPMENT OF PREFABRICATED SUBASSEMBLIES
26 Onsite Construction and Erection	RAPID ONSITE INSTALLATION
28 Labor Training Programs	ONE PERSON PER HOUSING PROJECT TO BE TRAINED
29 Community Involvement	SELF-HELP COMPLETION OF SYSTEM AFTER ONE TRAINING SESSION
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	INTEGRATION OF FOUR COMPLETELY DEVELOPED SUBSYSTEMS INTO ONE UNITIZED UTILITY CORE
36 Market Area	NATIONWIDE DISTRIBUTION CHANNELS

William B. Tabler

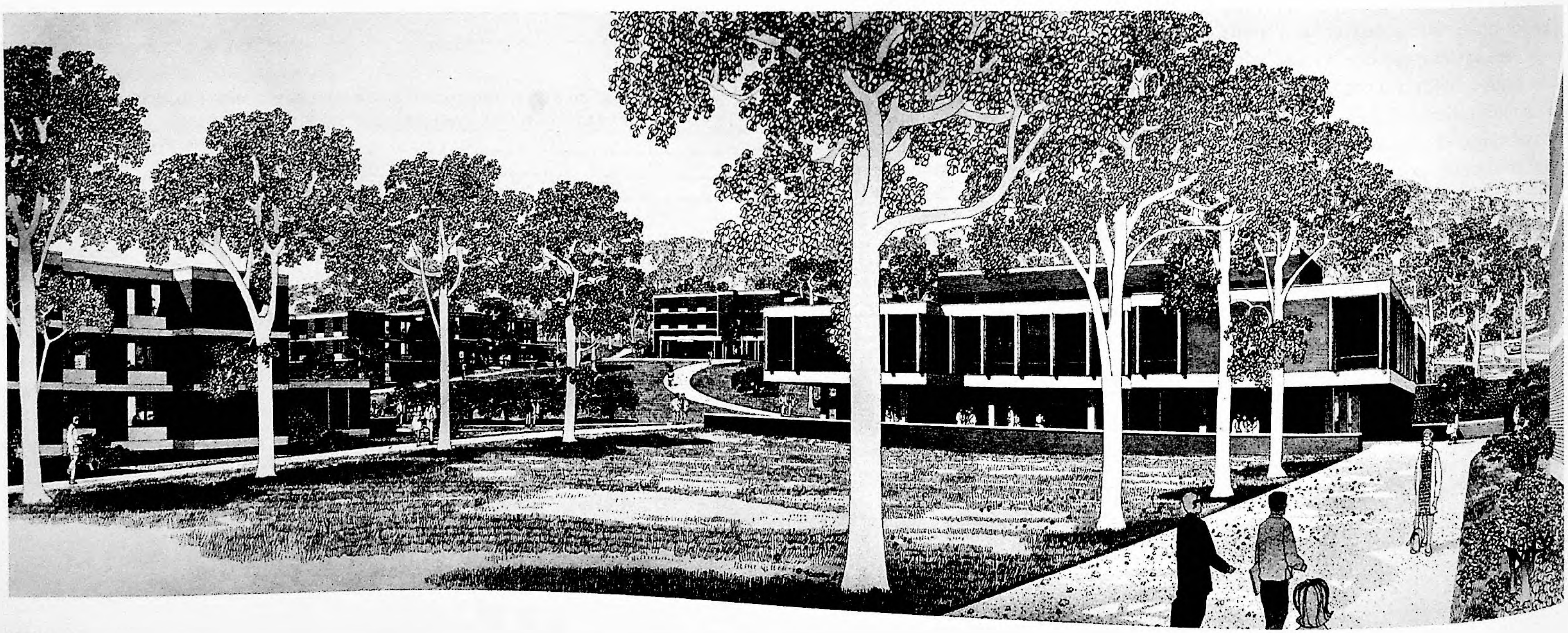
PROPOSER

William B. Tabler, Architect, New York, New York

This architectural firm proposes that it serve as a member of a team organized to develop economical systems of housing construction. In support of its proposal, the firms cites its broad experience in designing hotels and the fact that their success in producing economical and efficient projects has resulted from attention to details.

Furthermore, the firm has been a pioneer in building code study and in urging revisions to restrictive, wasteful building practices. Application of this sort of activity, and of the same principles which have resulted in successful projects of many types, should contribute to achieving a breakthrough in economical residential construction.

MANAGEMENT 33 **Proposer Organization** 34 **Internal Functions**	PROFESSIONAL SERVICES OFFERED IN BUILDING CODE STUDIES TO DEVELOP ECONOMICAL SYSTEMS OF HOUSING CONSTRUCTION. PROPOSER HAS BEEN SUCCESSFUL IN DESIGNING ECONOMICAL HOTELS & COLLEGE DORMITORIES
GENERAL 40 **Codes**	PROPOSER HAS BEEN SUCCESSFUL IN BUILDING CODE STUDIES WHICH HAVE RESULTED IN REVISIONS OF RESTRICTIVE, WASTEFUL BUILDING PRACTICES.



Tadjer-Cohen Associates

PROPOSER

Tadjer-Cohen Associates, Structural Engineers, Silver Spring, Maryland.

AFFILIATES

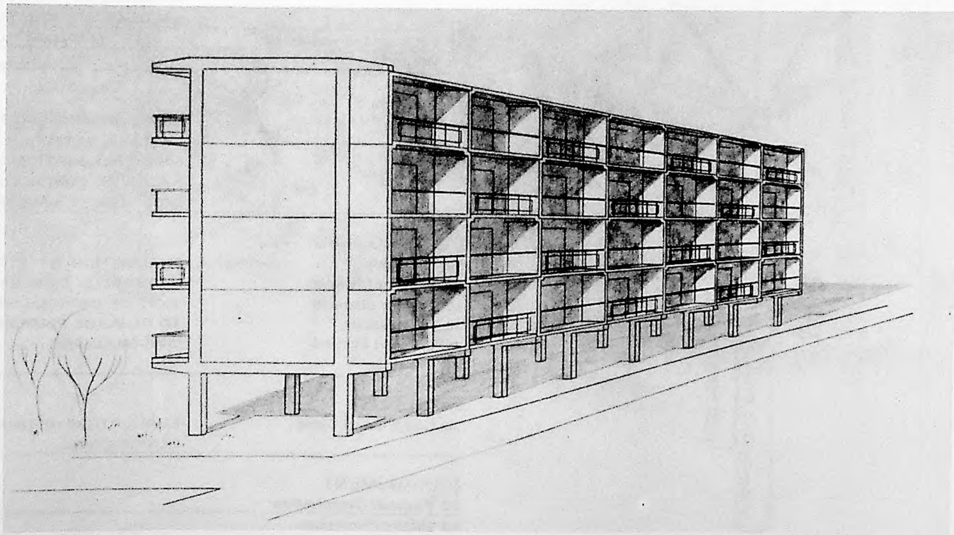
Petrona and Croes, Patent Rights on Thermocon Concrete, Aruba, Netherlands Antilles.

Determining the advantages and evaluating the performance of proprietary, aerated lightweight concrete, both as a material and as embodied in a staggered module system is the objective of this proposal. In order to meet that objective, the proposer would undertake the design, construction, and testing of an experimental dwelling employing both the material and the building concept.

The patented concrete to be evaluated is cellular in nature, consisting of portland cement, water, chemicals of a mineral origin, aluminum powders, and catalyzers, these latter being agents for the reaction which gassifies the mix, in the form of a slurry when placed, and causes it to expand to approximately twice its original volume. Evaluation of the product is expected to address the following factors: adequacy of its physical properties as a material; adequacy of the concrete as a system when employed in a prefabricated staggered module; appearance and marketability; and adaptability to large scale production.

The staggered module system in which the mix would be tested is evolved from open-ended volumetric living units, 12 ft. wide x 8 1/2 ft. high, and in lengths depending on architectural design, weight, and crane capacity. Modules are placed in low- or high-rise construction in a checkerboard fashion, both vertically and horizontally, with open spaces between modules alternating with the space enclosed by the modules. Thus, the bottom of a module above forms the ceiling of the living unit below, with its walls being formed by the exterior walls of the modules on either side. The result is that only half the number of modules needed for the more conventional stacking systems, produce the same amount of living space. Furthermore, the module will weigh about 9.2 tons, one-third the weight of the same module constructed of stone concrete, representing an advantage in terms of easier handling and reduced lifting requirements.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE & HIGH-RISE
14 State of Development	BUILDING SYSTEM COMPLETELY DEVELOPED BUT NOT BEING MARKETED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	EVALUATION OF AERATED LIGHTWEIGHT CONCRETE BOTH AS A MATERIAL AND AS EMBODIED IN VOLUMETRIC MODULES STACKED IN A CHECKERBOARD SYSTEM
PRODUCTION	
24 Offsite Production	MODULES OF LIGHTWEIGHT, AERATED CONCRETE, FABRICATED & CURED AS STANDARD CONCRETE
26 Onsite Construction and Erection	PLACING OF MODULES WITH ALTERNATING OPEN & CLOSED SPACES
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN, CONSTRUCTION, & TESTING OF EXPERIMENTAL DWELLING EMPLOYING THE LIGHTWEIGHT CONCRETE & THE STAGGERED MODULE CONCEPT
37 Delivery Rate	28 DWELLING UNITS PER DAY



Technical Planning Associates

PROPOSER CONSORTIUM

Technical Planning Associates, New Haven, Connecticut
Associated Engineering, New Haven, Connecticut

Development of criteria for the evaluation of complete building systems (such as Type A proposals for Operation Breakthrough) and research into the requirements for a site evaluation system are the two basic objectives of a program proposed by this consortium of architects, engineers and urban planners.

The first phase of the work, pertaining to the physical building system itself, would expect to discover and expand upon architectural criteria, such as: Suitability of space allocation to life styles and desires of potential occupants and relative costs; Initial and maintenance costs of building components and materials; and Costs and benefits of site arrangement. Structural systems would be measured against: Quantities and costs of materials; Types of horizontal, vertical and foundation structures and lateral stability; and Site investigation, including soil study and borings. Criteria for mechanical systems would include: Comparison of economies of types of heating systems; Study of conventional versus package plumbing systems; and Relationship of plumbing to site drainage and venting. Site planning and engineering criteria would include: Appropriateness of structure to site; Interrelationships of building system to density; Requirements for and economies of grading, utilities and landscaping; and Impact of system upon surrounding community.

The second phase of the program is aimed at setting up an evaluation system for determining, on a site-to-site basis, which of the many building systems evolved by the private sector is best fitted to the individual site. Four basic groups of criteria would be investigated, all of which, singly, or in interrelationship, feed into the decision-making process behind successful site planning. These groups are: Criteria for evaluation of building systems as they meet specific needs of specific population to be housed; Criteria for evaluation of the site as it meets needs of a particular building system; Criteria for evaluation of the site as it meets needs of population; and Criteria for analysis of the building system in terms of materials availability and production (labor market) capability of the location being considered.

SITE SYSTEM	
2 Density Range	STUDY OF INTERRELATIONSHIP OF BUILDING SYSTEM TO DENSITY
3 Topography	SOIL STUDY & BORINGS
8 Site Planning Services	DEVELOPMENT OF CRITERIA FOR A SITE EVALUATION SYSTEM; COST-BENEFIT ANALYSIS OF VARIOUS SITE ARRANGEMENTS; EVALUATION OF SITES TO FIT NEEDS OF VARIOUS BUILDING SYSTEMS
9 Community Involvement	EVALUATION OF IMPACT OF SYSTEM ON SURROUNDING COMMUNITY
10 Utilities	STUDY OF SITE UTILITY REQUIREMENTS
BUILDING SYSTEMS	
11 Housing Types	DEVELOPMENT OF CRITERIA FOR THE EVALUATION OF COMPLETE BUILDING SYSTEMS; RESEARCH OF ARCHITECTURAL CRITERIA SUCH AS SUITABILITY OF SPACE ALLOCATION TO LIFE STYLES & DESIRES OF POTENTIAL OCCUPANTS & RELATIVE COSTS; STUDY OF INITIAL & MAINTENANCE COSTS OF BUILDING COMPONENTS & MATERIALS
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations 20 Comfort Systems 21 Plumbing	EVALUATION OF STRUCTURAL SYSTEMS AGAINST QUANTITIES & COSTS OF MATERIALS; EVALUATION OF TYPES OF FOUNDATION STRUCTURE; EVALUATION OF VARIOUS HEATING SYSTEMS; STUDY OF CONVENTIONAL COMPARED TO PACKAGE PLUMBING SYSTEMS; STUDY OF RELATIONSHIP OF PLUMBING TO SITE DRAINAGE
ECONOMICS	
30 Construction Costs	EVALUATION OF QUANTITIES & COSTS OF MATERIALS; RELATIVE PLANNING & DESIGN COSTS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL CONSORTIUM
34 Internal Functions	RESEARCH ON BUILDING SYSTEMS & SITE SYSTEMS

Tetra-Cube Consortium

PROPOSER

Tetra-Cube Consortium, Dallas, Texas.

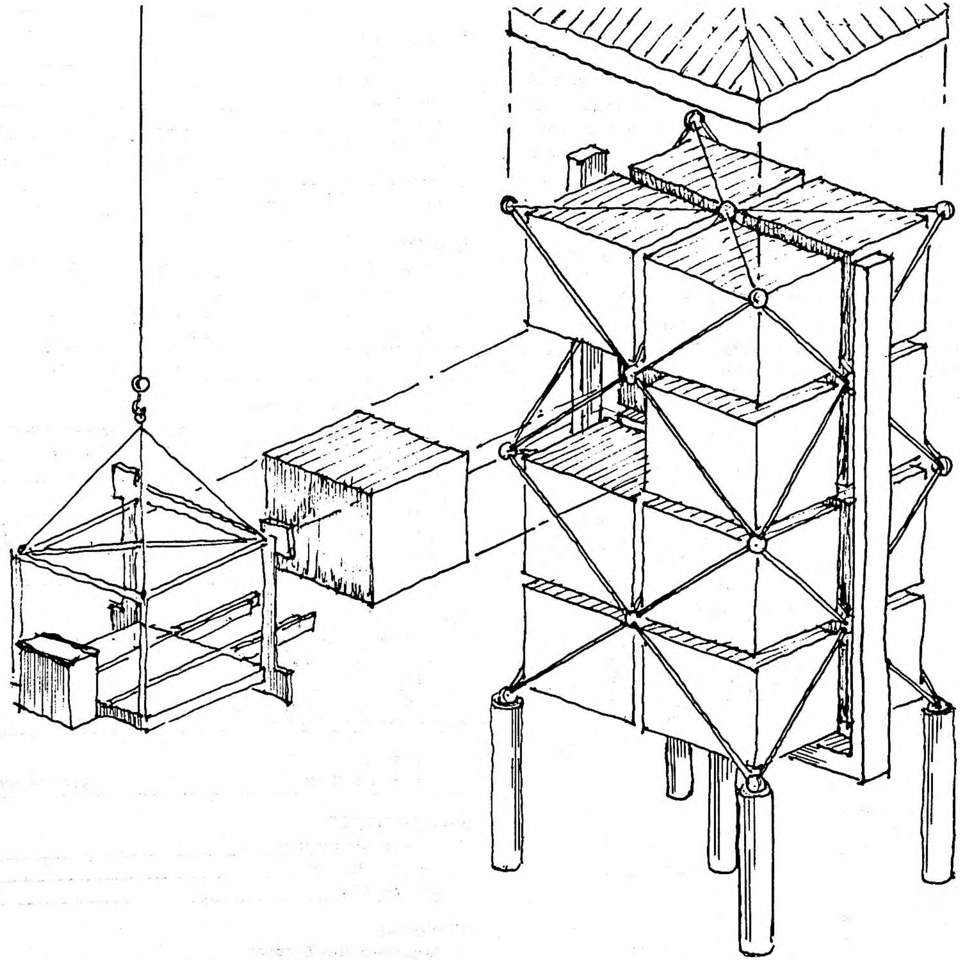
AFFILIATES

Tetra-Cube Spatial Company, Production and Planning; Lane Wood, Inc., Materials Supply; Home Metal Products Company, Materials Supply; Avery Engineering Company, Materials Supply; Curtis, Inc., Soundproofing; Chuck Williams Company, Onsite Erection; Howell Development Company, Production and Planning.

A cube and a tetrahedral space frame are the basic components of the innovative housing system proposed. Rationale for the system is combining the structural utility and efficiency of the tetrahedron with the comfort and versatility of the hexahedron—that is, the cube, an expression of more conventional post-and-lintel construction.

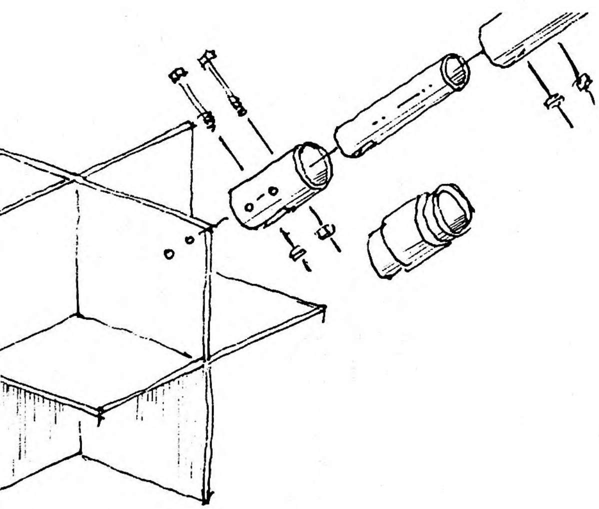
The tetrahedron is conceived of as possessing superior utility and efficiency because, unlike the cube, which develops moment in each of its joints, the tetrahedron develops only simple tension and compression forces with no moment. In this proposed system, therefore, the tetrahedral space frame is implemented in lightweight steel pipe with virtually no material being required extraneous to that along the lines of force which outline the tetrahedron itself. Connectors, designed to accommodate three-dimensional forces, join these pipe lengths at their intersections.

The other component of the system, a 17-ft. cubical living volume, is tucked inside the tetrahedron, with one or more modules, typically of lightweight, stressed-skin construction, making up a dwelling unit. The cubes are total weather envelopes, including both thermal and acoustical treatments and are furnished in a variety of finishes, both inside and out. Each cube affords 578 sq. ft. of floor space on two levels, with circular or straight stairways connecting the two floors, if required.



Erection of the proposed system is simple and speedy, the tetrahedral framework being susceptible to overnight set-up, with simple, drilled pier foundations being suitable for many projects, thus avoiding costly site preparation. The cubical living volumes are crane-placed and may be removed and relocated at a later date by simply removing temporarily one strut of the enclosing tetrahedron, without disrupting the overall structural system. Vertical chases along the outside of the space frame distribute utilties, including venting, to the living units.

Because the cubes are self-supporting but in the space frame bear no loads other than their own, they may be used in configurations ranging from single-family detached structures to multifamily high-rise developments.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL; URBAN RENEWAL
2 Density Range	24 TO 90 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	FLUID-EDGE CONCEPT TO JUXTAPOSE COMPATIBLE PEOPLE, MINORITY VERTICAL AGGREGATION
6 Nonresidential Functions	LAUNDRY; COMMUNITY SERVICE AMENITIES
9 Community Involvement	USER NEEDS CAREFULLY CONSIDERED
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	EFFICIENCY TO 4 BEDROOMS
13 Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DESIGN STAGE
15 Community Involvement	SYSTEM DESIGNED TO BE SHAPED FROM FORCES OF SOCIAL PRESSURE AT WORK IN THE COMMUNITY
BUILDING SUBSYSTEMS	
16 Structure	TETRAHEDRAL STEEL SPACE FRAME; CUBICLE MODULE INSERTS OF SANDWICH CONSTRUCTION
17 Exterior Elements	EXTERIOR UTILITY CHASE; MODULE SURFACES
18 Interior Elements	STAIRWELL
19 Foundations	DRILLED PILES
20 Comfort Systems	YEAR-AROUND HEATING & COOLING; DISTRIBUTION IN VERTICAL MECHANICAL CHASE
21 Plumbing	UNITIZED BATHROOM; GARBAGE DISPOSAL BY A PACKAGED, ENCLOSED GRAVITY SYSTEM
22 Electrical	CONVENTIONAL; DISTRIBUTION IN VERTICAL MECHANICAL CHASES
PRODUCTION	
24 Offsite Production	ALL COMPONENTS INCLUDING MODULES
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF FRAME; INSERTION OF MODULES; UTILITIES
27 Labor	SEMISKILLED AND UNSKILLED; SKILLED FOR HOT WIRING, PLUMBING, ETC.
28 Labor Training Programs	TO BE PROVIDED
29 Community Involvement	LOCAL LABOR EMPLOYED
ECONOMICS	
30 Construction Costs	\$17,500 PER UNIT (\$5.89 TO \$6.60 PER SQ. FT.), 1,000 UNITS PER YEAR
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DESIGN, TEST & DEVELOP BUILDING SYSTEM
37 Delivery Rate	OPTIMUM 1,000 UNITS PER YEAR
GENERAL	
39 Major Innovative Concepts	TETRAHEDRAL SPACE FRAME & CUBE BUILDING SYSTEM

Texas A & M University

PROPOSER

Texas A & M University, The Texas Agricultural Experiment Station, College Station, Texas

A program of research is proposed to develop new techniques and building procedures, which, in cooperation with private industry, will help meet the housing needs of low-income families. These concepts would be tested by actual construction of housing for 200 selected families. The three overall objectives of the proposed study, which would take place in typical rural/small urban areas, are: (1) To develop cooperation among low-income families in securing their own housing; (2) To demonstrate revisions in construction techniques leading to low-cost housing; and (3) To develop techniques for use of semiskilled or low-skilled individuals in the private house construction industry.

The 200 families participating in the program would be selected through community leadership. Open meetings would be held through which participants would be encouraged to discuss and articulate their needs, with the resultant information being fed back to the builders and architects working on the project. Groups of 20 to 25 families would be organized as a means of encouraging cooperation, with each group possibly including two families of aged or handicapped persons for whom the rest of the group would be encouraged to accept some responsibility.

The proposer intends to act as coordinator of the many activities to be performed by various interested parties and specifically to: (1) Secure cooperation of lending agencies, builders and community officials; (2) Organize participating groups; (3) Secure demographic data; (4) Work with group meetings; (5) Keep records; (6) Provide for follow-up meetings after houses are occupied; and (7) Tabulate, analyze and report on all data from the project.

SITE SYSTEM	
9 Community Involvement	200 FAMILIES TO BE SELECTED BY COMMUNITY LEADERSHIP TO PARTICIPATE IN A PROGRAM TEACHING COOPERATION TO SECURE THEIR OWN HOUSING; MEETINGS TO ESTABLISH FAMILY NEEDS
BUILDING SYSTEMS	
12 Unit Variations	1 TO 5 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
17 Exterior Elements 18 Interior Elements	DEMONSTRATE REVISIONS IN CONSTRUCTION TECHNIQUES TO REDUCE COSTS
PRODUCTION	
27 Labor	UNSKILLED AND SEMISKILLED
28 Labor Training Programs	BUILDER TO TRAIN LOW-INCOME LABOR
29 Community Involvement	USE OF LOCAL LABOR; SELF-HELP; PARTICIPATION OF LOCAL BUILDERS, LENDING INSTITUTIONS, & COMMUNITY OFFICIALS
ECONOMICS	
30 Construction Costs	GOAL OF $7,000 TO $13,000 PER UNIT ($7.50 PER SQ. FT.)
31 Financing Methods	CONVENTIONAL
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	RESEARCH TO DEVELOP NEW TECHNIQUES & BUILDING PROCEDURES, IN COOPERATIONS WITH PRIVATE INDUSTRY, TO HELP MEET THE HOUSING NEEDS OF LOW-INCOME FAMILIES; TESTING OF CONCEPTS BY CONSTRUCTION OF HOUSING FOR 200 SELECTED FAMILIES; PROPOSER TO SECURE COOPERATION OF LENDING INSTITUTIONS, BUILDERS & COMMUNITY OFFICIALS; PROPOSER TO ORGANIZE PARTICIPATING GROUPS & TABULATE, ANALYSE, & REPORT ALL DATA

James Reid Thomson

PROPOSER

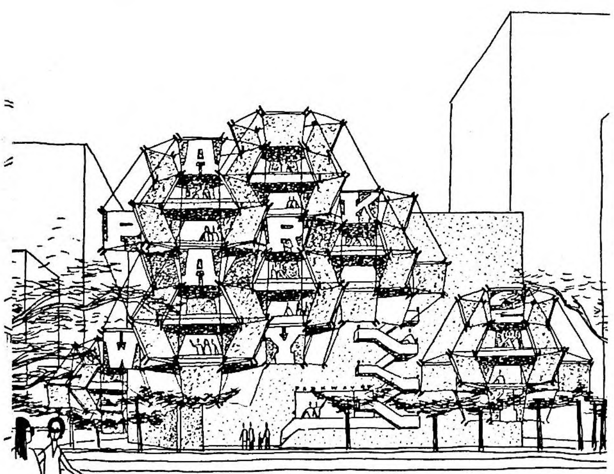
James Reid Thomson, AIA, Architect/Planner, Philadelphia, Pennsylvania

If, in nature, the most perfect structural systems (tension and minimum surface) are close-packed truncated octahedrons (soap bubbles) they must be wasteless; and a housing system embodying such a natural concept should produce highly economical shelter because it would use less material. Research, development, and construction of a model demonstrating this thesis is the purpose of this proposal.

Carrying forward from research which produced the suspended, planeal net structure which enclosed the German Pavilion at Montreal's Expo '67, the proposer postulates a four-vector, structural system suspended from massive reinforced concrete towers, with the intersecting members of the network creating octahedron-shaped spaces in which would be built up to 20,000 dwelling units. In a hypothetical project which would furnish 120,000 living units for the city of Philadelphia, six of these major towers would be located at points surrounding the city. Approximately eight minor towers would surround each of the larger towers, with the network of living units being suspended between them, looking something like six vast circus tents.

In the major towers would be located community facilities such as shopping centers, government offices, police stations, recreational areas, restaurants, and theatres, with the main level of the tower being the 50th floor. In the minor towers would be schools, smaller stores, cafes and local recreational facilities. The towers would be interconnected by public transportation facilities, with automobile parking being underground.

The four-vector, suspended structural system would be the primary, permanent component of the projected housing; the enclosures for the dwelling units would be the secondary, replaceable component. Infill walls incorporating molded-in furnishings and equipment could be changed at the will or desire of the occupant, with both interior and exterior faces of the truncated octahedron space thus susceptible to expressing the individuality of the family within.



SITE SYSTEM	
1 Site Situation	URBAN
2 Density Range	120,000 DWELLING UNITS IN A HYPOTHETICAL PROJECT AROUND CENTER CITY PHILADELPHIA
5 Planning Concepts	TENSILE CONGLOMERATE CONTAINING ALL DWELLING UNITS AND NON-RESIDENTIAL FACILITIES
6 Nonresidential Functions	SHOPPING CENTERS; GOVERNMENT SERVICES FACILITIES; RECREATIONAL AREAS
7 Circulation	HORIZONTAL PUBLIC TRANSPORTATION; TRAFFIC CIRCULATION SYSTEM; WALKWAYS; STAIRS; RAMPS; VERTICAL CIRCULATION WITHIN THE TOWERS
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY
13 Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14 State of Development	CONCEPTUAL STAGE; RESEARCH COMPLETE ON PREREQUISITE PLANEAL NET STRUCTURE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	TENSILE CONGLOMERATE USING CLOSE-PACKED TRUNCATED OCTAHEDRONS FORMING 4-VECTOR STRUCTURAL SYSTEM IN TENSION; MAJOR & MINOR CONCRETE TOWERS SUPPORTING ADDITIONAL NET FRAMEWORK; SUSPENDED TRUNCATED OCTAHEDRON LIVING UNITS
23 Furnishings	INTERCHANGEABLE INFILLS WITH FURNISHINGS MOLDED IN
PRODUCTION	
24 Offsite Production	PREFABRICATED COMPRESSION SQUARES FOR FORMING TRUNCATED OCTAHEDRONS; WALLS, FLOORS, & OTHER COMPONENTS
26 Onsite Construction and Erection	FOUNDATIONS; CONSTRUCTION OF TOWERS; NET STRUCTURE; ASSEMBLY & PLACING OF OCTAHEDRONS
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN OF TENSILE CONGLOMERATE HOUSING SYSTEM
36 Market Area	PHILADELPHIA, PA.; APPLICABLE ELSEWHERE
GENERAL	
39 Major Innovative Concepts	TENSILE CONGLOMERATE HOUSING SYSTEM

Timelapse, Inc.

PROPOSER

Timelapse, Inc., Palo Alto, California

AFFILIATES

Professor Henry W. Parker, Stanford University; Professor Clark H. Oglesby, Stanford University

A system of photographic recording is suggested to improve standard methods, implement new ideas, measure management effectiveness, develop work standards, teach new methods, and record methods and techniques both successful and unsuccessful. The system offered is in the motion picture mode and is applicable to all kinds of production activity, on large or small scale. It is a convenient means of bringing the job to the office or conference room and offers the opportunity for detailed study of project activity at great savings in time and energy.

The proposer, in addition to offering equipment to accomplish the industrial engineering measurement of a given job, also offers a consulting-analysis capability. The suggestion is that the system be employed on all government-sponsored housing projects as a cost-improvement and savings tool.

PRODUCTION	
25 **Onsite Production** 26 **Onsite Construction and Erection** 28 **Labor Training Programs**	USE OF PHOTOGRAPHIC EQUIPMENT TO IMPROVE STANDARD METHODS, DEVELOP WORK STANDARDS, TEACH NEW METHODS & RECORD METHODS & TECHNIQUES BOTH SUCCESSFUL & UNSUCCESSFUL
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	PROPOSAL TO USE PHOTOGRAPHY AS A MANAGEMENT TOOL IN CONSTRUCTION. A FULL SHIFT CAN BE RECORDED ON COLOR FILM FOR LESS THAN $10. ENABLES DETAILED STUDY OF PROJECT ACTIVITY & MEASUREMENT OF MANAGEMENT EFFECTIVENESS

Keith Titus

PROPOSER

Keith Titus, Architect, Valentine, Nebraska

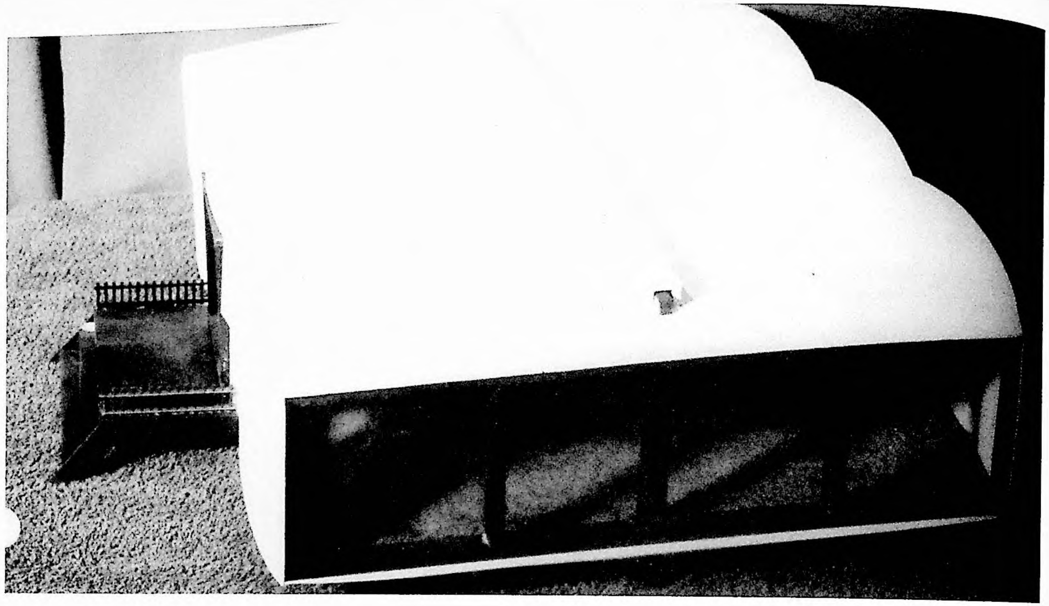
This proposer sets forth, in the preliminary design stage, a concept for a dwelling unit which is completely innovative from the structural standpoint and largely so with its accessories and supporting installations.

The designer calls for all components to be fabricated at a central plant. Essentially, the majority of the structure is preassembled at the factory and is loaded on a trailer-dolly rig for transport to the building site. Those components which would interfere with efficient over-the-road transport are designed to be stowed within the housing shell and thus readily available and accessible for onsite installation with minimal effort. Its foundation is a series of Deike anchors of adjustable nature so that the house may be site-leveled on mildly sloping sites.

The essential structural elements of the unit are a centralized steel, deep beam to which plastic panels are attached to form roof and walls. The beam has outriggers attached to the lower portion supported by A-frames welded in place. The outrigger attachment is accomplished through an innovative arrangement of end channels.

All wiring, plumbing, channelling, ducting, and accessory support connections are self-contained within the panels and/or structural members, resulting in single-connection requirements at the building site.

Kitchen and bathroom equipment are included as a basic part of the unit. Optional items are almost endless, such as closed-circuit TV, tape deck, intercom, garbage disposal, and movie projector. The proposer plans a pilot program and test model for completion during the winter of 1970/71.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
14 State of Development	BUILDING SYSTEM IN DESIGN STAGE REQUIRING DEVELOPMENT
BUILDING SUBSYSTEMS	
16 Structure	MODULE FORMED BY STRUCTURAL STEEL DEEP BEAM TO WHICH PLASTIC PANELS ARE ATTACHED TO FORM ROOF & WALLS; BEAM HAS OUTRIGGERS ATTACHED TO LOWER PORTION SUPPORTED BY A FRAME WELDED IN PLACE
19 Foundations	CONVENTIONAL; SERIES OF DEIKE ANCHORS
20 Comfort Systems	GAS OR OIL FURNACE; FIBERGLASS DUCTWORK
21 Plumbing	INTEGRATED WITH BUILDING SYSTEM AT FACTORY; PLASTIC PIPING WHERE APPROPRIATE
22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
PRODUCTION	
24 Offsite Production	MODULE STRUCTURE & COMPONENTS
26 Onsite Construction and Erection	FOUNDATION; PLACING OF MODULES; UTILITY HOOK-UP
29 Community Involvement	USE OF LOCAL CONTRACTORS; SELF-HELP ERECTION
ECONOMICS	
30 Construction Costs	$19.00 PER SQ. FT.
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	ARCHITECTURAL DESIGN

Toscano Homes

PROPOSER

Toscano Homes, Inc., West LaFayette, Indiana

The proposed system is adaptable to single-family attached as well as multifamily low-rise structures. The system is of post-and-beam construction, the advantage of the concept being essentially that the discreet use of a small number of large structural members lowers cost.

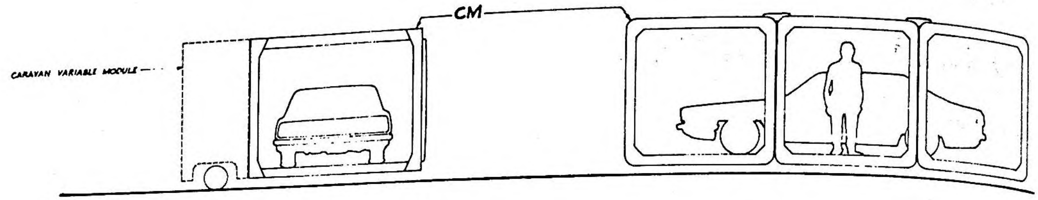
Basic framing is 6-in. x 6-in. posts tied to 6-in. x 8-in. joists, with the posts left exposed on both the interior and the exterior; flooring is 2-in. x 6-in. tongue-and-groove planking. Full benefits of this system is obtained in residential work with an open plan and a modular panel treatment such as 4-ft. gypsum board units and large glass areas. The use of this system allows a great latitude in the choice of interior as well as exterior decor. With the advancements made in weather- and fire-resistant panel siding available in standard 4-ft. x 8-ft. dimension and color, any number of exterior designs can be accomplished.

Since the basic design provides for 4-ft. x 8-ft. sections, the owner, builder, or occupant may select from a variety of interior and exterior applications. Because all materials are dimensional, local suppliers can satisfy all requirements of the project. Considerable self-help latitude is offered by the simplicity of design and the concept of minimum on-the-job training required.

The designer suggests individually controlled, unit electric heating elements. Sliding doors and windows allow for adequate ventilation; however, space is provided for through-wall cooling units. Cost savings are present in plumbing design, because the system is stacked with the full bath over the kitchen area.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	10 TO 20 DWELLING UNITS PER ACRE
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	PLANNED UNIT DEVELOPMENT
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION AND TESTING
BUILDING SUBSYSTEMS	
16 Structure	POST AND BEAM CONSTRUCTION
17 Exterior Elements	4 FT. x 8 FT. PANELS
18 Interior Elements	GYPSUM BOARD OR PLYWOOD PANELS; GYPSUM BOARD CEILING
19 Foundations	CONVENTIONAL; PENTA-TREATED BEAMS IN CONCRETE
20 Comfort Systems	CONVENTIONAL; INTEGRATED WITH BUILDING AND ELECTRICAL SUBSYSTEMS AT FACTORY
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	PANELS & COMPONENTS
26 Onsite Construction and Erection	ERECTION OF FRAMING & PANELS
28 Labor Training Programs	MINIMUM ON-THE-JOB TRAINING
29 Community Involvement	SELF-HELP LABOR
ECONOMICS	
30 Construction Costs	$10.00 PER SQ. FT., 100 DWELLING UNITS; $8.40 PER SQ. FT., 1,000 DWELLING UNITS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	PROPOSER WILL ENTERTAIN A CONSORTIUM
37 Delivery Rate	1,040 DWELLING UNITS PER YEAR (BEST RATE)
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL MODEL CODES

Trebron Holdings



PROPOSER

Trebron Holdings, Ltd., Don Mills, Ontario, Canada.

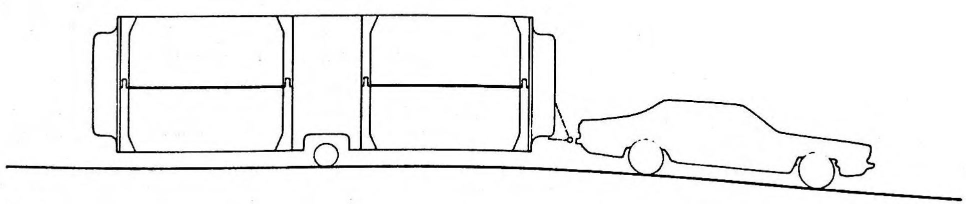
Constant modules are the innovative concept behind this proposed housing system. Constant modules are both design and construction elements—built up of aluminum or steel or both—8 ft. wide x 8 ft. high x 10 ft. long, and adaptable not only for housing, but unaltered or modified for uses as divergent as shipping containers, garages, trailers, bridges, aircraft containers, trucks, and high-speed rail systems.

Used for housing, the constant modules could be assembled into every kind of housing configuration, including mobile homes. The module itself, factory manufactured and assembled from four interlocking quarter sections, may be stacked, may be frame-supported, or may be suspended by tension or catenary long-span cables.

Foundations for the proposed housing are innovative, consisting of pneumatic support cushions resting directly on the ground (which only needs to be brought to level), with the load being transferred to these cushions by bearing diaphragms which are mounted under the modules. The bearing diaphragms are under tension, their entire areas being in continuous, intimate contact with the cushions, and float-supporting the structure above.

Provision for distribution of both heated and chilled air will be built into the ceilings, floors, and walls of the modules, with another innovative feature being the installation of heat reflectors on the roof for summertime cooling.

SITE SYSTEM	
1 **Site Situation**	URBAN; SUBURBAN; RURAL
2 **Density Range**	LOW TO HIGH DENSITY
4 **Climate**	ADAPTABLE TO ALL NATIONAL CLIMATES
5 **Planning Concepts**	CIRCULAR RING ARRANGEMENTS; OPEN SPACES; SEGMENTAL CLUSTERING; DECENTRALIZATION
6 **Nonresidential Functions**	BRIDGES UTILIZING CONSTANT MODULE CONSTRUCTION; COMMERCIAL FACILITIES
7 **Circulation**	MASS FLOW CORRIDORS FOR TRAFFIC
8 **Site Planning Services**	LAND-USE DISTRIBUTION PROPOSED
BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE; MOBILE
13 **Design Selection**	FROM STANDARD PLANS WITH OPTIONS
BUILDING SUBSYSTEMS	
16 **Structure**	SELF-SUPPORTING ALUMINUM OR STEEL MODULES; HORIZONTAL & VERTICAL CORES
17 **Exterior Elements**	VOLUMETRIC SHELL COMPOSED OF FOUR INTERLOCKING QUARTER SECTIONS
19 **Foundations**	PNEUMATIC FOUNDATION CUSHIONS WITH LATERAL TENSION TIES
20 **Comfort Systems**	ROOF HEAT REFLECTORS; HEATING-COOLING CIRCULATION IN CEILING, FLOORS & WALLS
23 **Furnishings**	PIVOTING TABLES; FOLD-AWAY BEDS
PRODUCTION	
24 **Offsite Production**	VOLUMETRIC MODULES
26 **Onsite Construction and Erection**	PLACE PNEUMATIC CUSHION FOUNDATION; PLACE MODULES
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEVELOP CONSTANT MODULE SYSTEM FOR HOUSING USE, MOBILE HOMES
GENERAL	
39 **Major Innovative Concepts**	ROOF HEAT REFLECTORS; CONSTANT MODULE CONCEPT SUITABLE FOR UNIVERSAL USES



Tresplan Associates, Inc.

PROPOSER

Tresplan Associates, Inc., Architects, Troy, New York

Development of a sophisticated method of analysis of urban activities is proposed as a tool for programming, planning, and design on the urban scale. The result would be an overall management method for the socioeconomic system of contemporary urban structure.

This program would analyze user needs in dwellings relating to food, work, recreation, personalization, and circulation. Activity analysis criteria would be developed from five categories: group sizes; sociometrics; age group involvements; time period influences,; activity domains; and activity-facility translations.

The information thus gathered would be used to assemble an activity model which could then be employed in three essential types of analysis: (1) Activity analysis of existing urban areas; (2) Planning, programming and design for existing urban areas; (3) Planning, programming and design of new Urban Communities. The goal of the studies would be a working document to be employed as a model by planners and designers in the preparation of facility programs and land-use plans.

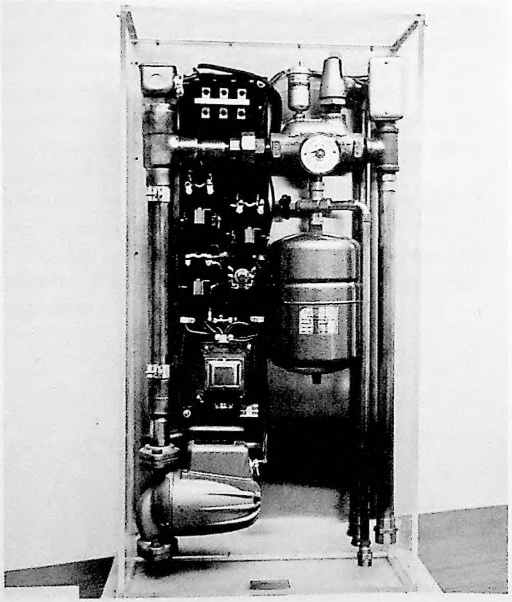
SITE SYSTEM	
5 Planning Concepts 6 Nonresidential Functions 7 Circulation 8 Site Planning Services 9 Community Involvement	ANALYSIS OF URBAN ACTIVITIES TO ESTABLISH USER NEEDS IN URBAN PLANNING, RECREATION, CIRCULATION, DWELLINGS & WORK. FIVE GROUPS OF ACTIVITIES ARE TO BE CONSIDERED: GROUP SIZE, AGE, TIME PERIOD INFLUENCES, ACTIVITY DOMAINS, ACTIVITY-FACILITY TRANSLATIONS; DEVELOPMENT OF A WORKING DOCUMENT FOR USE IN LAND-USE PLANNING
BUILDING SYSTEMS	
13 Design Selection	DEVELOPMENT OF WORKING DOCUMENT FOR DESIGN ANALYSIS
14 State of Development	CONCEPTUAL STAGE
15 Community Involvement	ANALYSIS OF USER NEEDS RELATING TO FOOD, WORK, RECREATION, PERSONALIZATION & CIRCULATION
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions 35 External Functions	DEVELOPMENT OF METHOD FOR ANALYSIS OF URBAN ACTIVITIES AS A TOOL FOR PLANNING, PROGRAMMING & DESIGN; DEVELOPMENT OF AN ACTIVITY MODEL FOR PLANNING NEW & EXISTING URBAN AREAS

Turbotec, Inc

PROPOSER

Turbotec, Inc., Water Heating Systems, South Windsor, Connecticut

This is a proposal for the application of a patented hydronic heating system for both space heating and domestic hot water. The concept includes a unique small boiler system with a programmed electric control box. The system, on demand from individual thermostats, activates progressive units of resistance heaters, which are added as demand increases and cut out as demand drops. Programming is designed for random selection in order to equalize wear ratio on the heating elements. Due to the small boiler design, instantaneous hot water or room heat response is available.



The system is adaptable to hydronic or hot air systems, and it also lends itself to conversion as a cooling element. By providing modified coil units in the plenum chamber of a hot air system with proper anti-freeze agents, this system could also be utilized with refrigeration units to produce a dual system for heating or cooling cycles.

The proposer indicates that considerable study is still in order to determine building code restrictions in various areas.

BUILDING SYSTEMS	
14 **State of Development**	ENGINEERING PROTOTYPES COMPLETED; FURTHER RESEARCH REQUIRED
BUILDING SUBSYSTEMS	
20 **Comfort Systems** 21 **Plumbing** 22 **Electrical**	HYDRONIC HEATING SYSTEM FOR LIVING SPACE & DOMESTIC HOT WATER; INCLUDES SMALL BOILER WITH PROGRAMMED ELECTRIC CONTROL BOX; INDIVIDUAL THERMOSTATS; EQUALIZED ON HEATING ELEMENTS; ADAPTABLE TO COOLING CYCLE; CAN BE MODIFIED TO OPERATE ON HOT AIR OR HYDRONIC, WATER; CLEAN; QUIET; SAFE; DEPENDABLE
ECONOMICS	
30 **Construction Costs**	$275 EACH FOR COMBINATION HOT WATER/COMFORT HEATER AT RATE OF 10,000 UNITS PER YEAR; 40% SAVINGS. $225 FOR COMFORT HEATER IN QUANTITY
MANAGEMENT	
33 **Proposer Organization**	CORPORATION
34 **Internal Functions**	DEVELOPMENT OF HYDRONIC HEATING SYSTEM FOR LIVING SPACE & DOMESTIC HOT WATER
GENERAL	
40 **Codes**	DETERMINATION OF CODE COMPLIANCE IN VARIOUS AREAS UNDERWAY

Union Carbide

PROPOSER

Union Carbide Corporation, Chemicals and Plastics, Operations Division, Bound Brook, New Jersey.

The principal object of this proposal is the development of techniques and procedures useful to architects and engineers in designing with building sandwich panels. The proposer suggests research on modular building panels employing an integral core of rigid polyurethane foam and skins of wood, plastics, or light-gauge metal. Material selections also would be investigated to improve known panel rigidity, bond, dimensional stability, and to resolve current problems with creep, flammability, vapor transfer, and blistering of plastic skins. Special emphasis would be placed on new techniques for economical mass production of this type of panel.

The studies would include the production of several small model panels, followed by the manufacture of full-scale panels. The research would not proceed to a finished prototype panel with connection mechanism, but would determine only the physical properties of the product.

The proposer has done considerable experimenting in foam products and has developed improved properties in the sandwich building panel, but there is need for improvement in specific areas. This proposal is directed at meeting that need, particularly in the area of production methods.

BUILDING SYSTEMS	
14 State of Development	MODULAR FOAM-CORED SANDWICH PANELS DEVELOPED; FURTHER STUDY PROPOSED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	PROPOSED STUDY OF POLYURETHANE-CORE SANDWICH PANEL TO ADDRESS BOND, CREEP, BUCKLING, FATIGUE, VAPOR TRANSFER, FOAM DENSITY, & BLISTERING. ONLY SELF-EXTINGUISHING FOAMS WILL BE CONSIDERED
PRODUCTION	
24 Offsite Production	STUDY OF PRODUCTION METHODS FOR POLYURETHANE-FOAM SANDWICH PANELS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF TECHNIQUES, & PROCEDURES TO AID ARCHITECTS & ENGINEERS IN DESIGN WITH ECONOMICAL POLYURETHANE-CORE SANDWICH PANELS

Union Carbide

PROPOSER

Union Carbide Corporation, Chemicals and Plastics, Operations Division, Boundbrook, New Jersey.

A research program for developing formulations and processes for producing molded building components from rigid polyurethane foam is called for in this proposal. Object of the studies would be to determine the effect of formulation variables on physical properties of foamed parts and to broaden the range of formulations, producing foamed parts at prescribed densities with prescribed physical properties. Still another object is to define the relation of formulation and processing conditions to produce parts having prescribed performance characteristics. Prototype parts would be constructed for use in a test house or houses.

Research on two types of molds is proposed: metal for producing integral skin panels and silicone-rubber for decorative parts. Tests to be conducted on the specimens prepared would cover core desnity, compressive strength, friability weight loss, flammability, high-temperature aging, flexural strength, and impact resistance. The molded pieces also would be checked for solvent resistance, surface toughness, abrasion resistance, and resistance to stain. All research would be done in the proposer's laboratory, with six months estimated as the time for the formulation study. With all molding processes defined, prototype parts would be designated for field testing in prescribed housing units.

BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	RESEARCH STUDY OF FORMULATIONS & PROCESSES TO PRODUCE MOLDED, RIGID POLYURETHANE-FOAM BUILDING COMPONENTS WITH PRESCRIBED PHYSICAL PROPERTIES
PRODUCTION	
24 Offsite Production	RESEARCH & DEVELOPMENT OF FORMULATIONS & PROCESSES TO PRODUCE RIGID POLYURETHANE BUILDING COMPONENTS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT OF FORMULATIONS AND PROCESSES FOR THE PRODUCTION OF MOLDED BUILDING COMPONENTS FROM RIGID POLYURETHANE FOAM

Uniplan

PROPOSER

Uniplan, Architects-Engineers-Planners, Princeton, New Jersey.

Investigation of a new technique for fabrication of concrete building elements is proposed. The technique, called the armature system, eliminates use of temporary forms by incorporation of prefabricated reinforcing systems which are designed and fabricated as independent structures. The system is capable of receiving, giving form to, and supporting structural concrete until it is cured. The armature becomes the integral tensile reinforcement unit. This is accomplished by using fast-setting, high-strength gypsum concrete applied to the armature as an intermediate support. The gypsum concrete is then sprayed on the armature from the interior side and can form the interior finish of the shell. The permanent structural concrete is then placed. The application reduces the requirement for onsite specialists and permits wider use of community and self-help labor for the project.

The armature system would be easily adaptable to industrialized mass production. The concept presents the opportunity for significant cost reductions. Production scheduling and quality control are inherent in the process; production of a finished product is accelerated considerably over conventional methods; and transportation costs are substantially reduced.

BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements	DEVELOPMENT OF REINFORCED CONCRETE UTILIZING ARMATURE SYSTEM; HIGH-STRENGTH FAST-SETTING GYPSUM CONCRETE SPRAYED ONTO A PREFABRICATED ARMATURE SUPPORTING STRUCTURE IN LIEU OF CONVENTIONAL FORMWORK.
PRODUCTION	
24 Offsite Production	PREFABRICATED ARMATURE SUPPORTING STRUCTURE
26 Onsite Construction and Erection	APPLICATION OF CONCRETE SPRAY TO THE ARMATURE
27 Labor	SEMISKILLED & UNSKILLED LABOR
29 Community Involvement	ARMATURE PROCESS LENDS ITSELF TO SELF-HELP
ECONOMICS	
30 Construction Costs	POTENTIALLY LOWER COSTS THAN CONVENTIONAL CONCRETING PROCESSES
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions 35 External Functions	RESEARCH, DESIGN & DEVELOPMENT OF ARMATURE PROCESS UTILIZING PREFABRICATED SUPPORTING STRUCTURES IN LIEU OF TEMPORARY FORMS TO SUPPORT SITE-APPLIED CONCRETE
37 Delivery Rate	HIGHER UNIT PRODUCTION RATE THAN WITH CONVENTIONAL CONCRETE PROCESSES
GENERAL	
39 Major Innovative Concepts	ARMATURE CONCEPT FOR STRUCTURAL CONCRETE WORK
40 Codes	MAJOR CODE PROBLEMS UNLIKELY

United States Ceramic Tile

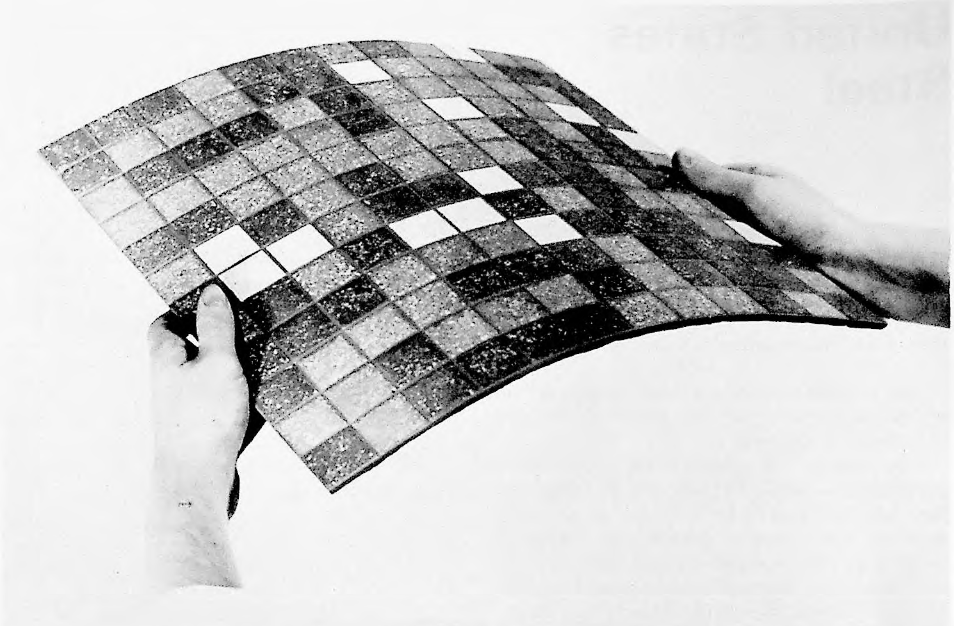
PROPOSER

United States Ceramic Tile Company, Canton, Ohio

The proposer indicates that basic research and feasibility have been completed and now offers an advanced research and development, design and testing program for an innovative concept in manufacturing and installing a pregrouted ceramic, mosaic tile system for floors and walls.

Assemblies proposed consist of 144 ceramic, mosaic tiles with edge bonding, which binds the tile in a sheet and leaves the surfaces free of grouting material. The sheet is formed with flexible bonding material. Advantages are flexibility, resilience, imperviousness to water and other fluids. The unit may be assembled at a factory location and shipped without vibration, chipping, or powdering at the joints. Such an assembly creates an expansion joint around each piece of ceramic. Factory assembly of the units offers the additional advantage of cost reduction since it is adaptable to mass-production industrialized housing.

Assemblies may be installed with mastic or epoxy, or they can be dry-set or installed with conventional mortar. Almost any subsurface will accept the assembly unit. The back of the assembly is completely exposed, hence there is 100-percent bond with the subsurface.



BUILDING SUBSYSTEMS	
18 Interior Elements	DEVELOPMENT OF PREGROUTED CERAMIC TILE SUITABLE FOR INTERIOR FLOORS & WALLS
PRODUCTION	
24 Offsite Production	PREGROUTED CERAMIC TILE ASSEMBLED NOT SUBJECT TO TRANSPORT DAMAGE
27 Labor	PREGROUTED CERAMIC TILE ADAPTABLE TO HIGH-PRODUCTION INDUSTRIALIZED HOUSING
ECONOMICS	
30 Construction Costs	A PROPOSED 27% REDUCTION IN PRODUCTION COST
32 Useful Life	CERAMIC TILE OUTLASTS MANY OTHER CONVENTIONAL & NEW PRODUCTS
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	DEVELOPMENT OF PREGROUTED CERAMIC TILE ASSEMBLIES FOR MASS PRODUCED HOUSING; CONTINUED RESEARCH, PRODUCT DESIGN, COMPOUNDING, PROCESSING & TESTING

United States Steel

PROPOSER

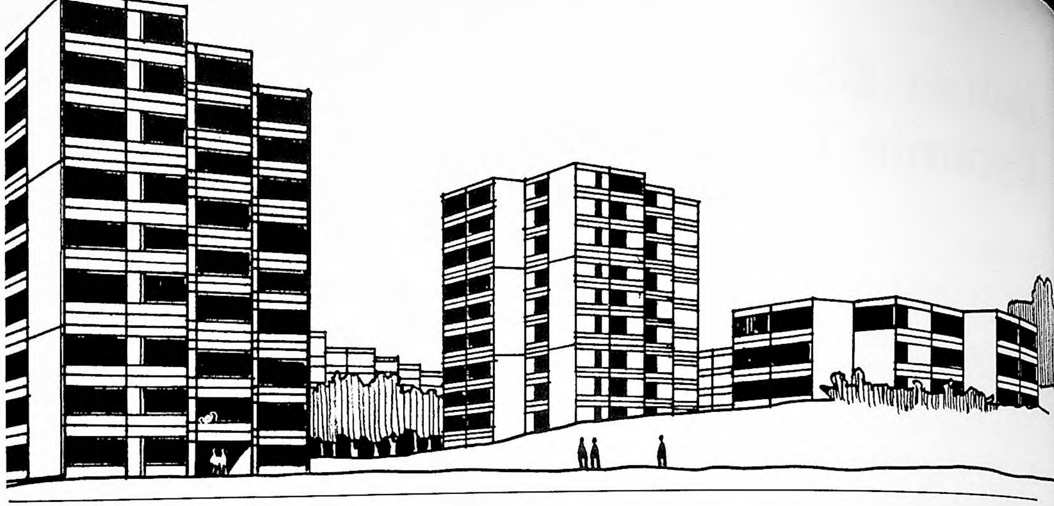
United States Steel Corporation, Pittsburgh, Pennsylvania

This proposal presents a program for development of high-rise housing systems integrating modular units and supporting structures.

The proposer has developed and constructed a prototype of a module unit with steel stud walls, steel floor joists, and gypsum board interior. However, it is proposed that a full-scale research and development program be conducted for three innovative, high-rise systems using factory-made modular units. The plan is to prove the feasibility of stacking modules vertically, horizontally, or in combinations of vertical and horizontal stacking.

The investigation would be directed to: (1) A self-supporting module of sufficient strength to support one or two additional module loads; (2) A composite module containing wind-resisting members as well as the independent module members; and (3) An integral module containing wind-resisting and gravity-load members which can be vertically stacked with no added external framing. Various manufacturing and erection techniques will be studied, all efforts, of course, being directed to minimizing cost of materials and labor. The stacking concept with the factory-made modules would reduce, in large measure, the onsite skilled labor conventionally required.

Interior materials range from the conventional through prefinished steels. Exterior finishes visualized are color-coated metal curtainwalls, brick, porcelain on steel, and aluminum sheet. An innovative, nonbearing, prefabricated, movable partition which can be cut for doorways as required would be investigated.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY HIGH-RISE
12 Unit Variations	EFFICIENCY; 1 TO 6 BEDROOMS
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
14 State of Development	BUILDING SYSTEM PARTIALLY DEVELOPED; FURTHER RESEARCH & DEVELOPMENT REQUIRED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	STUDY OF: (1) MODULES CAPABLE OF SUPPORTING OTHER MODULES WITH SUBSEQUENT PLACEMENT INTO INDEPENDENT CLEAR-SPAN RIGID FRAME; (2) MODULES CONTAINING WIND RESISTING & SPAN MEMBERS IN COMBINATION WITH VERTICAL SUPPORT COLUMNS; (3) MODULES CONTAINING ALL STRUCTURAL ELEMENTS REQUIRED FOR HIGH-RISE CONSTRUCTION WITHOUT SUPPLEMENTAL FRAMING. INCORPORATION OF STEEL FRAMING MEMBERS; CONVENTIONALLY DESIGNED FOUNDATIONS
20 Comfort Systems 21 Plumbing 22 Electrical	CONVENTIONAL; INTEGRATED WITH BUILDING SYSTEM AT FACTORY
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULES
26 Onsite Construction and Erection	PLACING OF MODULES; UTILITY HOOKUPS; FOUNDATIONS
ECONOMICS	
31 Financing Methods	CONVENTIONAL
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	RESEARCH & DEVELOPMENT OF MODULAR UNITS FOR HIGH-RISE BUILDING SYSTEMS
GENERAL	
40 Codes	ANTICIPATE SOME DIFFICULTY WITH FIRE CODES

Universal Precision Structures

PROPOSER

Universal Precision Structures, Oscar Singer, FRIBA, Architectural Consultant, Richmond, Surrey, England

AFFILIATE:

Jan Bobrowski & Partners, Consulting Engineers

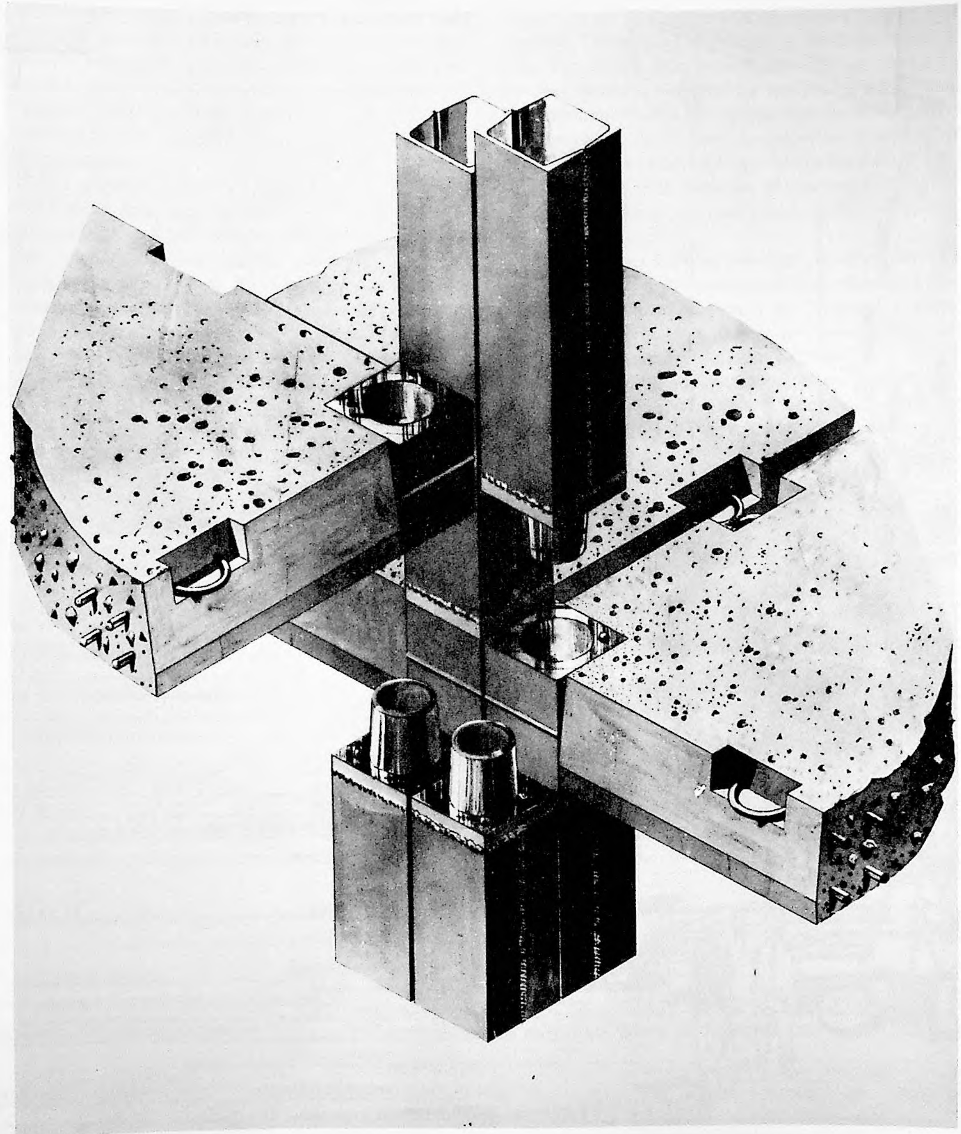
A concept of an essentially two-component building system that could be erected like a child's toy without site casting and by the use of entirely unskilled labor is presented for study.

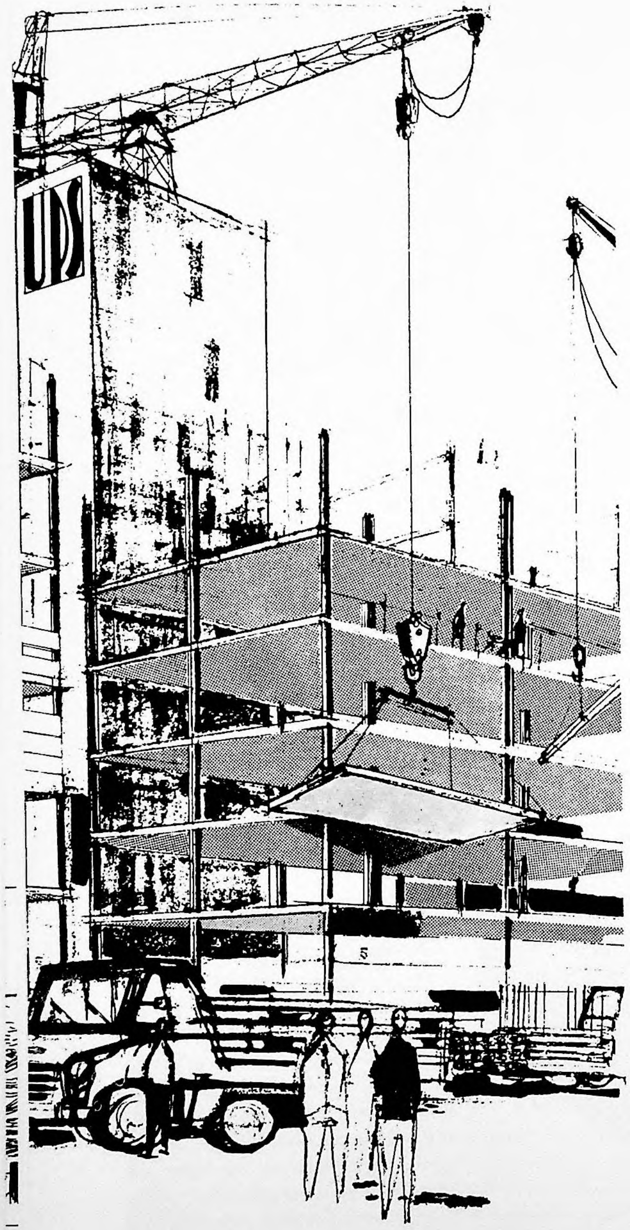
The two components consist of a hollow floor slab, 20 ft. x 10 ft. x 8 in. thick, and a hollow metal pipe column 6 in. x 6 in. in dimension. The floor-ceiling slab is to be cast in specially designed precisioned steel molds, incorporating sockets in the plate slab for insertion of the columns. The columns, in turn, have tapered spigots at each end which fit into these sockets. Sockets are spaced so that in low-rise structures only two columns are needed for support; in high-rise structures more columns can be inserted.

Key to the system is the precise machine treatment of the spigots and sockets—which in themselves form the complete system for dry-joining the elements of the structure, without grouting, bolting or other mechanical connecting devices. Erection of a building of almost any height thus becomes an assembly of slabs and columns, eliminating beams. The building is made self-supporting during erection because of the tight fit of the elements, and a minimum labor force is required that includes almost no skilled workers.

Interior partitions are to be made of conventional materials and can be made with elements to assume shear stresses of the building for added stiffening beyond that provided by the slab-and-column assembly.

The system would allow application of almost any material for a weather envelope, considerable variation of appearance, and suitability to any climate.





Universal Precision (continued)

SITE SYSTEM	
4 **Climate**	ADAPTABLE TO ALL NORMAL CLIMATES; SUITABLE FOR HIGH WIND AND EARTHQUAKE CONDITIONS
5 **Planning Concepts**	FLEXIBLE
6 **Nonresidential Functions**	SUITABLE FOR SCHOOLS, HOSPITALS, HOTELS, FACTORIES
BUILDING SYSTEMS	
11 **Housing Types**	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE AND HIGH-RISE
13 **Design Selection**	FLEXIBLE
14 **State of Development**	DESIGN STATE; PROTOTYPE DEVELOPMENT REQUIRED
BUILDING SUBSYSTEMS	
16 **Structure**	HOLLOW PRECAST REINFORCED CONCRETE FLOOR-CEILING SLABS SUPPORTED BY VERTICAL, HIGH-YIELD HOLLOW STEEL COLUMNS
17 **Exterior Elements**	WEATHER ENVELOPE OF OPTIONAL CONVENTIONAL MATERIALS
18 **Interior Elements**	CONVENTION MATERIALS & COMPONENTS
19 **Foundations**	CONVENTIONAL; DESIGNED FOR SITE CONDITIONS
20 **Comfort Systems**	PROVISION FOR DEVELOPMENT OF BASIC SUBSYSTEMS
PRODUCTION	
24 **Offsite Production**	CONCRETE SLABS PRODUCED IN SPECIAL FORMS; STEEL COLUMNS (LARGE PROJECTS)
25 **Onsite Production**	CONCRETE SLABS PRODUCED IN SPECIAL FORMS; STEEL COLUMNS
26 **Onsite Construction and Erection**	FITTING TOGETHER OF SLABS & COLUMNS
27 **Labor**	PRIMARILY UNSKILLED
ECONOMICS	
30 **Construction Costs**	$2.28 PER SQ. FT. ESTIMATED (INCLUDES BOTH SLABS & COLUMNS)
MANAGEMENT	
33 **Proposer Organization**	PRIVATE COMPANY
34 **Internal Functions**	DESIGN & DEVELOP SLAB-COLUMN BUILDING SYSTEM
36 **Market Area**	WITHIN 100 MILES OF PLANT SITES
37 **Delivery Rate**	PROPOSED 20,000 SPIGOT/SOCKET JOINTS PER YEAR; 5,000 CONCRETE SLABS (MINIMUM)
GENERAL	
39 **Major Innovative Concepts**	TWO STANDARD BUILDING COMPONENTS, EASILY ASSEMBLED & MASS-PRODUCED
40 **Codes**	IN COMPLIANCE WITH MODEL CODES

University of California

PROPOSER

The Regents of the University of California, Los Angeles, California
Department of Urban Land Economics

The proposer considers that "housing" is a multifaceted economic good—a complex combination of economic, social, psychological, and physical factors—which produces services that are experienced by a household. While many have alluded to its multifaceted complexity, no adequate method has yet been developed for measuring accurately the level of "housing" actually enjoyed by a household, or for computing accurately the total economic benefits and costs of "housing"; if the national housing goals are to be met, information and data on such levels and costs are held to be essential.

The proposal is directed toward development of a method for measuring the level of "housing" actually produced by any "household-housing unit" combination, and thus enjoyed by the household, as well as housing's economic costs. The principal objective is to provide a practical methodology, centered on a computerized data processing and computation model, which will enable government agencies to determine or predict actual housing levels and costs quickly and accurately.

In this approach a set of potential housing services associated with each housing unit is described in the form of a set of Components of Housing Service Production. These will be classified in component groupings. The process links housing service enjoyment with housing service production by identifying all production components and household characteristics making an important contribution to production of each housing service. The result will be a well-defined set of production components and a set of household characteristics. Each item in each set can be measured quantitatively.

The next step in the system is the development of a set of production parameters, or a multielement profile, which measures accurately the "housing" enjoyed by the household. The project will proceed through two phases—research and design, and test.

Details of computing housing levels and housing costs, and just how these should be compared, will be determined during the course of the proposed developed project.

SITE SYSTEM	
1 **Site Situation**	URBAN; ADAPTABLE TO RURAL
2 **Density Range**	PROPOSED TESTING FOCUSED ON HOUSING UNITS IN RELOCATION PROGRAM FOR PLANNED CENTURY FREEWAY IN LOS ANGELES COUNTY
5 **Planning Concepts**	DEVELOP MEANS TO QUANTIFY HOUSING SERVICE PROVIDED BY SITE FACILITIES SYSTEMS & PLOT OF LAND
6 **Nonresidential Functions**	DEVELOP MEANS TO QUANTIFY HOUSING SERVICE AS RELATED TO CHARACTERISTICS OF NEIGHBORHOOD, REGION, & ASSOCIATED ECONOMIC ACTIVITIES
8 **Site Planning Services**	DEVELOP A PRACTICAL METHODOLOGY WHEREBY GOVERNMENT AGENCIES CAN PREDICT ACTUAL HOUSING LEVELS & COSTS QUICKLY & ACCURATELY
9 **Community Involvement**	SURVEYS OF ECONOMIC, SOCIAL, PSYCHOLOGICAL & PHYSICAL FACTORS OF SAMPLE HOUSEHOLDS & HOUSING UNITS
BUILDING SUBSYSTEMS	
16 **Structure**	CLASSIFICATION OF PHYSICAL CHARACTERISTICS OF HOUSING UNIT STRUCTURE
ECONOMICS	
30 **Construction Costs**	PROJECT WILL PERMIT HOUSING COST BENEFIT ANALYSIS, CALCULATION OF HOUSING COSTS
MANAGEMENT	
33 **Proposer Organization**	EDUCATIONAL FACILITY
34 **Internal Functions**	MANAGEMENT; RESEARCH & DESIGN PHASE—DETAILED CONCEPTUAL WORK, DATA MODEL, COMPUTER PROGRAM; DATA GATHERING; TESTING PHASE; REPORT PREPARATION
35 **External Functions**	PORTIONS OF SURVEYING ACTIVITIES
36 **Market Area**	NATIONAL; APPLICATION TO "OPERATION BREAKTHROUGH" OR HOUSING MARKET AGGREGATION STUDIES

University of California

PROPOSER

The Regents of the University of California, Berkeley, California
Institute of Urban and Regional Development and Associated Centers

Research and development on the problems of market aggregation, site selection, land assembly, and government financing associated with Operation Breakthrough are proposed. Assuming that the more complex problems lie in the areas of marketing and site assemblies rather than in housing technology, this project will focus primarily on land and land development. Two strategies for overcoming current obstacles to land use will be studied: 1) development of very large sites of new community size; and 2) development of a large number of smaller scattered sites. Major studies for each of these will involve the following:

- The development of investment and cash flow models for land assembly and development under alternative market aggregation strategies for larger or scattered smaller sites.
- Analysis of state, city and county costs and benefits for large scale and scattered smaller site construction.
- Suitability of different building technologies tested under the Breakthrough program for large-scale or scattered sites and the influence of proposed housing types upon marketing strategies.
- Simulation of prototypical development processes from program inception through late marketing, employing advanced land-use technology.
- Monitoring of selected large and scattered site developments in the West and Southwest, referring to market rates, institutional development, and social and demographic composition.
- Implementing measures required for widespread use of mass-produced housing with particular attention to state legislation and state or local regulatory policies on land and land development.

The proposer notes that new town strategy deserves careful examination as a potential means of marketing a mass-production housing program. An important alternative is the scattering of developments of 500 to 1,000 units throughout metropolitan areas. The profitability of each approach to developers, the advantages and disadvantages of related costs and benefits to local and state governments will be examined. Legislative solutions to obstacles uncovered in the research will be proposed. The technologies adopted will, in turn, impose their own site and merchandizing strategies on the program.

SITE SYSTEM	
1 Site Situation	STUDY OF: NEW TOWN; METROPOLITAN AREAS; MARKET AGGREGATION
2 Density Range	STRATEGIES FOR SCATTERED SMALLER SITES; EXPLORE COST-BENEFITS OF LARGE SCALE (20 SITES @ 10,000 UNITS) VS. SCATTERED (1,000 SITES @ 200 UNITS) SITE STRATEGIES
5 Planning Concepts	SIMULATION OF PROTOTYPICAL DEVELOPMENT PROCESS; EVALUATION OF APPROPRIATE ROLE FOR LARGE & SCATTERED SITES
9 Community Involvement	MONITORING OF SITE DEVELOPMENTS IN WEST & SOUTHWEST FOR MARKETING RATES, INSTITUTIONAL DEVELOPMENT, & SOCIAL & DEMOGRAPHIC COMPOSITION
BUILDING SYSTEMS	
11 Housing Types	EXAMINE SUITABILITY OF "BREAKTHROUGH" HOUSING TECHNOLOGIES & INFLUENCE OF HOUSING TYPES UPON MARKETING STRATEGY
ECONOMICS	
30 Construction Costs 31 Financing Methods	ANALYSIS OF STATE, CITY & COUNTY COSTS & BENEFITS FOR LARGE & SCATTERED SMALLER SITE CONSTRUCTION OF "BREAKTHROUGH" HOUSING; DEVELOP INVESTMENT & CASH FLOW MODELS FOR LAND ASSEMBLY & DEVELOPMENT FOR ALTERNATIVE STRATEGIES FOR SCATTERED SMALLER SITES
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY—RESEARCH INSTITUTE
34 Internal Functions	RESEARCH & DEVELOPMENT; STUDIES; ANALYSES; SIMULATION; TESTING; EVALUATION
GENERAL	
40 Codes	DEVISE PARTICULAR STATE LEGISLATION & STATE OR LOCAL REGULATORY POLICIES FOR LAND DEVELOPMENT TO SECURE EFFECTIVE WIDE-SPREAD USE OF MASS PRODUCED HOUSING

University of Pennsylvania

BUILDING SUBSYSTEMS

20 Comfort Systems	DESIGN & DEVELOPMENT OF A CLEAN AIR SYSTEM EQUIPPED WITH HIGH EFFICIENCY PARTICULATE (HEPA) FILTERS, BLOWERS & DISTRIBUTORS THAT WOULD BE CAPABLE OF REUSE OF UP TO 90% OF THE CONDITIONED AIR; THE RESULT WOULD BE REDUCED POWER CONSUMPTION & LESS WEAR ON EQUIPMENT

MANAGEMENT

33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions 35 External Functions 36 Market Area	PROPOSED STUDY & DESIGN OF PROTOTYPE CLEAN AIR SYSTEM USING HEPA FILTERS; REPORT ON FEASIBILITY & COST; PERFORMANCE CRITERIA; PRELIMINARY DESIGN FOR APPLICATION TO FOUR HOUSING CONFIGURATIONS; DIAGRAMMATIC GUIDELINES FOR INSTALLATION

PROPOSER

University of Pennsylvania, Office of Research Administration, Philadelphia, Pennsylvania

Design and development is proposed for a clean air system for housing, equipped with high efficiency particulate (HEPA) filters. HEPA filters, which effect absolute removal of particles down to 0.3 microns, have long been used commercially in areas where biomedically clean air is essential by the electronic, space and pharmaceutical industries and in medical facilities. The proposer hopes to extend these applications to housing, noting, however, that presently the performance of these filters is relatively unknown to architects and engineers.

The mechanical subsystem which should result from the study would consist of blowers, the HEPA filters, and distributors and would effect the reuse of up to 90 percent of the previously conditioned, sensibly fresh inside air, at a significantly reduced draw on electric power. A further result would be less wear on equipment and filters, than is the case when unconditioned air must be treated and heated or cooled. The system would be particularly helpful in housing for the aged, those in physically weakened condition, those with allergies, and families with infant children.

The products of the proposed study would include: (1) Design for a prototype subsystem; (2) Report on feasibility and cost; (3) Performance criteria; (4) Preliminary design for application to four housing configurations, from single-family detached homes to high-rise; and (5) Diagrammatic guidelines for installation.

Noted as a constraint is the fact that model codes and most local building codes contain restrictions on the recirculation of inside air.

University of Pennsylvania

PROPOSER

University of Pennsylvania, Office of Research Administration, Philadelphia, Pennsylvania

Research is proposed to determine how low- and moderate-income groups, new-comers to the new home market, themselves perceive their housing needs. Rationale for such research is found in evidence that the housing preferences of many people in these groups differ markedly from those of middle-income home-buyers, and in the obvious conclusion that economic and social resources will be wasted if the nation's residential building industries develop building systems which overlook these differences.

There are seven areas which the proposer intends to explore as hypotheses of the factors low-income families identify with good housing: (1) Safety and security; (2) Style and design features reflecting racial pride; (3) Unwillingness to accept substitute or imitative materials; (4) Efficient use of space; (5) Self-expression and individualism in design; (6) Aversion to newer forms of ownership; and (7) Provision for outdoor and street life as part of the living pattern.

The study, in two phases, would consist primarily of interviews, tentatively in one or two standard metropolitan statistical areas, with buyers, tenants, small merchant builders, residents of innovative housing projects, and others directly involved in the low-income, volume housing market. Phase I would test various approaches to determining consumer preferences and evaluate preliminary findings. Phase II would extend the research in the directions offering the most promise for application of the systems approach to the problems of homebuilding.

SITE SYSTEM	
5 **Planning Concepts** 6 **Nonresidential Functions** 7 **Circulation** 8 **Site Planning Services** 9 **Community Involvement**	RESEARCH TO DETERMINE LOW- & MODERATE-INCOME USER NEEDS REGARDING SAFETY & SECURITY, USE OF SPACE, PATTERNS FOR CIRCULATION; INTERVIEWS WITH BUYERS, TENANTS, RESIDENTS OF INNOVATIVE HOUSING PROJECTS & OTHERS INVOLVED IN LOW-INCOME HOUSING
BUILDING SYSTEMS	
15 **Community Involvement**	RESEARCH TO DETERMINE LOW- AND MODERATE-INCOME USER NEEDS REGARDING SELF-EXPRESSION & INDIVIDUALISM IN HOUSING DESIGN, UNWILLINGNESS TO ACCEPT SUBSTITUTE OR IMITATIVE MATERIALS, STYLE & DESIGN FEATURES REFLECTING RACIAL PRIDE
MANAGEMENT	
33 **Proposer Organization**	EDUCATIONAL FACILITY
34 **Internal Functions**	TWO PART RESEARCH PROPOSAL; PHASE ONE TO DETERMINE CONSUMER PREFERENCES & EVALUATE THE INFORMATION; PHASE TWO TO RESEARCH AREAS OFFERING THE MOST PROMISE FOR APPLYING THE SYSTEMS APPROACH TO PROBLEMS OF HOMEBUILDING

Uniwest Development

PROPOSER

Uniwest Development, Inc., Portland, Oregon.

AFFILIATES

MacFarlane Investments; Uniwest, Inc., Sales; Image, Inc., Advertising; Era, Inc., Design and Planning; Milton C. Lankton, Attorney; Alton R. Hooten, Architect; Dennis J. McLaughlin, Architect; Norman Kleehammer, Urban Designer.

This proposal sets forth a long-range plan for establishment and expansion of a prototype community through three stages of time: 1969-1975, 1990-2015, 2025-2055.

Basic to the plan is a tinker-toy-type building unit of factory-produced components. The initial effort, during the first time period, would be establishment of low-cost, studio apartment units, and multibedroom and low-rise structures. Phase two would provide for the dismantling of phase one units and their replacement with high-rise structures of the same components. The initial-phase structures would be removed and re-established as the core for a new development of phase-one type.

Proposed is a dwelling unit manufactured in 12-ft. wide x 12-ft. 6 in. high x 30-ft. 5 in. long sections. The units would be produced in component sections; living and dining room section, kitchen-family room and bath area, and bedroom and second bath area. Individual components would be delivered to site area. The units would then be bolted to tiers, posts, and to each other. Flexibility of design permits a variety of contours and architectural affects.

Stacking of the units to form multiple structures is to be by crane. The stacking design is such that each unit may utilize the roof of a unit below as a private garden and patio.

Floor plans will be developed to meet local code requirements for given development areas. Structural, mechanical, and electric systems are to be treated in like manner.

Physical and internal traffic connections would also be customized for local site conditions.

SITE SYSTEM	
1 Site Situation	5 MILES OUTSIDE INNER URBAN CORE
2 Density Range	DENSITY WILL INCREASE IN THREE CHRONOLOGICAL STAGES
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY
4 Climate	ADAPTABLE TO ALL CLIMATES
5 Planning Concepts	PLANNED UNIT DEVELOPMENT BUILT IN THREE SUCCESSIVELY EXPANDING STAGES
6 Nonresidential Functions	SERVICE AREAS; COMMERCIAL AREA; GREEN BELTS; SURFACE & MULTILEVEL PARKING
7 Circulation	CIRCULATION PROVISIONS WILL CHANGE AS REQUIREMENTS IN SUCCESSIVE STAGES CHANGE
8 Site Planning Services	PLANNING SERVICES IN THREE STAGES; 1969-1975; 1990-2015, 2025-2055 A.D.
9 Community Involvement	UNIQUE SITE WILL ASSURE ECONOMIC INTEGRATION
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED, MULTIFAMILY LOW-RISE IN STAGE ONE; MULTIFAMILY HIGH-RISE IN LATER STAGES
14 State of Development	DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure	VOLUMETRIC MODULES BOLTED TO TIERS, POSTS, & TO EACH OTHER
20 Comfort Systems	DESIGNED TO MEET LOCAL CODE REQUIREMENTS
21 Plumbing	
22 Electrical	
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULE
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF MODULES; FINISHES; UTILITIES
ECONOMICS	
30 Construction Costs	$14.00 PER SQ. FT. FOR PROTOTYPE UNITS; A 15 TO 20 PERCENT REDUCTION ANTICIPATED AT RATE OF 1,000 UNITS PER YEAR
31 Financing Methods	CONVENTIONAL & FHA FINANCING
32 Useful Life	LONGER USEFUL LIFE THAN PRESENT CONVENTIONAL ONSITE CONSTRUCTION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOP PROPOSED SITE IN THREE STAGES TO REFLECT CONTEMPORARY REQUIREMENTS
36 Market Area	PORTLAND, OREGON
37 Delivery Rate	1,000 UNITS PER YEAR
GENERAL	
40 Codes	SYSTEM WILL BE DESIGNED TO MEET LOCAL CODES

Urban, Calabretta & Lewis

PROPOSER

Urban, Calabretta & Lewis, Architects-Engineers-Planners, Columbus, Ohio.

The system offered is based on concrete panel and band beam construction and lends itself to continued addition and alteration. Essentially, the concept calls for structural wall panels to be site cast. Floor systems and beams are of off-site manufacture. Wall panels and beams may be gravity cast or extruded. Insulation is obtained with plastic foam, sprayed on the interior or exterior. Exterior finishes may be colored concrete, furred wood, brick, or stone, are site applied, and exterior work can be completed in a single day. Partitions would be of lightweight concrete block. Interior finish, insulation and painting may be accomplished by prospective occupants, but installation of cabinets, fixtures, partitions, frames, and doors, however, require skilled craftsmen.

The system may be installed on concrete, steel or wood piling, concrete block, or reinforced concrete. It can also be adapted to precast vertical units. All interior units, mechanical and electrical appliances, and equipment are of standard supply and material.

Although the system is identical to one proposed for a housing authority, it has not been fully developed, and some problems need to be defined and solved.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
2 Density Range	ABOUT 13.7% OF LAND OCCUPIED BY HOUSING
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
5 Planning Concepts	LAND USE CONCEPTS ACCORDING TO URBAN LAND INSTITUTE STUDIES
6 Nonresidential Functions	RECREATIONAL & COMMERCIAL AREAS; LAUNDRY; SOCIAL HALL; DAY CARE CENTER; SCHOOL
7 Circulation	CUL-DE-SACS; SEPARATE VEHICULAR TRAFFIC; PEDESTRIAN UNDERPASSES
8 Site Planning Services	PROPOSER SUPPLIED
10 Utilities	UNDERGROUND PRIMARY ELECTRICITY SUPPLY TO TRANSFORMER & SECONDARY SERVICING 20 UNITS
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & SINGLE-FAMILY; MULTIFAMILY LOW-RISE
12 Unit Variations	1 TO 6 BEDROOMS
13 Design Selection	FROM STANDARD PLANS WITH OPTIONS
14 State of Development	FURTHER DESIGN AND DEVELOPMENT REQUIRED
BUILDING SUBSYSTEMS	
16 Structure	SITE-CAST CONCRETE STRUCTURAL WALL PANELS; BAND BEAM CONSTRUCTION; ROOF
17 Exterior Elements	COLORED CONCRETE, STUCCO, BRICK, OR STONE FACING
18 Interior Elements	LIGHTWEIGHT BLOCK PARTITIONS; VINYL ASBESTOS TILE FLOOR STAIRS
19 Foundations	CONVENTIONAL; SLAB OR BEARING WALLS, PERIMETER FOOTINGS; PILINGS
20 Comfort Systems	UNITIZED HEATING & COOLING SYSTEM WITH DUCTS
21 Plumbing	COPPER SUPPLY PIPES; PLASTIC WASTE PIPES; UNITIZED PLASTIC BATHROOM
22 Electrical	CONVENTIONAL WIRING
23 Furnishings	BUILT-IN METAL OR WOOD CABINETS WITH PLASTIC FINISHES
PRODUCTION	
24 Offsite Production	FLOOR SYSTEM AND BEAMS; UNITIZED BATHROOM
25 Onsite Production	ONSITE CASTING OF CONCRETE WALLS
26 Onsite Construction and Erection	FOUNDATION; ERECTION OF WALLS; ROOF; FLOOR; STAIRS; FINISHES; UTILITIES
29 Community Involvement	SELF-HELP FOR INTERIOR FINISH, INSULATION, AND PAINTING
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN AND DEVELOP HOUSING SYSTEM
36 Market Area	ATLANTA, GEORGIA AREA
37 Delivery Rate	EXTERIOR SHELL COMPLETED IN ONE DAY
GENERAL	
40 Codes	CONVENTIONAL ELECTRICAL AND PLUMBING IN CONFORMANCE WITH ALL APPLICABLE CODES

UDDC/BSD

PROPOSER CONSORTIUM

Urban Design and Development Corporation, Washington, D.C.
(Original Consortium Member: Urban America, Inc., Washington, D.C.)
Building Systems Development, Inc., San Francisco, California

This proposer suggests utilization of administrative and management techniques benefiting the demand sector by assisting the State of Illinois to aggregate housing markets for volume construction. The approach builds on the experience of a previously formed multicity consortium, operating within and among states. Primary objective is to implement collective power in obtaining optimum demands for industrialized housing and collective needs in accordance with the HUD schedule.

The proposer's program: (1) Would identify clients ready to collectively acquire industrialized housing and a process through which necessary actions could be undertaken; (2) Would implement a workable market aggregation process; and (3) Would evaluate the market process and the products which resulted in prototype applications.

The proposal addresses factors involving volume, quality, economy, and diversity of housing, and includes definition of user needs, types of clients, construction schedules, constraints between client and supplier, codes, and regulations.

The basic concern of the study is to identify necessary aggregate clients, together with collective data, and bring these new clients together immediately, parallel to the activities of industry to structure production and supply.

SITE SYSTEM	
1 Site Situation	URBAN
5 Planning Concepts	DEVELOPMENT OF AGGREGATE MARKET FOR INDUSTRIALIZED HOUSING TO FACILITATE SITE PLANNING
9 Community Involvement	IDENTIFICATION OF USER NEEDS AS TO SITE, BUILDING SYSTEMS, AND DEMAND IN ILLINOIS
BUILDING SYSTEMS	
15 Community Involvement	IDENTIFICATION OF USER NEEDS AS TO SITE, BUILDING SYSTEMS, AND DEMAND IN ILLINOIS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions **35 External Functions**	DEVELOPMENT OF AGGREGATE HOUSING MARKETS FOR VOLUME CONSTRUCTION; DETERMINATION OF OPTIMUM DEMANDS FOR INDUSTRIALIZED HOUSING; IDENTIFICATION OF GROUPS OF CLIENTS READY TO COLLECTIVELY PURCHASE INDUSTRIALIZED HOUSING; EVALUATION OF MARKET AGGREGATION PROCESS & THE RESULTING HOUSING
36 Market Area	ILLINOIS
GENERAL	
39 Major Innovative Concepts	MARKET AGGREGATION FOR VOLUME HOUSING DEMAND

Value Engineering Company

PROPOSERS

Value Engineering Company, Alexandria, Virginia
Mariani and Associates, Washington, D.C.

Personnel and facilities are offered in this proposal to conduct research and development required to establish an innovative concept for future housing programs.

The proposer visualizes two major sections of effort: (1) Use of a non-profit sponsor buying and developing land, arranging for financing, installation of roads and utilities, mass buying of building materials and components, and arranging for other services. (2) Use of homesteader who will acquire an equity in his home by doing the majority of the construction of the home.

The program, which is designed to test a large number of the proposer's theories, is essentially a cooperative development program which intends to overcome the lack of large scale programs readily adaptable to needs of the rural poor and, in summary, deliver quality housing at a cost that every wage earning family unit can afford and effectively eliminate the housing gap for many low-income families.

SITE SYSTEM	
1 Site Situation	PROGRAM DESIGNED FOR HOUSING RURAL POOR
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
13 Design Selection	FLEXIBLE PLANNING VARIATIONS
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	DEVELOPMENT OF A PANEL & WOOD FRAME SYSTEM CAPABLE OF BEING ERECTED BY "HOMESTEADER" EQUITY PARTICIPATION; RELOCATABLE PARTITIONS; PREFABRICATED KITCHEN-BATH; EASILY INSTALLED FOUNDATIONS WITH EXPANDABLE FOOTING SYSTEM
PRODUCTION	
29 Community Involvement	USE OF LOCAL LABOR IN SELF-HELP EQUITY CONSTRUCTION OF HOME
ECONOMICS	
31 Financing Methods	SELF-HELP EQUITY PARTICIPATION
MANAGEMENT	
33 Proposer Organization	PRIVATE COMPANY
34 Internal Functions	VALUE-ENGINEERED ANALYSIS & DEVELOPMENT OF HOUSING PROGRAM
35 External Functions	NONPROFIT SPONSOR TO BUY & DEVELOP LAND, ARRANGE FINANCING, INSTALLATION OF ROADS & UTILITIES, LARGE SCALE BUYING OF BUILDING MATERIALS & OTHER NECESSARY SERVICES

George C. Vaughn & Sons

PROPOSER CONSORTIUM

George C. Vaughan & Sons, Manufacturer-Distributer-Developer, San Antonio, Texas
Southwest Forest Industries, Inc., Lumber Products, Phoenix, Arizona
Alamo Lumber Company, Contractors, San Antonio, Texas
Strann, Inc., Builder-Developer, Houston, Texas
Builders Supply Company, Manufacturers and Distributors, San Antonio, Texas
Jesse A. Baker, Builder, Gonzales, Texas

This group proposes a program for research, design, and development of a three-dimensional component construction system, together with a delivery and field erection and placement system. The wood-frame system would be geared to include single-family detached and attached and multifamily low-rise units. The theory herein presented is that great economic advantage can be obtained in material and labor by using production line methods of assembly and fabrication while maintaining a conventional appearance, durability, and ease of maintenance.

The proposed design program visualizes a prototype project to actually manufacture, deliver, and complete a series of the above noted dwellings as three-dimensional components and/or module homes in the South Texas rural and urban markets.

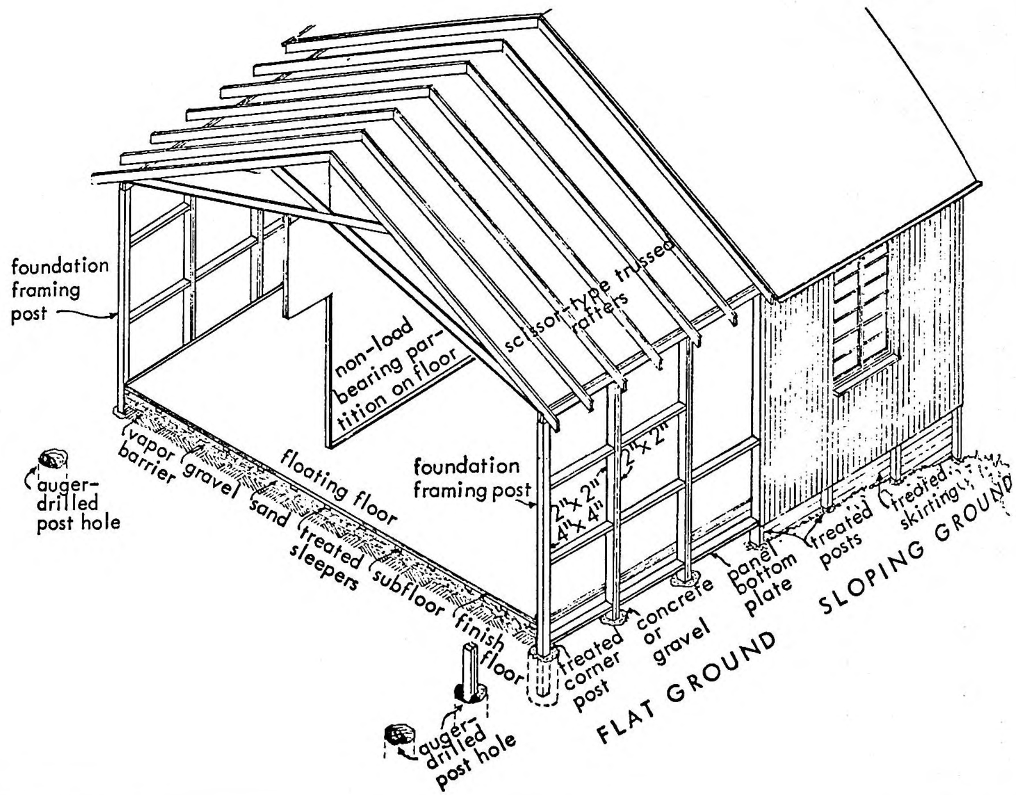
SITE SYSTEM	
1 Site Situation	SMALL CITIES; RURAL
2 Density Range	15 TO 20 DWELLING UNITS PER ACRE
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE
14 State of Development	BUILDING SYSTEM IN CONCEPTUAL STAGE; CONSORTIUM ESTABLISHED IN CONSTRUCTION
15 Community Involvement	LIMITED
BUILDING SUBSYSTEMS	
16 Structure	CONVENTIONAL WOOD-FRAME VOLUMETRIC MODULES
17 Exterior Elements	BRICK VENEER OR OTHER
18 Interior Elements	
19 Foundations	DEVELOPMENT OF FOUNDATIONS SUITABLE FOR MODULES
20 Comfort Systems	
21 Plumbing	CORE WHERE APPLICABLE
22 Electrical	INTEGRATED IN FACTORY
PRODUCTION	
24 Offsite Production	VOLUMETRIC WOOD FRAME MODULE
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF MODULES, UTILITY INSTALLATIONS
29 Community Involvement	MAXIMUM USE OF LOCAL UNSKILLED LABOR
ECONOMICS	
31 Financing Methods	CONVENTIONAL; FHA; VA; FMHA
32 Useful Life	50 YEARS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DEVELOPMENT OF FACTORY-PRODUCED MODULAR HOUSING SYSTEM, SUITABLE FOUNDATIONS, & TRANSPORTATION SYSTEM
36 Market Area	SOUTH TEXAS
37 Delivery Rate	600 HOMES
GENERAL	
40 Codes	ADAPTABLE TO MODEL CODE

Virginia Polytechnic Institute

PROPOSER

Virginia Polytechnic Institute & State University, Wood Research and Wood Construction Laboratory, Blacksburg, Virginia

Studies of an integrated foundation-framing system are proposed, in which foundation and anchorage are provided by extending the principal framing posts of the structural walls downward to appropriate foundation levels in the ground. The system would eliminate conventional foundation work, would be adaptable to any terrain, and would require no additional bracing or framing members.



SITE SYSTEM
3 **Topography** — ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS

BUILDING SYSTEMS
14 **State of Development** — DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING

BUILDING SUBSYSTEMS
16 **Structure**
17 **Exterior Elements**
18 **Interior Elements**
19 **Foundation**
STUDY OF INTEGRATED WOOD FOUNDATION-FRAMING SYSTEM IN WHICH FOUNDATION & ANCHORAGE ARE PROVIDED BY EXTENDING THE PRINCIPAL FRAMING POSTS OF THE STRUCTURAL WALLS DOWNWARD TO APPROPRIATE FOUNDATION LEVELS. THE SYSTEM WOULD ELIMINATE CONVENTIONAL FOUNDATION WORK, & WOULD REQUIRE NO ADDITIONAL BRACING OR FRAMING.

PRODUCTION
24 **Offsite Production** — PRESSURE-TREATED WOOD POSTS TO RESIST DECAY & TERMITES
26 **Onsite Construction and Erection** — OVERSIZE POST HOLES DUG WITH SHOVEL OR AUGER; EACH ELONGATED PART OF FRAMING MEMBER INSERTED IN POST HOLES

MANAGEMENT
33 **Proposer Organization** — EDUCATIONAL FACILITY
34 **Internal Functions** — STUDY OF INTEGRATED WOOD FOUNDATION-FRAMING SYSTEM

Virginia Polytechnic Institute

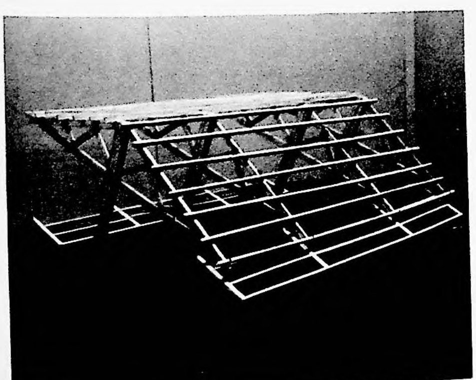
PROPOSER

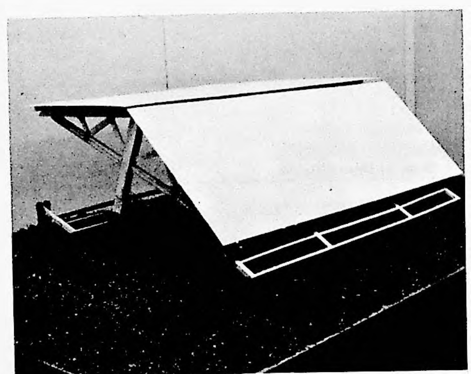
Virginia Polytechnic Institute and State University, Blacksburg, Virginia

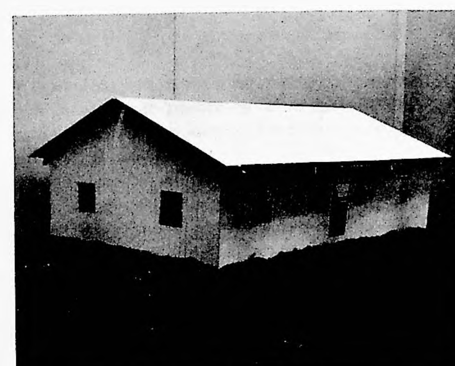
Proposed for development are design and erection procedures for prefabricated, pole-type timber, rigid-frame housing that can be tilted into place. Of particular interest is the fact that this technique could be used in rural areas and other locations where contractors have little experience in prefabricated construction techniques.

The optimum combination will be sought for balanced structural design, prefabrication of components, pole-type construction, tilt-up erection, and counter-balancing rigid frame designs. The objective of the project will be to develop structural procedures for collectively utilizing the cost-saving advantages of all concepts.

SITE SYSTEM	
1 Site Situation	RURAL; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
BUILDING SYSTEMS	
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements 19 Foundations	DEVELOPMENT OF DESIGN & ERECTION PROCEDURES FOR PREFABRICATED POLE-TYPE TIMBER RIGID-FRAME HOUSING THAT CAN BE TILTED INTO PLACE
PRODUCTION	
24 Offsite Production	FABRICATION OF STRUCTURAL MEMBERS
26 Onsite Construction and Erection	FRAME TILTED INTO PLACE
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	RESEARCH; DEVELOPMENT; DESIGN; TESTING
GENERAL	
40 Codes	ADAPTABLE TO ALL NATIONAL CODES







Virginia Polytechnic Institute

PROPOSER

Virginia Polytechnic Institute & State University, Wood Research and Wood Construction Laboratory, Blacksburg, Virginia

Mass-produced foundations for mass-produced housing are proposed, based on criteria for optimum utilization of pressure-treated wood poles and posts. Despite wide use of pressure-treated wood for construction, techniques for design and construction of pole-and-post house foundations—including required spacings of different sizes and lengths in different soils—are limited. Once available, such design data can be introduced, in tabular form and with nomographs, in textbooks and handbooks for easy access by architects, engineers, and others.

SITE SYSTEM	
3 Topography	STUDY OF SOIL BEARING CAPACITY OF A VARIETY OF SOIL CONDITIONS; PREPARATION OF TABLES & CHARTS FOR LOADS SUPPORTED BY POLES & POSTS
BUILDING SYSTEMS	
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
19 Foundations	STUDY OF PERFORMANCE OF WOOD POLES & POSTS IN COMMONLY ENCOUNTERED SOILS; APPLICATION OF INFORMATION TO WOOD FOUNDATION SYSTEMS USING DURABLE PRESSURE TREATED POLES & POSTS
PRODUCTION	
24 Offsite Production	DESIGN & CONSTRUCTION OF MASS PRODUCED WOOD FOUNDATION PLATFORMS
26 Onsite Construction and Erection	DESIGN & CONSTRUCTION OF SITE ERECTED WOOD FOUNDATION PLATFORMS
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	EVALUATION OF ECONOMICS OF VARIOUS TYPES OF WOOD FOUNDATIONS

Virginia Polytechnic Institute

PROPOSER

Virginia Polytechnic Institute, College of Architecture and Research Division, Blacksburg, Virginia.

This proposal centers on study of the possibilities of drive-in housing. It is envisioned that now-familiar camping trailer or truck camper might become a part of a permanent house structure, specifically designed to mate with a mobile unit. This would enable greater use of a mobile home by permitting the conventional house to be enlarged when the mobile home was not otherwise in use. Or, the mobile home itself—through various modifications—would become the housing unit capable of expansion wherever the owner chose to park it. An investigation of the possibilities of such ideas for a large-scale (minimum 20,000 persons) development would be undertaken.

BUILDING SYSTEMS	
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure	STUDY OF POSSIBILITY OF MODIFYING CONVENTIONAL HOUSE & MOBILE HOME SO THAT THE TWO COULD BE JOINED WHEN MOBILE HOME WAS NOT BEING USED
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	STUDY OF POSSIBILITY OF JOINING MOBILE HOMES & CONVENTIONAL HOUSES ON A LARGE SCALE (MINIMUM 20,000 PERSONS) DEVELOPMENT

Virginia Polytechnic Institute

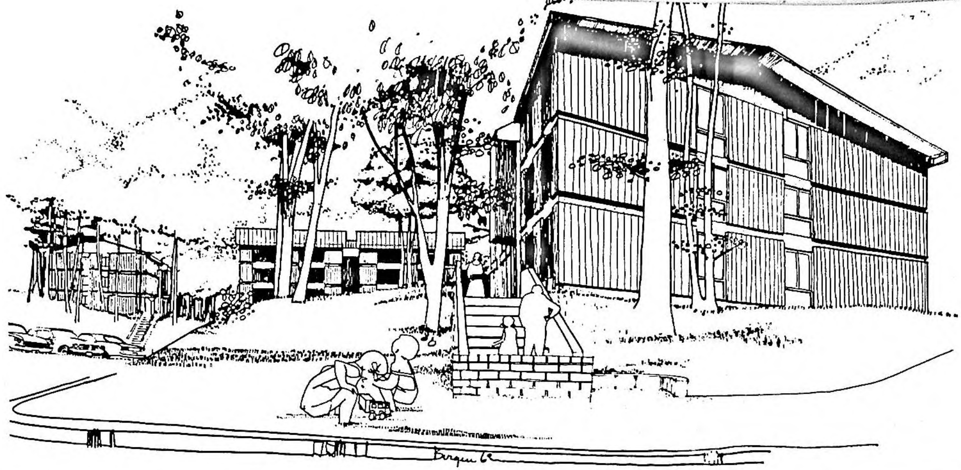
PROPOSER

Virginia Polytechnic Institute, College of Architecture, Blacksburg, Virginia.

AFFILIATES

Redman Industries, Inc., Schultz Construction Corporation.

A detailed study is proposed of the module system now in use at Reston, Va., with the idea of extending the system's possibilities through panelization and use of adaptations of the system in high-rise and other large-structure configurations. Other possibilities would be explored using the Reston system as a starting point. The module system presently is based on steel framing, a wet utility module, and a dry module. The study would explore the economics of a programmed renewal policy in order to maximize the quality of the housing environment through a rigorous systems analysis. Financing schemes would be formulated to discourage environmental neglect. The building system would utilize current mobile home production facilities.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
8 Site Planning Services	EXPLORE THE ECONOMICS OF A PROGRAMMED RENEWAL POLICY TO MAXIMIZE THE QUALITY OF THE HOUSING ENVIRONMENT THROUGH A RIGOROUS SYSTEMS ANALYSIS
BUILDING SYSTEMS	
11 Housing Types	MULTIFAMILY LOW-RISE, POSSIBLE HIGH-RISE
12 Unit Variations	1 TO 4 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING OPTIONS
14 State of Development	CURRENT MOBILE HOME PRODUCTION FACILITIES; BUILDING SYSTEM DEVELOPED
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	STUDY OF RESTON MODULE SYSTEM WET & DRY MODULES; STEEL FRAMING; POTENTIAL OF GREATER USE OF PANELS
19 Foundations	CONVENTIONAL; TO BE DESIGNED FOR SPECIFIC SITE CONDITIONS
20 Comfort Systems 21 Plumbing 22 Electrical	SELF-SUPPORTING WET MODULE CONTAINING ALL PLUMBING, HEATING, & ELECTRICAL EQUIPMENT
PRODUCTION	
24 Offsite Production	PANELS & WET MODULE; FORMULATE PRODUCTION SYSTEMS FOR INITIAL HOUSING UNITS & COMPONENTS FOR IN-SERVICE RENEWAL
25 Onsite Production	
ECONOMICS	
30 Construction Costs	$11,653 PER UNIT ($9.13 PER SQ. FT.), 1,000 UNITS
31 Financing Methods	FORMULATE FINANCING SCHEMES THAT DISCOURAGE ENVIRONMENTAL NEGLECT
32 Useful Life	STRUCTURE—50 YEARS; INTERIOR—40 YEARS
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	STUDY OF RESTON MODULE SYSTEM WITH IDEA OF EXTENDING THE SYSTEM'S POTENTIAL THROUGH PANELIZATION

Virginia Polytechnic Institute

PROPOSER

Virginia Polytechnic Institute and State University, Blacksburg, Virginia

A study to develop structural design procedures for mass-production of economy housing is offered. Need for such a study and criteria is backed by the belief that the United States could be producing at least 50 percent more houses, with the same amount of structural materials as is now being applied, if all parts were utilized in integral structural systems.

The study would consist of research of all major housing elements. Areas for consideration include research of structurally balanced flooring and roofing systems consisting of wood joists, subflooring or sheathing and finish flooring. Structurally balanced walls and partitions would also be studied.

BUILDING SYSTEMS	
14 State of Development	CONCEPTUAL; FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	STUDY OF STRUCTURALLY BALANCED FLOOR, ROOF, WALL & PARTITION SYSTEMS INCLUDING WOOD JOISTS, SUBFLOORING OR SHEATHING & FINISH FLOORING
PRODUCTION	
24 Offsite Production	FABRICATION OF JOISTS
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions 35 External Functions	RESEARCH OF STRUCTURAL PROPERTIES & INTERACTIONS OF ALL MAJOR HOUSING ELEMENTS; DEVELOP DESIGN PROCEDURES FOR MAXIMUM UTILIZATION OF RESEARCH RESULTS; ASSEMBLE DESIGN TABLES & OTHER AIDES FOR EXPEDITING HOUSING PRODUCTION

Washington Center For Metropolitan Studies

PROPOSER

Washington Center for Metropolitan Studies, Washington, D.C.

Basically, this proposal is for developing a system for proper analysis of the constraints imposed on the private housing market by local government actions. It would select the most promising changes in zoning ordinance concepts, capital programming procedures, and master planning to overcome these constraints.

A data collection and analysis of current local government decisions, and the processes producing them, would form the basis of the proposal. Together, this information would comprise a systems base for analyzing the constraints imposed on the private housing market by local government actions. The final product of the studies would be a detailed statement of all private costs and returns, estimates, and estimating procedures associated with each existing and proposed local government decision-making process. Recommendations for change also would be included.

Developers now are forced to act as coordinators for the decision-making process involving zoning and land use. One purpose of this proposal is to research the importance of the frustration factor involved in this process. Decisions concerning plat approvals, building permits, services and utilities, professional fees, and rights-of-way would be analyzed.

The impact of proposed changes in the local government decision-making process would be studied. The hypothesis that government change can lower significantly private development costs would be scrutinized, with an investigation of zoning-like alternatives that might be better suited to mass production of housing. Also sought would be new procedures for obtaining permission to develop land.

SITE SYSTEM 1 **Site Situation** 2 **Density Range** 9 **Community Involvement** 10 **Utilities**	ANALYSIS OF LOCAL CONSTRAINTS ON SITE SITUATION IMPOSED BY LOCAL GOVERNMENT—BUILDING PERMITS, ZONING, TAXES, RIGHT-OF-WAY, UTILITIES, ETC.
ECONOMICS 30 **Construction Costs** 31 **Financing Methods**	ANALYSIS OF EFFECTS ON PRIVATE COSTS & RETURN ON INVESTMENT CAUSED BY LENGTHY LOCAL GOVERNMENT PROCESSES
MANAGEMENT 33 **Proposer Organization**	NONPROFIT INSTITUTION
34 **Internal Functions**	ANALYSIS OF CONSTRAINTS IMPOSED ON PRIVATE HOUSING MARKET BY LOCAL GOVERNMENT; RECOMMENDATIONS REGARDING TAX POLICY, LOBBYING
GENERAL 40 **Codes**	STUDY OF LOCAL HOUSING CODES & ZONING ORDINANCES.

Washington Center for Metropolitan Studies

PROPOSER

The Washington Center for Metropolitan Studies, Washington, D.C.

This unique proposal suggests research and development for a turnkey approach to the design, production, and marketing of furniture suited to the needs of low-income families, to be sold to them at lowest possible price levels. Major furniture manufacturers will be encouraged to design and build such furniture to federal standards of design, construction, and competitive pricing. The products will be offered to families occupying federally-assisted low- and moderate-income units with credit terms minimizing monthly outlays and interest charges. Furniture payments could be incorporated into monthly rental payments, thereby lowering collection costs.

The proposer will first conduct consumer preference studies. Conferences will bring a cross section of low-income family members together with interior designers for discussion of needs and preferences. The designers will show sketches and/or full scale models of proposed furniture designs. They also will visit low-income families in their homes for interviews. Where negative reactions are encountered, family members will be asked to recommend design improvements. Modern design, with its cost-saving potential, will be emphasized.

Field interviews will be conducted with a cross section of furniture manufacturers (8 to 10) to discuss production costs, price considerations, time schedules and distribution problems. Marketing may be through local public and private nonprofit housing sponsors with the use of such devices as illustrated catalogs and display apartments. Cost savings will be sought through modern production methods and materials, efficient distribution, and economies resulting from quantity ordering and marketing directly to the consumer without retail mark-ups.

Foreign literature will be searched to learn the experiences of other nations with similar programs, if there are any in operation. This effort will focus primarily on Japan, England, Finland and the Scandinavian countries. Existing literature on design of furniture for applications related to low-income housing also will be reviewed. The results of these reviews will be combined with results of the consumer studies to provide suggestions for furniture meeting the program objectives.

Ongoing relevant federal programs will be researched for possible adaptation to this approach. New legislation may be required.

BUILDING SUBSYSTEMS

23 Furnishings	DEVELOPMENT OF A PROGRAM TO PROVIDE GOOD-QUALITY, REASONABLY PRICED FURNITURE WHICH CONSIDERS USER NEEDS & CONSUMER ACCEPTANCE TO LOW-INCOME FAMILIES

MANAGEMENT

33 Proposer Organization	NONPROFIT INSTITUTION
34 Internal Functions	DEVELOP PROCEDURES FOR A TURNKEY APPROACH TO DESIGN, PRODUCTION, & MARKETING OF GOOD-QUALITY, LOW-PRICED FURNITURE FOR LOW-INCOME FAMILIES
36 Market Area	NATIONWIDE MARKETING THROUGH LOCAL PUBLIC & PRIVATE NONPROFIT HOUSING SPONSORS

Donald Watson

PROPOSER

Donald Watson, AIA, Guilford, Connecticut.

Development of an open building system that can be assembled at the site by low-skilled labor is proposed for study. The study would aim at the development of a packaged home, factory made for delivery to various sites for assembly by the owner. The system would be achieved by use of panels that combine exterior skin, structure, and insulation. Research would include a review of existing technologies to determine feasible materials and fabrication techniques, design of the building system, exploration of various planning options for the system evolved, and testing of the critical fabrication and construction processes developed.

SITE SYSTEM

1 Site Situation	URBAN; SUBURBAN

BUILDING SYSTEMS

11 Housing Types	SINGLE FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION

BUILDING SUBSYSTEMS

16 Structure 17 Exterior Elements 18 Interior Elements	RESEARCH & DEVELOPMENT OF A FACTORY-MADE HOUSE DESIGNED FOR ON-SITE SELF-HELP ERECTION; RESEARCH ON BUILDING MATERIALS; BUILDING SYSTEM WOULD UTILIZE STRESSED-SKIN PLYWOOD PANELS, PREFRAMED PANELS, OR FIBERGLASS SANDWICH PANELS

PRODUCTION

24 Offsite Production	RESEARCH & TESTING OF FABRICATION TECHNIQUES FOR FACTORY BUILT HOUSES
26 Onsite Construction and Erection 27 Labor 29 Community Involvement	DEVELOPMENT & TESTING OF A HOUSE THAT CAN BE SITE ERECTED USING SELF-HELP LABOR

MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	RESEARCH & TESTING OF MATERIALS & FABRICATION TECHNIQUES FOR A FACTORY-BUILT HOUSE THAT CAN BE SITE ERECTED USING SELF-HELP LABOR

Donald Watson

PROPOSER

Donald Watson, AIA, Guilford, Connecticut.

This proposal is aimed at evaluation of existing projects as a basis for site planning criteria. The proposer points out that architects and developers at present find themselves making decisions about site layout and design with little or no systematic criteria for planning of public spaces, especially as it affects actual activity patterns of the users. Development of such information, based on a systematic study, would be of major advantage.

SITE SYSTEM

6 Nonresidential Functions	RESEARCH TO DETERMINE THE REQUIREMENTS OF A NONRESIDENTIAL AREA IF IT IS TO SUCCESSFULLY SERVE THE COMMUNITY
7 Circulation	RESEARCH ON CIRCULATION SYSTEMS TO DETERMINE WHICH MEET THE NEEDS OF LARGE FAMILIES & THE ELDERLY
8 Site Planning Services	MODELLING OF ACTIVITIES INTO AN ACTIVITY SYSTEM, CORRELATING PHYSICAL DESIGN PARAMETERS & ACTUAL ACTIVITY PATTERNS
9 Community Involvement	RESEARCH TO DETERMINE THE SOCIAL INTERACTION & COMMUNICATION WHICH ACTUALLY OCCUR IN THE ENVIRONMENT AS A RESULT OF SITE DESIGN DECISIONS

PRODUCTION

29 Community Involvement	SELF-HELP ERECTION OF PANELS

MANAGEMENT

33 Proposer Organization	PROFESSIONAL
34 Internal Functions	RESEARCH & FILM DOCUMENTATION OF CASE STUDIES; PRESENTATION OF FINDINGS AS PLANNING & EVALUATION CRITERIA

West Virginia University

PROPOSER

West Virginia University, Morgantown, West Virginia.

The technical feasibility of producing mineral wool from coal ash for building applications has been demonstrated. It is proposed that advanced research and development be undertaken in three major areas related to this process: (1) A detailed projection of the economics of producing mineral wool in this manner for use in residential construction; (2) Examination of the feasibility of production on a large scale; and (3) an investigation of the possibility of collecting gases emitted during ash melting for conversion into useful byproducts. Studies to date show that mineral wool of a quality comparable with commercial wool can be produced from virtually any coal ash including bottom slag, bottom ash, flyash, and limestone modified flyash.

Field testing is suggested of mineral wool-based products and housing components constructed from them such as insulating batts, pipe lagging, acoustic tile, and loose insulation for walls. A three-phase approach is set out: Phase 1, equipment design and installation, would require 9 months; Phase 2, experimental evaluations, would require 2 years, examining the performance of four coal ash slags and two limestone modified flyashes; Phase 3, economic evaluations, would take 6 months, 3 of them running concurrently with Phase 2. The entire project, including construction of production plant and field testing, would cover 3 years.

Feasibility studies would determine cost factors involved in the process of collecting and converting sulphur-ladened offgases which are more highly concentrated than power plant flue gases. Tests have indicated that these gases might readily be refined into other useful products thus reducing the cost of mineral wool production.

BUILDING SUBSYSTEMS	
17 Exterior Elements 18 Interior Elements	INVESTIGATION OF THE FEASIBILITY OF PRODUCING MINERAL WOOL INSULATING FIBER & BUILDING COMPONENTS FOR CONSTRUCTION USE FROM COAL ASH
PRODUCTION	
24 Offsite Production	FEASIBILITY STUDY OF LARGE SCALE PRODUCTION OF MINERAL WOOL PRODUCTS FROM COAL ASH
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL INSTITUTION
34 Internal Functions	RESEARCH & DEVELOPMENT OF MINERAL WOOL PRODUCTS FROM COAL ASH

West Virginia University

PROPOSER

West Virginia University, Morgantown, West Virginia

Investigations into the use of solid waste materials—including (but not limited to) fly ash, mine tailings, incinerator refuse, and slag—as a component of low-cost concrete is proposed. It is suggested that successful use of such materials would be helpful in solving both the problem of producing low-cost concrete materials and in disposing of solid waste products.

A four-phase research plan would include: (1) Exhaustive technical and feasibility studies of the production of aerated pozzolan or similar products from solid wastes, including surveys of the type and availability of suitable materials in the United States; (2) A detailed evaluation of those solid wastes which appear suitable; (3) Studies of means to upgrade marginal raw materials found suitable, and establish quality controls; (4) A preliminary economic evaluation of the product and production of demonstration specimens.

Waste items suggested for initial study include: fly ash, sludge resulting from treatment of acid mine drainage; municipal incinerator refuse; bauxite tailings; phosphate mining wastes; copper and other metallurgical tailing wastes or dump products; anthracite culm; and blast furnace slag. Other materials may also be studied.

PRODUCTION	
24 Offsite Production	INVESTIGATION OF SOLID WASTE MATERIALS WHICH MAY BE SUITABLE FOR USE IN CONCRETE
MANAGEMENT	
33 Proposer Organization	EDUCATIONAL FACILITY
34 Internal Functions	RESEARCH PROPOSAL TO DETERMINE THE FEASIBILITY OF USING WASTE MATERIALS SUCH AS FLY ASH, ACID MINE DRAINAGE, INCINERATOR REFUSE, BAUXITE TAILINGS, BLAST FURNACE, SLAG, & OTHER SOLID WASTES TO MAKE LOW-COST CONCRETE. STUDIES OF "AERATED POZZOLAN"; UPGRADING WASTE; EVALUATION & DEMONSTRATION OF SPECIMENS

Western Company

PROPOSER CONSORTIUM

The Western Company, Research Division, Richardson, Texas
Oneida Perlite Corporation, Development and Testing, Malad City, Idaho
Merril & Associates, Dallas, Texas
Consulting Associates, Dallas, Texas
Woodward-Cape & Partners, Architectural Design, Dallas, Texas

Advanced development and testing of a pressed-perlite, concrete construction material system is proposed by this research group. Objective of the research is to develop a high-strength, low-cost product suitable for use in wall panels and ceiling tiles, combining the advantages of precast materials with the thermal insulative properties of conventional wall and ceiling construction.

Presently, pressed-perlite concrete is made by adding a stated proportion of water to a dry mixture of perlite and cement, the water being almost immediately absorbed by the perlite. Next, by compressing the mixture at 100 to 200 lb. per sq. in., the perlite particles are forced into interlocking contact, and the water previously retained by the perlite is forced out and becomes available for hydration, the result being a high-quality, structural material with extremely good insulating properties.

Standard, modular wall panels made of such a product, when fully developed, could have utility distribution lines pressed into them; they would be suitable for easy transport, quick erection, and simple connection, and they would be fireproof, waterproof, termiteproof, and inexpensive.

BUILDING SUBSYSTEMS	
17 Exterior Elements 18 Interior Elements	DEVELOPMENT AND TESTING OF PRESSED-PERLITE CONCRETE CONSTRUCTION MATERIAL FOR HIGH QUALITY, LOW-COST WALL AND CEILING SYSTEMS
21 Plumbing	PLUMBING COULD BE INTEGRATED TO FORM A UTILITY PANEL
22 Electrical	INTEGRATED WITH BUILDING SUBSYSTEM AS A UTILITY PANEL
PRODUCTION	
24 Offsite Production	DEVELOPMENT OF PRESSED-PERLITE CONCRETE FOR WALL & CEILING SYSTEMS
ECONOMICS	
30 Construction Costs	ESTIMATED 25% TO 40% REDUCTION
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions 35 External Functions	RESEARCH TO DEVELOP HIGH-STRENGTH, LOW-COST PRODUCT SUITABLE FOR USE IN WALL PANELS AND CEILING TILES, COMBINING ADVANTAGES OF PRECAST MATERIALS WITH THE THERMAL INSULATIVE PROPERTIES OF CONVENTIONAL WALL AND CEILING CONSTRUCTION

Western Company

PROPOSER CONSORTIUM

The Western Company, Research Division, Engineers, Richardson, Texas
Consulting Associates, Computer Systems, Dallas, Texas
Herman Miller Research, Space Planning, Dallas, Texas
Merrill Research Association, Market Research, Dallas, Texas
Southwestern Dynamics
Development Dynamics, Construction Management
Donald Kerr Real Estate, Land Utilization
Woodward, Cape and Partners, Architects, Planners

Development of a management, organizational, and technical program is proposed, which will facilitate a systems approach to the overall housing problem. The program would consist of planning analyses, computer programs, and a compilation of data and procedures necessary to meet the needs of an individual community.

Among the factors to be considered in the program are: Socio-architecture; land use analysis; space utilization; materials, structures, and construction techniques; environmental simulation; advanced management tools; and computer-aided architectural design. Detailed studies in each of these areas will be conducted, feasibility will be established, and the format and techniques to be utilized will be determined.

SITE SYSTEM	
8 Site Planning Services	LAND USE ANALYSIS
BUILDING SYSTEMS	
15 Community Involvement	CONSIDERATION OF SOCIO-ARCHITECTURE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	ANALYSIS OF STRUCTURES & ARCHITECTURAL DESIGN; COMPUTER-AIDED ARCHITECTURAL DESIGN; ANALYSIS OF BUILDING MATERIALS
PRODUCTION	
26 Onsite Construction and Erection	ANALYSIS OF CONSTRUCTION TECHNIQUES
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions 35 External Functions	DEVELOPMENT OF A MANAGEMENT, ORGANIZATION & TECHNICAL PROGRAM TO FACILITATE A SYSTEMS APPROACH TO HOUSING PROBLEMS

Westinghouse Electric

PROPOSER

Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

A research, development and design study is proposed encompassing innovative concepts for the integration of existing and developmental materials, products, and services into a modular system for providing, together with simple movable panels, all the essential features of a home interior. The elements of such a modular system would include provision for unitized bathroom and kitchen components, lighting systems, appliance centers, fireplace assemblies, and living and bedroom resource packages. Excluded from the scope of the proposed study would be the utilities distribution system and utilities core concept.

Systems analysis would be utilized to determine the most functional and desirable combinations of spaces, appliances, and appointments; movable functional modules would be designed in which these appliances and appointments would be incorporated, the modules also being used to effect the various interior space arrangements desired. The modules are expected to be developed from the proposer's existing or developmental product lines by means of: Redesign as necessary to reduce cost or to simplify and enhance a home-like appearance; integration of cabinetry, appliances, and lighting; and selection or development of low-cost, attractive alternate materials for joining, fabricating, and beautifying.

BUILDING SYSTEMS	
14 State of Development	FURTHER RESEARCH REQUIRED FOR DESIGN & CONSTRUCTION
BUILDING SUBSYSTEMS	
18 Interior Elements 20 Comfort Systems 21 Plumbing 22 Electrical	RESEARCH, DEVELOPMENT & DESIGN STUDY OF INNOVATIVE CONCEPTS FOR THE INTEGRATION OF EXISTING AND DEVELOPMENTAL MATERIALS, PRODUCTS & SERVICES TO PROVIDE ESSENTIAL FEATURES OF A HOME INTERIOR; UTILIZES MOVABLE PANELS AND UNITIZED BATHROOM & KITCHEN COMPONENTS
23 Furnishings	FIREPLACE ASSEMBLIES; LIVING & BEDROOM RESOURCE PACKAGES
PRODUCTION	
24 Offsite Production	IDENTIFICATION & DEVELOPMENT OF PRODUCTS, MATERIALS, & PROCESSES SUITABLE FOR MASS PRODUCTION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	SYSTEMS ANALYSIS; INDUSTRIAL DESIGN; ENGINEERING; MATERIALS PROCESS STUDIES; MANUFACTURING
GENERAL	
39 Major Innovative Concepts	MODULAR SYSTEM FOR ESSENTIAL INTERIOR HOUSING APPOINTMENTS
40 Codes	TO BE ADAPTED TO ALL NATIONAL CODES

Westinghouse Electric

PROPOSER

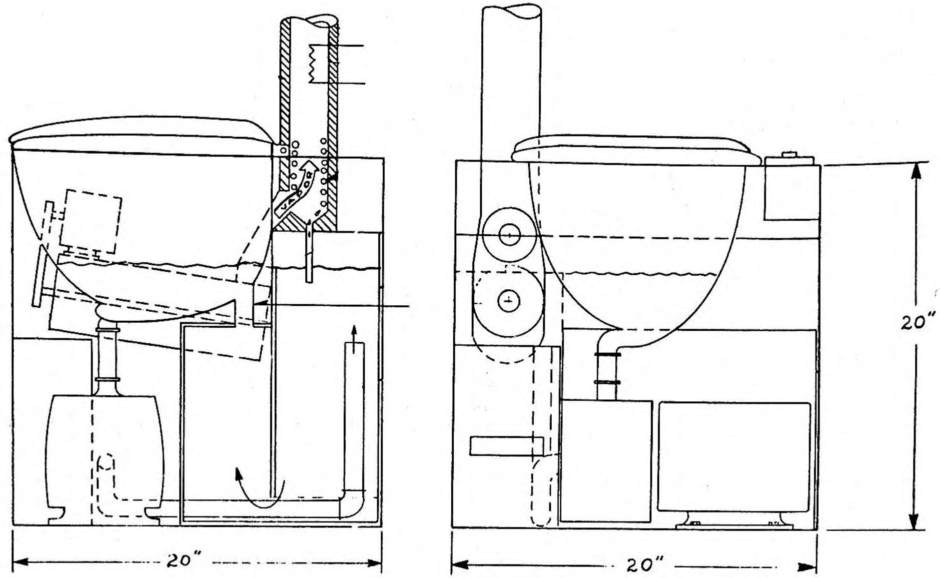
Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

The design and evaluation of fiber-reinforced, lightweight, inorganic sandwich panels as building elements or materials are prime objectives of this proposal. Within a 2-year time span, material compositions would be investigated looking toward: the fabrication of a durable, lightweight, cementitious material; development of a fiber-reinforced core of lightweight concrete; and design and fabrication of an iron alloy fiber. The research would also develop a lightweight foamed-plaster-gypsum material for interior wall application and lead to fabrication of a structural panel combining the three elements to form a sandwich wall material.

The main objective is to determine the effectiveness of newly developed fiber reinforcement and lightweight concretes by evaluating the effects of fiber concentration, fabrication methods, and alloy composition. Strength measurements would be made of the sandwich composite and the three individual wall components. Thermal properties also would be determined. The proposed program would run from material selection through panel fabrication and strength and durability tests, to the final prototype module fabrication.

BUILDING SYSTEMS	
14 State of Development	PRODUCTION FACILITIES OPERATIONAL; BUILDING SYSTEM DESIGN STAGE
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	TEST & PRODUCE PROTOTYPE FIBER-REINFORCED LIGHTWEIGHT INORGANIC SANDWICH PANELS & MODULES; DESIGN & EVALUATE A FIBERGLASS-REINFORCED LIGHTWEIGHT INORGANIC COMPOSITE MATERIAL SUITABLE AS A BUILDING ELEMENT OR CONSTRUCTION MATERIAL
PRODUCTION	
24 Offsite Production	PANEL & MODULE FABRICATION
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT & TESTING OF LIGHTWEIGHT FIBER-REINFORCED INORGANIC SANDWICH PANELS & MODULES

Westinghouse Electric



PROPOSER

Westinghouse Electric Corporation, Research Laboratories, Pittsburgh, Pennsylvania.

Development and testing is proposed for two nonaqueous sanitary waste treatment systems. The systems would embody a new concept in sanitary waste disposal in which the waste is treated at the point of origin, rather than being transported by a relatively large volume of water to a distant and costly-to-build-and-operate sewage treatment plant.

The rationale for the proposed work is one of more effective management of our water resources, in addition to the reverse motivation implicit in financing and building more and more costly sewage treatment facilities. The proposer points out that the average person requires about 100 gallons of water a day for his personal needs, with the largest percentage of that being for the transport of waste materials—in commode flushing, at 5 gallons per flushing. Their position is that this is gross mismanagement of water resources, and the systems proposed for development would obviate such dissipation of a natural resource.

The proposed systems consist essentially of a nonaqueous fluid such as freon, being used in a commode in the conventional manner as a flushing fluid, or, in more technical terms, as a transport medium or carrier. The fluid would flush into a storage tank where the solid and liquid wastes would be separated from the freon, the freon being cycled to the system for subsequent reuse. The wastes would be completely disposed of through incineration, producing an ash, water vapor, and carbon dioxide. There would be no effluent from the system to be disposed of externally.

The two systems to be developed would be an individual type for single-family use, and an integral system serving many commodes in a high-rise project, with central incineration of the waste products.

SITE SYSTEM

10 Utilities	DEVELOPMENT & TESTING OF TWO NONAQUEOUS SANITARY WASTE TREATMENT SYSTEMS; SEWAGE TREATED AT THE POINT OF ORIGIN, RATHER THAN TRANSPORTED BY VOLUME OF WATER TO SEWAGE TREATMENT PLANT

BUILDING SYSTEMS

14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION, & TESTING

BUILDING SUBSYSTEMS

21 Plumbing	STUDY OF A COMMODE UTILIZING NONAQUEOUS FLUID SUCH AS FREON AS A TRANSPORT MEDIUM; SOLID & LIQUID WASTES SEPARATED FROM THE FREON; FREON WASTES DISPOSED OF INCINERATION

MANAGEMENT

33 Proposer Organization	CORPORATION
34 Internal Functions	DEVELOPMENT, TESTING

GENERAL

39 Major Innovative Concepts	DEVELOPMENT OF NONAQUEOUS SANITARY WASTE SYSTEMS

Westinghouse Electric

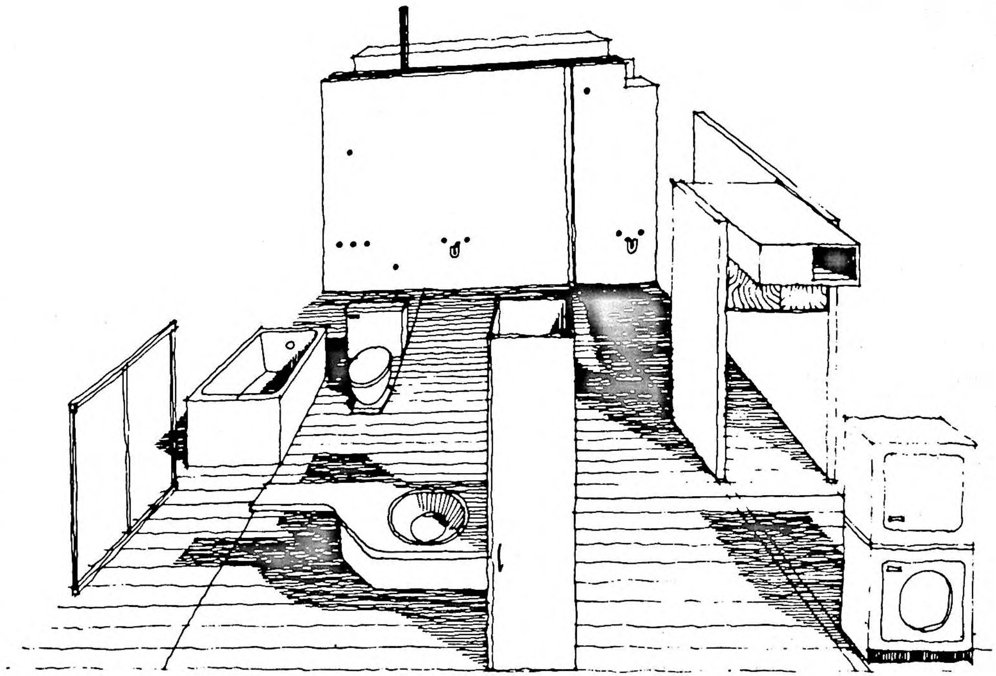
PROPOSER

Westinghouse Electric Corporation, Research Laboratories, Pittsburgh, Pennsylvania.

Study, evaluation, and recommendations for improvements and innovations in the design, manufacture, and installation of residential utility systems is offered by this proposer. Recognizing that no major cost reductions are to be expected in the individual components which make up the basic service subsystems in a dwelling—that is, heating, ventilation and air conditioning, electrical distribution, plumbing, and appliances—the proposer instead intends to concentrate on achieving overall savings and higher production rates by better integration of these subsystems with the building structure.

It is in the factory assembly of these components into appliance centers, utility cores, plumbing walls and other such concepts that the initial potential for cost reduction is expected to be found, although no single design, material selection, or innovation of itself is expected to be a panacea. It is believed, rather that the proposed study will arrive at compromises between flexibility and standardization through which high production and lower costs may result. Investigation into the relationship of the structural shell, interior partitions and the utility center, core, or wall, leading to determination of the exact interface between factory and onsite work should produce further guides to greater economy and production.

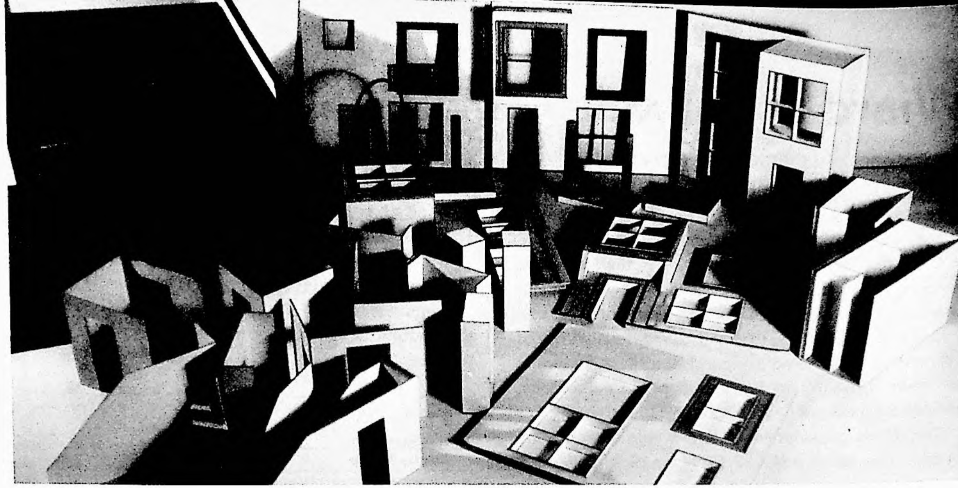
The proposed work would be in three phases: A field and literature survey; evaluation and costing of utilities and their distribution systems; and summary and recommendations. Selection and detailing of model layouts for several representative structures, and cost analysis of these layouts, would be included in the proposed work. This information will lead to recommendations for the initiation of specific development programs which should provide innovative solutions to technical problems identified as sources of excessive costs or factors limiting high-volume production.



Exploded View of Utility Wall Concept

BUILDING SUBSYSTEMS	
20 Comfort Systems **21 Plumbing** **22 Electrical**	STUDY OF PLUMBING SYSTEMS TO DEVELOP COST REDUCTIONS; DEVELOPMENT OF PLUMBING WALLS, APPLIANCE CENTERS, UTILITY CORES, UNITIZED KITCHENS, & BATHROOMS
PRODUCTION	
24 Offsite Production **25 Onsite Production** **26 Onsite Construction and Erection**	STUDY TO DETERMINE OPTIMUM INTERFACE BETWEEN FACTORY & ONSITE WORK; EMPHASIS PLACED ON DESIGNS CAPABLE OF HIGH VOLUME WITH MINIMUM TOOLING OR INVESTMENT & WAYS TO REDUCE & FACILITATE ONSITE INSTALLATION
27 Labor	UNSKILLED, SEMISKILLED
29 Community Involvement	POSSIBLE SELF-HELP UTILITY HOOKUPS
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	FIELD & LITERATURE SURVEY; EVALUATION & COSTING OF UTILITY SYSTEMS & DISTRIBUTION SYSTEMS; SUMMARY & RECOMMENDATIONS

Todd E. Wexman



PROPOSER

Todd E. Wexman, Architect, Chicago, Illinois.

AFFILIATES

Edward T. Mesterharm

A housing system is proposed that is essentially a catalog of parts. The philosophy which underlies this concept may be stated as an awareness of the importance of living in an environment which responds to us. Allowances must be made for the need of persons to manipulate things and make their own mark.

The proposed system accordingly is almost a cafeteria-like spreading out of the many components from which the prospective owner or occupant may assemble the living environment most suitable to his needs and desires. Included among these items, in addition to a basic shell, are canopies, front porch kits, single- and double-height bay extenders, balconies, awning kits, storage units, bathroom-lavatory components, decorator packages, cooling units, furnishing components, landscaping packages, and appliances.

The system offers the client the potential, for example, of moving into a 20 ft. x 30 ft. shell with very few embellishments—a polyurethaned plywood floor, white-primed wall surfaces, and a minimum of storage facilities. Later, this family may paint or add a bay extender, a front porch, or an air conditioner—all, in accordance with its own needs and financial capacity at the time. Instead of being thrust into a finished product built to minimum standards, the client is offered the opportunity to participate in the making of a constantly evolving home.

The basic shell of the system presently is viewed as wood-frame construction, with this evolving perhaps into a steel framed or molded fiberglass system. The concept of the system as a catalog of parts would continue, however, with interchangeability of components by many manufacturers being explored, to broaden the concept even further.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY ATTACHED & DETACHED; MULTIFAMILY LOW-RISE
12 Unit Variations	1, 3, 4 BEDROOMS
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
16 Structure	20 FT. X 30 FT. WOOD FRAME
17 Exterior Elements 18 Interior Elements	A HOUSING SYSTEM UTILIZING A WIDE VARIETY OF PARTS FROM WHICH THE OWNER MAKES SELECTIONS IN ORDER TO BUILD A LIVING ENVIRONMENT SUITABLE TO HIS NEEDS & DESIRES; BASIC SHELL, CANOPIES, FRONT PORCH KITS, SINGLE- & DOUBLE-HEIGHT BAY EXTENDERS, BALCONIES, AWNING KITS, STORAGE UNITS, BATHROOM/LAVATORY COMPONENTS, DECORATOR PACKAGES, COOLING UNITS, FURNISHING COMPONENTS, LANDSCAPING PACKAGES, APPLIANCES
19 Foundations	CONVENTIONAL; FOUNDATION BEARING WALLS, SPREAD FOOTINGS & COLUMNS
20 Comfort Systems 21 Plumbing 22 Electrical 23 Furnishings	HOUSING SYSTEM PROVIDES HOMEOWNER A CHOICE IN UTILITIES & FURNISHINGS
PRODUCTION	
29 Community Involvement	SELF-HELP FINISHING; LOCAL CONTRACTORS & SUBCONTRACTORS
ECONOMICS	
30 Construction Costs	$13,728 PER DWELLING UNIT FOR VOLUME PRODUCTION
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN; PROTOTYPE CONSTRUCTION; TESTING

Wiard & Burwell

PROPOSER

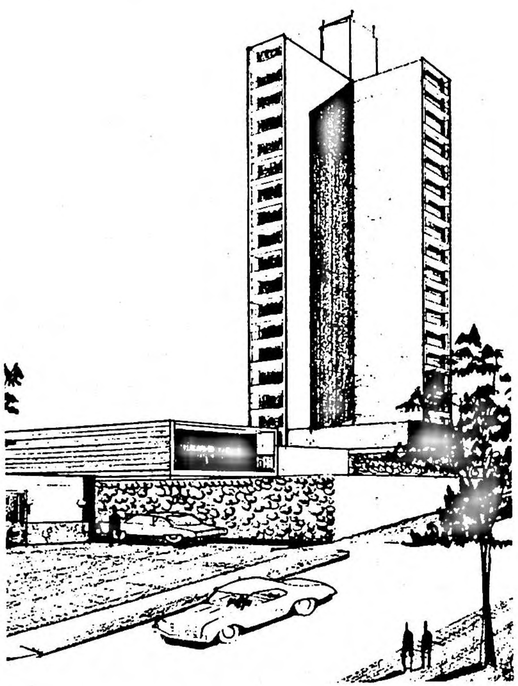
Wiard & Burwell, Architects Planners, Rochester, New York

Extrusion of room-sized modules is the innovative concept put forward by this proposer for research and subsequent development into a complete housing system. The extrusion process and the materials utilized are held forth as being inexpensive, offering potential for great flexibility in house design and appearance, and being capable of producing superior shelter.

Two types of extruded modules would comprise the system. The outer shell—10 ft. high, 19 ft. wide, and extruded to any length required—would be made of a cement asbestos mixture and would consist of an outer wall, with integrally die-formed structural eye-beams about 3 ft. on center jutting out around its inside perimeter. The inner shell, 8 ft. high, 18 ft. wide, extruded of thermoplastic crystaline polymer, is slipped inside the outer shell, cemented to and supported by the eye-beams (which act as stand-off struts), in effect, forming a box beam structure.

The space between inner and outer shells serves as a distribution plenum for heated or chilled air, with plumbing lines readily being run beneath the bottom of the inner shell (the floor of the module). Electrical distribution would be by printed circuits, which would be stenciled on the outside surface of the inner shell as it feeds out from the extrusion machine. Carpeting, where desired or required, would be produced by factory flocking of the floor surface to a 1/8 in. depth. Prefabricated slip-in units (also to be extruded) for bathroom, kitchen, and other facilities are conceived of as being inserted into the modules onsite and represent the third major component in this extruded, modular system.

Site work is pictured as requiring only placement of the modules on prepared concrete pads or footings, which would contain heating plant, electric meter, and plumbing connections.



SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN; RURAL
2 Density Range	SINGLE-FAMILY TO HIGHRISE
9 Community Involvement	COMMUNITY SUGGESTIONS ENCOURAGED IN ENVIRONMENTAL PLANNING
10 Utilities	PLUG-IN FACILITIES FOR UTILITIES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
12 Unit Variations	FLEXIBLE
13 Design Selection	FLEXIBLE
14 State of Development	DESIGN STAGE
15 Community Involvement	GAMING TECHNIQUES OF MODULAR DESIGN TO RELATE INHABITANT WITH DWELLING DESIGN & ENCOURAGE PRIDE OF HOME
BUILDING SUBSYSTEMS	
16 Structure 17 Exterior Elements 18 Interior Elements	DEVELOPMENT OF MODULES FORMED OF EXTRUDED CEMENT ASBESTOS OUTER SHELL WITH INTEGRALLY DIE-FORMED STRUCTURAL EYE-BEAMS JUTTING INWARD TO SUPPORT AN EXTRUDED SLIPPED-IN CRYSTALINE POLYMER INNER SHELL; INNER EXTRUDED SHELL RECEIVES SLIP-IN UNITS FOR ROOMS; FACTORY-FLOCKED FLOOR SERVES AS CARPETING
19 Foundations	CONVENTIONAL; FOOTINGS
20 Comfort Systems	SPACE BETWEEN OUTER & INNER SHELLS SERVES AS DISTRIBUTION PLENUM FOR HOT OR CHILLED AIR
21 Plumbing	PIPING TO KITCHEN & BATH UNITS RUNS BETWEEN STRUCTURAL BEAMS
22 Electrical	PRINTED CIRCUITS STENCILED WITH CONDUCTIVE PAINT ON OUTER SURFACE OF INNER SHELL
23 Furnishings	
PRODUCTION	
24 Offsite Production	MODULE OUTER & INNER SHELL; SLIP-IN UNITS
26 Onsite Construction and Erection	FOUNDATIONS; PLACING OF SHELLS; INSERTION OF SLIP-IN UNITS; UTILITY HOOK-UPS
27 Labor	MINIMUM SKILLS REQUIRED
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN OF EXTRUDED HOUSING SYSTEM
GENERAL	
39 Major Innovative Concepts	INDUSTRIALIZED THREE-COMPONENT EXTRUDED HOUSING CONCEPT

Wilsey & Ham

PROPOSER

Wilsey & Ham, Planning-Architecture-Engineering-Surveying, San Mateo, California

Proposed here is use of a financial feasibility forecasting system, employing computer techniques, to provide clearly outlined multiple choices for prospective investors in housing projects. The proposer and an accounting firm have developed a financial analysis and simulation system which defines various opportunity options before funds are committed to business ventures. This provides quick evaluation of many variable cost and revenue items materially affecting the forecast being considered. Analyses are developed, period by period, throughout the life of the project under consideration and provide the planner, economist, engineer, and manager with several sets of assumptions and development plan alternatives in a comparatively short time.

In any project design and planning process the system would be used to test economic feasibility of an existing land use or master plan and to evaluate the economic feasibility of a project already in process of development. Used as a design tool, it evaluates alternate development concepts for greatest profitability. In a typical computer run, more than 20,000 information bits are assimilated and stored for recall. This forecasting procedure employs certain basic constant assumptions, recognized as conventional accounting and financial management principles and practices.

SITE SYSTEM

8 **Site Planning Services**	COMPUTER GENERATED ANALYSIS OF ECONOMIC FEASIBILITY OF LAND USE PLAN & EVALUATION OF ALTERNATE DEVELOPMENT CONCEPTS

ECONOMICS

30 **Construction Costs**	DEVELOPMENT OF COMPUTER PROGRAM TO DETERMINE FINANCIAL FEASIBILITY OF OPERATION BREAKTHROUGH PROPOSALS; PROGRAM WILL DEAL WITH FINANCIAL ANALYSIS OF BUILDINGS SYSTEMS, LAND PLANNING & ENVIRONMENTAL IMPROVEMENTS, PROTOTYPE CONSTRUCTION, VOLUME PRODUCTION, AND NEW TOWN DEVELOPMENT

MANAGEMENT

33 **Proposer Organization**	CONSORTIUM
34 **Internal Functions**	DEVELOPMENT OF COMPUTER PROGRAM TO DETERMINE FINANCIAL FEASIBILITY THROUGH USE OF SIMULATION MODEL

Wilsey & Ham

PROPOSER

Wilsey & Ham, Planning-Architecture-Engineering-Surveying, San Mateo, California

AFFILIATES

Kelso, Cotton, Seligman & Ray, Law-Finance-Economics; Optimum Systems, Inc., Computer Systems and Mathematical Models

Two major urban systems would be studied under this proposal, to determine feasibility of their application in the structuring of an entirely new city complex of up to million inhabitants. The first would be the physical (environmental) system including city planning, urban design form, housing, commercial and industrial structures, and all other physical facilities. The second system would involve economic, financial, legal, and corporate structure considerations. To be determined is the process of wealth creation and the techniques for generating income flow to people from two sources—wages from employment, and equity derived from private property ownership holdings of corporate stock, urban real estate, bonds, and other capital investments.

These compatible urban and socio-economic systems would then be analyzed by electronic computers and mathematical models. The end objective of the project would be construction of advanced-quality housing products within the framework of a totally preplanned urban environment. Tested would be techniques of private ownership diffusion of the economic base, with sufficient income distribution to enable all new city residents to afford quality housing. This approach would eliminate the need for federal, state, or local subsidies.

The research planned would seek to eliminate or reverse present land and labor cost inflation, raise the purchasing power of potential home buyers and tenants, and broaden citizens' economic participation in the land development and construction industries. The proposer feels that the housing systems being developed through the Operation Breakthrough program provide an opportunity to demonstrate as many as 12 different prototype systems in the context of a large new city.

SITE SYSTEM	
1 Site Situation 2 Density Range 5 Planning Concepts 6 Nonresidential Functions 7 Circulation 8 Site Planning Services 9 Community Involvement	CREATION OF A NEW CITY WITH A POPULATION OF 1 MILLION, INCLUDING THE DESIGN OF A COMPLETE PHYSICAL-ENVIRONMENTAL SYSTEM (CITY PLAN, URBAN DESIGN FORM, HOUSING, COMMERCIAL-INDUSTRIAL STRUCTURES & SOCIO-ECONOMIC SYSTEMS, ECONOMIC, FINANCIAL, LEGAL & CORPORATE ORGANIZATIONAL STRUCTURE.)
ECONOMICS	
30 Construction Costs 31 Financing Methods 32 Useful Life	DEVELOPMENT OF SYSTEM FOR NEW CITY, INVOLVING ECONOMIC, FINANCIAL, LEGAL & CORPORATE CONSIDERATIONS
MANAGEMENT	
33 Proposer Organization	CONSORTIUM
34 Internal Functions	DEVELOPMENT OF NEW CITY; COMPUTER & MATHEMATICAL MODEL ANALYSIS

Winter, Bzik & Plimley

PROPOSER

Winter, Bzik & Plimley, Design/Administration, San Francisco, California

AFFILIATES

The Koppers Company, Manufacturing Feasibility Consultant; University of California, School of Environmental Studies, Proposed Project Sponsor

Development of a low-cost, fiberglass-reinforced polyester house is proposed as a subject of research, with the eventual goal being a dwelling that can be purchased by families earning less than $100 a month.

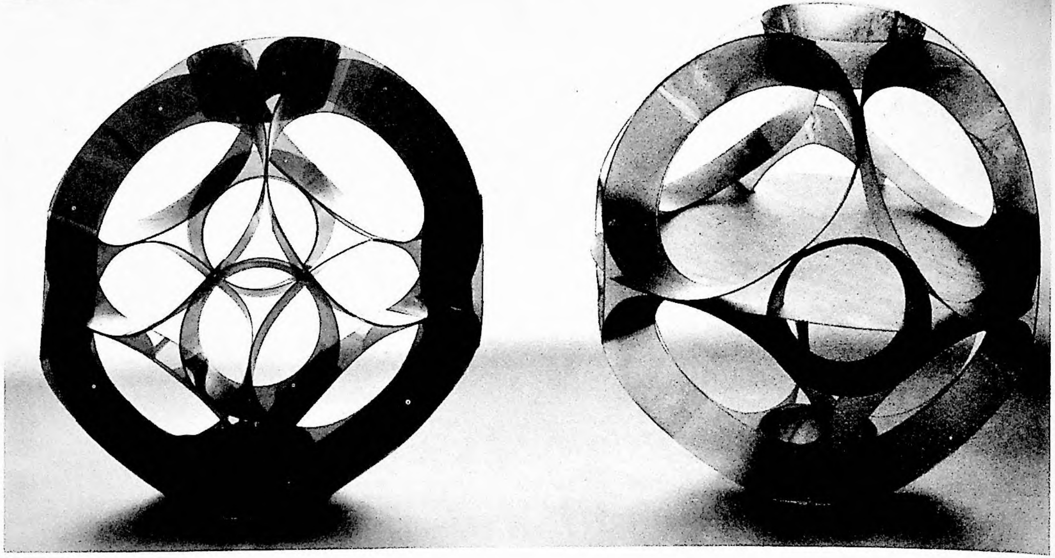
Although the cost of fiberglass-reinforced polyester structures presently is high, particularly in relation to conventional, wood-frame construction, a potential for substantial savings which might invert this relationship merits investigation. This potential lies not in materials cost (probably stabilized at the present high rate of production) but rather in areas such as simplification of building processes—molding, not hammer-and-nail, and simplication of detail—use of large, snap-in window and door frames, and elimination of high-skill labor.

The system proposed for research and development probably would consist of two types of volumetric modules—one for living space, another for utilities and equipment—with at least two modules usually being required to make a dwelling unit. A highly rationalized production schedule would entail the following steps: (1) Spraying of the shell (with windows and doors set in the mold as required), removal from the mold, and curing; (2) Installation of utilities and services, including wiring (raceways or conduits being molded previously in shell) and application of interior finishes; (3) Installation of closets and storage space; (4) Manufacture of connecting units such as corridors; (5) On-site placement of foundations, with prefabricated footings perhaps being used to reduce costs; and (6) Shipment of modules to the site, placement on foundations, and plug-in of utilities.

Although the concept presently is viewed as most suitable for one-story, single-family usage, it could be used in high-rise projects, with bare steel framework being erected, into which the modules could be slotted, attached, and hooked up.

SITE SYSTEM	
5 Planning Concepts	MEANDERING LINEAR PARKS; CLUSTERS
6 Nonresidential Functions	ART COLONY COMPLEXES; ENCLAVES FOR THE ELDERLY; COMMERCIAL FACILITIES
10 Utilities	SITE UTILITIES ADAPTED TO PLUG INTO HOUSING UNIT UTILITIES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED & ATTACHED; MULTIFAMILY LOW-RISE & HIGH-RISE
13 Design Selection	SELECTION FROM STANDARD PLANS WITH OPTIONS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION, & TESTING
BUILDING SUBSYSTEMS	
16 Structure	FIBERGLASS-REINFORCED POLYESTER VOLUMETRIC MODULE
17 Exterior Elements	OPTIONAL ACCESSORY ITEMS
18 Interior Elements	SPRAYED PLASTER CEILINGS; GYPSUM BOARD WALLS; CLOSET ASSEMBLIES; FLOORING
20 Comfort Systems 21 Plumbing 22 Electrical	UTILITIES, MECHANICAL PIPING AND DUCTING, & ELECTRICAL CONDUIT MOLDED INTO STRUCTURE
23 Furnishings	MOLDED FURNITURE
PRODUCTION	
24 Offsite Production	VOLUMETRIC MODULE; FOUNDATION ELEMENTS
26 Onsite Construction and Erection	FOUNDATION; PLACING OF VOLUMETRIC MODULE; PLUG-IN UTILITY CONNECTIONS
27 Labor	PRIMARILY UNSKILLED & SEMISKILLED
ECONOMICS	
30 Construction Costs	$21.21 PER SQ. FT. WITH 50% ADDITIONAL SAVINGS ANTICIPATED ON ELECTRICAL, MECHANICAL & MASONRY
31 Financing Methods	CONVENTIONAL; GOVERNMENT SUBSIDIZED; EQUITY
MANAGEMENT	
33 Proposer Organization	PROFESSIONAL
34 Internal Functions	DESIGN & TEST OF LOW-COST PREFABRICATED, FIBERGLASS-REINFORCED POLYESTER HOUSING SYSTEM
GENERAL	
40 Codes	PROBLEMS ANTICIPATED

Yantra



PROPOSER

Yantra Corporation, Bolinas, California.

A 40-ft.-diameter spherical shell made up of filament-wound truncated cones, the outer faces of the cone segments covered with four layers of mylar film pressurized to form a stressed skin, comprise the basic weather envelope of this innovative and highly unusual single-family dwelling. The basic shape, geometrically evolved from conically faced polyhedra, is a conjugate hybrid having 32 cones or circular faces. These faces (sealed with mylar lenses, metalized to reflect solar heat and retain inside heat make the house, positioned on its conical base, look like a massive, many-faceted crystal.

Though unconventional in appearance, shape, and design, the structure may be produced on a highly industrialized basis. The two types of cones used in assembly of the shell—the facial cone being 13 ft. in diameter, the vertical cone, 10 ft. in diameter—are mandrel-wound spun filament, cured under tension, the entire process being highly amenable to automatic production. The spun cones then are sawed into equal-sized sections, the facial cones into three parts, the vertical cones into five parts. It is these cone parts which constitute the basic modules of the spherical house system. Sixty of the vertical modules, for example, when finally reconstituted as globular living space built up around its axial pillar, comprise the 12 vertical cones which make the sphere.

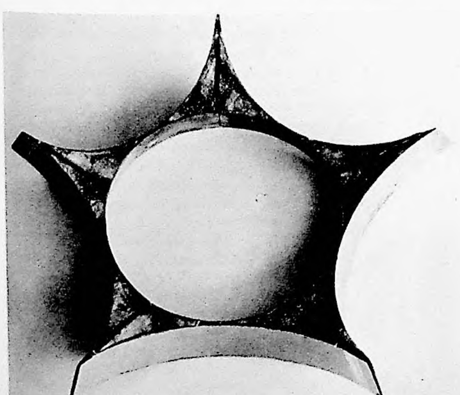
Entrance to the dwelling is via a broad spiral stairway in the conical base. This leads to the first level within the sphere, a circular utility plate where heating-cooling and washer-dryer facilities will probably be located, their connections being made to the central axial pillar, which will serve as a channel for all utilities and ventilation throughout the structure. The next level up is the primary floor plate, 37 ft. in diameter, being just below the girth of the sphere. Here will be located all living areas, including kitchen and bathroom modules, and adult bedrooms.

SITE SYSTEM	
1 Site Situation	URBAN; SUBURBAN
3 Topography	ADAPTABLE TO ALL NORMAL TOPOGRAPHY & SOILS
4 Climate	ADAPTABLE TO ALL NATIONAL CLIMATES
BUILDING SYSTEMS	
11 Housing Types	SINGLE-FAMILY DETACHED
13 Design Selection	FLEXIBLE OPEN PLANNING VARIATIONS
14 State of Development	DESIGN STAGE REQUIRING DEVELOPMENT, PROTOTYPE CONSTRUCTION & TESTING
BUILDING SUBSYSTEMS	
16 Structure	FILAMENT-WOUND CONES & CENTRAL PILLAR FLUE; FLOOR PLATE COMPRISED OF TEN 26-DEGREE PIE-SHAPED MODULES; THE STRUCTURE HAS THE SHAPE OF A CONICALLY FACED POLYHEDRA; SPHERE IS MADE UP OF 12 VERTICAL CONES
18 Interior Elements	PARTITIONS WILL BE HONEYCOMB CORES AND PLASTIC SKINS ON INFLATED PANELS
21 Plumbing	BATHROOM MODULES
PRODUCTION	
24 Offsite Production	ENTIRE STRUCTURE CAN BE PRODUCED ON AN INDUSTRIALIZED BASIS
26 Onsite Construction and Erection	ASSEMBLY OF MODULES INTO SPHERICAL SHAPE
27 Labor	SEMISKILLED ERECTION TEAMS
29 Community Involvement	SELF-HELP
ECONOMICS	
30 Construction Costs	UNDER $13,000 PER UNIT FOR OVER 1,000 UNITS PER YEAR
MANAGEMENT	
33 Proposer Organization	CORPORATION
34 Internal Functions	RESEARCH, DESIGN & DEVELOPMENT
GENERAL	
39 Major Innovative Concepts	SPHERICAL BUILDING SYSTEM, SOUNDPROOF MYLAR LENS STRUCTURE WITH EVOLUTING-TORUS CIRCULATION PATTERN

Above that will be the children's level, probably a semicircular plate (about three-fifths of a circle) having sufficient room to sleep four children with optional radial partitions for privacy, and a spiral stair or ramp connecting it with the level below.

Assembly of the modules into an eventual spherical shape is accomplished by use of an onsite production jig on which the parts are matched and interlocked by corrugations along the sides, the entire assembly then being formed into an integral unit. These vertical cones (or vertices) and facial cones then are built up around the base, alternating in stages as the various floor plates, central pillar, mechanical modules and other parts are inserted, with the sphere only being closed at its apogee when every operation inside has been completed.

The three floor plates are assembled from 10- to 36-degree-wide segments of the respective areas (fewer for the children's level). Each triangular segment is fastened by one vertex to the central pillar and by the other two to the inside of the spherical shell. Partitions for the structure will be sandwich panels of plastic skin with honeycomb core. All the modules are factory fabricated and identical and can be joined by unskilled persons; erection of the sphere may be accomplished in 7 man-days, or even less, under large tract conditions.



type B proposals

UNRELEASED INFORMATION

The following is a listing of proposers who, because of proprietary interests or for other reasons, did not release their proposal data for publication.

Advance Planning Research Group, Inc., Kensington, Maryland
Alpena Community College, Alpena, Michigan
V. H. Anderson Associates, Cincinnati, Ohio
Ove Arup & Partners, Consulting Engineers, London, England
Morris Asimow, Los Angeles, California
Landrum E. Bagwell, Brevard, North Carolina
David Baker, Architect, Washington, D.C.
Battelle Memorial Institute, Columbus, Ohio
Theodore H. Bentley, Los Angeles, California
Boston Architectural Center, Boston, Massachusetts
Brauer Corporation, Ingleside, Texas
Brink & Roberts, Architects, LaMesa, California
Builder's Mart, Inc., Naples, Florida
F. X. Burkart, Johns Island, South Carolina
California Science Dynamics, LaJolla, California
California State Polytechnic College, San Luis Obispo, California
Campbell, Aldrich & Nulty, Boston, Massachusetts
Certain-Teed Development Corporation, Ambler, Pennsylvania
Cluster Planned Homes, Inc., Portland, Oregon
College Heights Village, Inc., Newark, New Jersey
Computer Aid Company, Inc., Dallas, Texas
Construction Components Systems, Inc., Jackson, Mississippi
Cooper-Dickerson Industries, Beaumont, Texas
Corporation Mid America, Chicago, Illinois
Dabcovich & Company, Inc., Lexington, Massachusetts
Louis P. DeMonge, Englewood, New Jersey
Design & Construction Systems, Titusville, Florida
Development Research Associates, Los Angeles, California
W. B. Dolphin, Chicago, Illinois
Edwards Industrial Corporation, Atlanta, Georgia
Environmental Systems, Los Angeles, California
Ernst & Ernst, Washington, D.C.
FCE-Dillon, Inc., Cleveland, Ohio
Facilities Data Systems, San Francisco, California
Foresight Building Corporation, Irving, Texas
Foundation for the Advancement of Graduate Study in Engineering, Newark, New Jersey
Chester Garton, Chapman, Kansas
General Research & Development, Mesa, Arizona
Geodesic Manufacturing, Davison, Michigan
Gibbons, Heidtmann & Salvador, White Plains, New York
Godley Construction Co., Inc., Charlotte, North Carolina
Dr. C. E. Goetz, Yucca Valley, California
Graves Construction Company, Inc., Hilton Head Island, South Carolina
Grillias, Savage & Alves, Santa Ana, California
Groutlock Corporation of Ohio, Canton, Ohio
Keith Haag & Associates, Cuyahoga Falls, Ohio
Robert Lee Hall & Associates, Memphis, Tennessee
Harper-Drake & Associates, Inc., Milwaukee, Wisconsin
Hedron-City, New York, New York
Housing Associates of America, Los Angeles, California
Huntington Distributors, Inc., Candor, North Carolina
I. M. Marketing, Inc., Perry, New York
Industrial & Product Design, Inc., Houston, Texas
Inland-Ryerson Construction Products Co., Milwaukee, Wisconsin
Institute for Personal Effectiveness in Children, San Diego, California
Inter-Agency Committee on Mexican Affairs, Washington, D.C.
Jenn-Air, Indianapolis, Indiana
Kelley, Chrzanowski & Associates, Lake Bluff, Illinois
LIFA Products of Florida, Inc., Sarasota, Florida
Lautner & Waters, Hollywood, California
A. M. Lee, Provo, Utah
Wojcieh G. Lesnikowski, New Haven, Connecticut
Living Space, Inc., Yellow Springs, Ohio
L. D. Long Construction Co., Atlanta, Georgia
Lorbec Corp., Beverly Hills, California
John Crosby McEwen, AIA, St. Louis, Missouri
McKinsey & Co., Inc., Washington, D.C.
William J. McShane, Pittsburgh, Pennsylvania
Marcum, Inc., New York, New York
Richard E. Martin & Associates, Philadelphia, Pennsylvania
Master Development Corporation, Aspen, Colorado
Metropolitan Structures, Inc., Chicago, Illinois
Middleton & Associates, Normal, Illinois
Milbar Industries, Cleveland Heights, Ohio
Mod Structures, Corpus Christi, Texas
Modular Constructors, Inc., Woburn, Massachusetts
Module Systems, Inc., Quincy, Maine
Monsanto Research Corporation, St. Louis, Missouri
Naughton Equipment Co., Inc., Birmingham, Alabama
Mel O'Brien, Memphis, Tennessee
Daniel O'Connell's Sons, Inc., Holyoke, Massachusetts
Olin Corporation, New Haven, Connecticut
Panelbilt Corporation Paramount, California
Paul E. Pate & Associates, College Station, Texas
Public Facilities Associates, Inc., Madison, Wisconsin
Real Estate Development Corporation, Columbus, Ohio
Rotak Corporation, Inglewood, California
Rural Housing Economic Development, Calverton, L.I., New York
Satellite Plastics, Lincoln, Nebraska
Southwestern Perma Built Homes, Beeville, Texas
Stanford Research Institute, Menlo Park, California
Stanley Works, The, New Britain, Connecticut
State University of New York, Albany, New York
Owen M. Stolz & Associates, Dayton, Ohio
George J. Stowasser, Waukesha, Wisconsin
Structural Stoneware, Inc., Minerva, Ohio
TRW Systems Group, Redondo Beach, California
Thermo Electron Corporation, Waltham, Massachusetts
L. J. Thompson, Shawnee Mission, Kansas
Three R Corporation, Pawtucket, Rhode Island
Training Corp. of America, Falls Church, Virginia
Tri-Par Homes, Perry, Michigan
Unihab, Inc., Cambridge, Massachusetts
Union Carbide Corporation, Bound Brook, New Jersey
United States Building Corporation, Los Angeles, California
Updown, Inc., Seattle, Washington
Urban Development Corporation, Wayne, New Jersey
Urban Systems Research & Engineering, Inc., Boston, Massachusetts
Valkyrie Enterprises, Inc., Seattle, Washington
R. G. Vanderweil Engineers, Inc., Boston, Massachusetts
Veracity Corporation, Glen Echo, Maryland
Bernard Wagner, Washington, D.C.
Gehres D. Weed, Architect, Saskatoon, Prov. Saskatchewan, Canada
West Carolina Home Builders, Inc., Greenville, South Carolina
West & Conyers, Sarasota, Florida
Arnold Zogry Associates, Inc., Raleigh, North Carolina

appendix I

ALPHABETICAL INDEX OF HOUSING SYSTEMS PROPOSERS

appendix II

GEOGRAPHICAL INDEX OF HOUSING SYSTEMS PROPOSERS WHO RELEASED PUBLICATION INFORMATION

U.S.A.

ALABAMA

Birmingham
- Magic Homes, Inc. 448

Mobile
- S.S. Steele & Company, Inc. 578

ARIZONA

Chandler
- Apollo Franchise Corporation 305

Phoenix
- Southwest Forest Industries 514

Yuma
- N.J. Riebe Enterprises, Inc. 285

CALIFORNIA

Bakersville
- Dave Gardner Cross Associates 18

Benica
- Foamcor, Inc. 90

Berkeley
- Aitken/Collin & Associates 2
- Associated Home Builders of Greater Eastbay, Inc. 24,307
- Fisher-Jackson Associates 372
- Housing Advocates 408
- Pioneer Homes, Division of Up-Right, Inc. 284
- Herman D. Ruth & Associates 505

Bolinas
- Yantra Corporation 570

Campbell
- GRA-TEC, Inc. 389

City of Industry
- Roberts Consolidated Industries, Inc. 498

La Jolla
- Huntley & Blazier 410

Los Angeles
- Christiana Western Structures, Inc. 48
- Continental Homes, Inc. 344
- Daniel-Mann-Johnson-Mendenhall 349
- Peat, Marwick, Mitchell & Company 485
- Regents of the University of California 186
- Ring Brothers Corporation 543

Oakland
- Beamer/Wilkinson & Associates 312
- Building Block Investment Group 40
- East Oakland Fruitvale Planning Center, Inc. 359
- Hamilton & Williges 397
- Spaceshell, Inc. 515

Ontario
- Lockheed Aircraft Corporation 128

Orange
- Sproul Construction Corporation 208

Palm Springs
- Material Systems Corporation 136

Palo Alto
- Auerbach Corporation 308
- Lakeland Homes 279
- Optimum Systems, Inc. 475
- Stanford University 516
- Timelapse, Inc. 531

Redondo Beach
- TRW Systems Group 228

San Diego
- Five Points Housing Consortium 88,374
- Man Factors 452

San Francisco
- Bechtel Corporation 26
- William Blackwell, Architect 313
- Fillmore Community Development Association, Inc. 371
- Christian Frey, AIA 378
- Torus Corporation 290
- Transamerica Corporation 242
- Winter, Bzik & Plimley 569

San Jose
- Stanford Builders, Inc. 287

San Mateo
- Wilsey & Ham 567

Santa Ana
- Consultants Network, Inc. 341
- Insulation Systems, Inc. 420

Santa Barbara
- H.S. Bowser 317

Torrance
- Goldsworthy Engineering, Inc. 388

Walnut
- Module Construction, Inc. 461

COLORADO

Boulder
- Hauser Research & Engineering Company 402
- Pantek Corporation 164

Denver
- Concrete Fabricators Company, Inc. 340
- Denver Research Institute 352
- The Perl-Mack Company 170

CONNECTICUT

Darien
- Dunlap & Associates, Inc. 357

Guilford
- Donald Watson, AIA 559

Hartford
- Omniform, Inc. 160

Lakeville
- McTerry Contracting Company 447

New Haven
- Charles H. Brewer 318
- Technical Planning Associates 526

South Windsor
- Turbotec, Inc. 536

Stamford
- HA-FE-BI-RI 96
- The SMS Partnership 507

Yalesville
- William R. Singer, Jr. 286

DELAWARE

Wilmington
- Hercules, Inc. 104
- Module Communities, Inc., Delaware 150

DISTRICT OF COLUMBIA

Washington
- American Systems Building Company, Inc. 20
- Ashtrom-Cafritz 22
- Checchi & Company 329
- Cleveland Consulting Corporation 333
- Coverbond Corporation 345
- Development Research Associates 353
- F.C.H. Services, Inc. 370
- Hackett Housing Systems, Inc. 275
- International Research & Technology Corporation 423
- Institute of Public Administration 116
- Harold Lewis Malt Associates, Inc. 449
- McClaughry Associates, Inc. 446
- Mid-City Developers, Inc. 138
- Multi-Racial Corporation 464
- The Freeman Group 274
- Urban Design & Development Corporation 549
- Washington Center for Metropolitan Studies 557
- George Washington University 385

FLORIDA

Clearwater
- A.G. Smith & Associates 198

Fort Lauderdale
- Alpha-Plus Associates 6

Jacksonville
- William Morgan 463

Lake Wales
- Whitmire & Allen, Inc. 260

Miami
- Reditruss International, Inc. 494

Miami Beach
- Richard Allen Rose, Architect 502

Princeton
- Allied General Inc. 4

St. Petersburg
- Modumatic Building Units 462

Tampa
- Modumatic Building Units 462

FOREIGN

appendix III

ABSTRACTING PROCESS

GENERAL

The abstracting process scope included: (1) The extracting of information from the proposals; (2) Preparation of the information for publication and (3) Input for a housing technology information data base.

The systematized extraction of data from the proposals required a means of information classification that would allow handling of all proposal information, that would take into consideration the information needs of users and thereby indicate possible voids in the proposal information, and that would allow the inclusion of new types of housing system data that might develop from future HUD activities.

A review was made of existing information classification systems related to housing, building, and environmental design, and none was found to be sufficiently comprehensive. Consequently, a group of professionals, which comprised those who had developed relevant classification systems and those with a working knowledge of information systems, were invited to a meeting where the project objective was described and opinions and knowledge were sought as to the most feasible approach. The resulting discussion provided an extensive supply of information, knowledge, and advice.

Then, for the purpose of structuring the classification vehicle, a group of professional consultants and industry people having a wide range of expertise in various disciplines were brought together to develop the basic criteria for the classification vehicle. It was concluded that:

(1) The classification system ultimately should serve the widest possible range of potential users: those engaged in ownership and management, finance, planning and design, production/acquisition, distribution, marketing, regulation, and research/development, related to the housing field.

(2) The classification vehicle should be structured with flexibility to allow for storage and retrieval of various combinations of data.

Subsequently, a detailed classification outline was drafted which included characteristics dealing with such considerations as: application (adaptability, use, limitations, availability); economics (financing and costs); state of development; production/construction/marketing; properties (physical and other); and user, environmental, and community considerations.

After considerable drafting, series of detailed questionnaires (125 typewritten pages) was developed which covered the following areas: Site Systems; Building (Design) Systems; Subsystems (engineering considerations); Site and Building Mechanical Subsystems (plumbing, heating-ventilating-cooling, and electrical); Management/Production/Construction; Economics (costs and financing); and User/Environment/Community. These questionnaires were then used as a means for systematically extracting the information contained in the proposals.

The extraction was performed at HUD over a three-month period by a group of some 28 persons, including graduate students from several universities along with several professionals, working under careful supervision to insure accuracy and consistency. Teams were formed representing expertise in site planning, architectural design, structural and civil engineering, mechanical engineering, economics (for costs, financing, management, production and construction), and sociology. The extractors were briefed on the objective and the process, were cautioned about the propriety of the information contained in the proposals, and were instructed on the importance of reporting the information in the proposals specifically as it was given without personal interpretation or judgment exercised.

While the questionnaires were quite detailed and comprehensive, the proposals were not always so. In many cases, proposal information was scanty or ambiguous, which made difficult the task of stating the proposer's intentions in concise terms. In some cases, information in one part of the proposal conflicted with that in another part, and in other cases the concepts presented were so broad and nebulous that the specific intent of the proposer was unclear.

The extent to which the proposers responded to the HUD Request for Proposal (RFP) varied from broad comprehension and minute detail to brief one- or two-page statements. However, all released proposals, regardless of content, were included in the processing.

PUBLICATION PREPARATION

The volume of proposals and the need to include information on all of them in one publication limited the amount of space that could be devoted to each proposal. In order to cover the major points of each proposal and at the same time provide a method for quick reader comprehension of the significant details, a summary information chart was developed to accompany the written descriptions. Every precaution was taken so that all proposals would be treated consistently according to the amount of relevant data included.

The written descriptions were developed by a group of five professional construction industry writers working under close supervision. The writers were given access to the detailed questionnaires and to the brief, general, descriptive statements taken from each proposal. Concurrently, the same material was reviewed for data to be used in the summary information charts. The graphic materials accompanying the proposals were reviewed and appropriate selections made to be included in the finished publication.

Graphics included in the proposals ranged from exotic color photographs to working drawings, ozalid copies of pen sketches, printed brochure materials and even rough pencil sketches. Where adequate reproducibe illustrations were available, they were selected for this publication. If reproducible materials were not included, a special request was made of the proposer for suitable black and white prints. Because of space limitations, of course, many good illustrations could not be included. Since the publication was not intended as a vehicle for evaluating the systems and since the variety of living unit plans available was almost limitless, no floor plans were included unless they were necessary to describe the design concept or construction process.

The final step in the process was receipt from the proposer of approvals on the manuscript, summary information chart, and chosen illustrations. Proposers were asked to review the material and were instructed to make changes only where necessary to insure technical accuracy. For every proposal abstract in this publication, HUD has on file a release signed by a responsible officer of the proposer organization. Where the proposer, for proprietary or other reasons, preferred not to have his material included, only the proposer's name has been listed in the alphabetical index.

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appendix IV

PROTOTYPE SITE PROPOSALS

ALABAMA
- Tuskegee

ALASKA
- Fairbanks

ARKANSAS
- Little Rock (2)
- Pine Bluff
- Hope
- Maumelle
- Marvelle
- Marianna
- Mt. Ida

ARIZONA
- Tucson (2)

CALIFORNIA
- San Bernardino
- San Diego
- Long Beach
- Sacramento
- Oceanside
- Los Angeles County
- Rosemead
- Val Verde
- Montebello (2)
- Fresno
- Los Angeles (4)
- San Francisco

COLORADO
- Denver (4)

CONNECTICUT
- Stamford
- Hartford (2)
- Milford

DELAWARE
- New Castle County (2)
- Dover

DISTRICT OF COLUMBIA

FLORIDA
- Orlando
- Jacksonville
- Tampa (2)
- Deerfield Beach
- Hollywood
- Dade County
- Broward County
- Apopka

GEORGIA
- Macon (3)
- Atlanta (2)

ILLINOIS
- East St. Louis
- North Chicago
- Decatur
- Chicago (4)

INDIANA
- Anderson
- South Bend
- Indianapolis (10)
- Columbus
- Hammond
- Gary (3)
- East Chicago
- Evansville (3)
- Mishawaka
- Terre Haute
- Marion
- Ft. Wayne (2)
- Kokomo (3)

KANSAS
- Kansas City
- Newton

KENTUCKY
- Pikeville

MARYLAND
- Baltimore
- Simpsonville
- Damascus (3)
- Grasonville
- White Oak
- Germantown

MASSACHUSETTS
- New Bedford
- Springfield (2)
- Pittsfield
- Lynn (2)

MICHIGAN
- Alpena
- Alma
- Saginaw
- Muskegon Heights
- Grand Rapids
- Flint
- Port Huron
- Sterling Heights
- Walled Lake (2)
- Kalamazoo (5)
- Battle Creek (3)
- Monroe
- Detroit
- Bay City

MINNESOTA
- Winona
- St. Paul (7)
- Albert Lea (2)
- Jonathan

MISSISSIPPI
- Vicksburg
- Laurel

MISSOURI
- Kansas
- St. Louis (3)
- Kinloch
- St. Louis County (3)

NEBRASKA
- Grand Island
- Alliance
- Scottsbluff

NEW JERSEY
- Newark (2)
- Jersey City (4)

NEW MEXICO
- Albuquerque (4)

NEW YORK
- New York (4)
- Albany
- Rockaway
- Rome
- North Greenbush
- Syracuse
- Grand Island
- Staten Island
- Spencerport
- Brockport
- Peekskill

NORTH CAROLINA
- Raleigh (2)
- Newton
- Fayetteville
- High Point
- Winston-Salem
- Greensboro
- Hickory
- Durham
- Charlotte (2)

OHIO
- Lucas County
- Canton (3)
- Lucasville
- Cincinnati (3)

OREGON
- Portland

PENNSYLVANIA
- Philadelphia
- Danville

RHODE ISLAND
- Pawtucket

SOUTH DAKOTA
- Sioux Falls

TENNESSEE
- Memphis (3)
- Cookeville

TEXAS
- Fort Worth
- Houston

VERMONT
- Winooski

VIRGINIA
- Newport News
- Reston
- Woodbridge

WASHINGTON
- King County
- Seattle
- Mountlake Terrace
- Vancouver

WEST VIRGINIA
- Martinsburg
- Charleston

appendix V

PROTOTYPE SITE DESIGN AND RELATED SERVICES PROPOSALS

Abreu & Robeson, *Brunswick, Georgia*	Architects, Engineers
McLendon & Holbrook, Inc	Mechanical Engineers
Bush, May & Williams	Electrical Engineers
Harry Hunter & Associates	Structural Engineers
Jordon, Jones & Goulding	Site Engineers
T.M. Baumgardner & Associates	Landscape Architects
Adleman, Siegel, & Associates, *Philadelphia, Pennsylvania*	Architects, Planners, Landscape Architects
Albert C. Martin & Associates, *Los Angeles, California*	Planning, Architecture, Engineer
Anderson, Barker & Rinker, *Denver, Colorado*	Architects
THK Associates, Inc.	Planners
Frazier & Gingery	Engineers
Lee F. Johnson	Housing Consultant
Barton-Aschman Associates, Inc., *Chicago, Illinois*	Architecture, Planning Engineering
Beckman, Swenson and Associates, *Pittsburgh, Pennsylvania*	Planners, Architects
Behnke-Ness-Litten & Tkach, *Cleveland, Ohio*	Landscape Architects, Planners
Bovay Engineers, Inc., *Houston, Texas*	Engineers, Planners
Building Systems Development, Inc., *San Francisco, California*	Architects, Planners
Saski, Walker Associates, Inc.	Landscape Architects
Murray & McCormick, Inc.	Engineers
Burggraf and King, *State College, Pennsylvania*	Landscape Architects, Planners
Candeub, Fleissig and Associates, *Newark, New Jersey*	Planners, Community Development
Louis Gardner and Associates	Architects
A.W. Martin and Associates	Engineers
Vincent C. Cerasi	Landscape Architect
Carter & Burgess Inc., *Fort Worth, Texas*	Engineers, Planners
Caudill Rowlett Scott, *Houston, Texas*	Architects, Planners, Engineers
Cerf Stanford Ross, *Houston, Texas*	Architects, Planners
Wilbur Smith & Associates	Engineers
Bernard Johnson Engineers	Engineers
Bovay	Engineers
Cloethiel Woodard Smith & Associates, *Washington, D.C.*	Architects
Collins, Du Tot and Associates, *Philadelphia, Pennsylvania*	Planners, Landscape Architects
Louis Sauer Associates	Architects
Concept Environment, Inc., *Laguna, California*	Architecture, Planning
Conklin & Rossant, *New York, New York*	Architects, Planners
Control Data, Meiscon Division, *Chicago, Illinois*	Engineers
Carl L. Gardner and Associates, Inc.	Planners
Keck and Keck	Architects
Cornell, Howland, Hayes & Merryfield, *Seattle, Washington*	Engineers
John Morse & Associates	Architects, Planners
Daniel, Mann, Johnson & Mendenhall, *Los Angeles, California*	Planning, Architecture Engineering
David A. Crane, *Philadelphia, Pennsylvania*	Architects, Planners
David Volkert and Associates	Engineers
Cambridge Sevén Associates, Inc.	Design Graphics •
Cope, Linder, Walmsley	Landscape Architects
Alan M. Voorhees and Associates	Traffic Engineers
DeLeuw, Cather and Company, *Chicago, Illinois*	Engineers
Design International, Inc., *Notre Dame, Indiana*	
E.N. Turano, Architects, *New York, New York*	Architects, Planners
Eckbo, Dean, Austin & Williams, *San Francisco, California*	Landscape Architects, Planners
George S. Nolte, Inc.	Engineers
ERA, Incorporated, *Portland, Oregon*	Architects, Planners
Feloney and Sturgis, *Cambridge, Massachusetts*	Architects
Five Points Housing Consortium, *San Diego, California*	
Kenneth E. Anderson	Architect
A.J. Blaylock Associates	Engineers
Commercial Facilities, Inc.	Developers
Hazard Products, Inc.	Manufacturers
Nielson Construction Co.	Contractors
Rick Engineering Co.	Civil Engineers and Planners
Mosher Drew & Watson Associates	Architects
Flatow, Moore Bryan & Fairburn, *Albuquerque, New Mexico*	Architects, Engineers, Planners
W.E. Burk	
Gilbert Oliver, *San Francisco, California*	Architect
Wertheim & van der Ploeg	Landscape Architects
Gruen Associates, *Los Angeles, California*	Architecture, Planning, Engineering
Linesch and Reynolds	Landscape Architects
Hall & Goodhue, *Monterey, California*	Architects, Planners
Shuirman-Rogoway and Associates	Civil Engineers
Kenneth R. Anderson, Inc.	Landscape Architect
Harland, Bartholomew and Associates, *St. Louis, Missouri*	Planning, Engineering, Landscape Architecture
Harnish, Morgan & Cusey, *Ontario, California*	Architects, Planners
King & King	Civil Engineers
Erikson, Peters & Thoms	Landscape Architects
Thoraldson, Matthewson, Argabright & Doby	Electrical Engineers
Associated Consultants	Management Systems
Harold Lewis Malt Associates, *Washington, D.C.*	Urban Landscape Design
Brown, Wright and Mano	Planners
Henry Cohen Associates	Management Services
William R. Ewald, Jr.	Community Planning
Alexander Lurkis Associates	Site Engineering
Hellmuth, Obata & Kassabaum, Inc., *St. Louis, Missouri*	Architects
Howard, Needles, Tammen & Bergendoff, *Alexandria, Virginia*	Engineers
Jansons & Roberts	Architects
InterDesign Inc., *Minneapolis, Minnesota*	Architects, Planning, Landscape Architecture
Jack Sidener, *Honolulu, Hawaii*	Architect, Planner

John S. Bolles *San Francisco, California*	Architects, Engineers, Planners
Kendree and Shepherd *Pittsburgh, Pennsylvania*	Planners, Architects, Engineers
Keyes, Lethbridge & Condon *Washington, D.C.*	Architects
Mr. Carl Feiss	Planning and Urban Design
Eberlin and Eberlin	Civil Engineers
Frank J. Sullivan Associates	Mechanical Engineers
Environmental Programs, Inc.	Human Behavior and Urban Design
Kivett and Myers *Kansas City, Missouri*	Architects, Planners
KRS Associates *Reston, Virginia*	Planners
Laurence E. & Beatriz de Coff Coffin *Washington, D.C.*	Landscape Architects
Groll, Astore and Koerner, Inc.	Architects, Planners
Fry & Welch Associates	Architects
Lee Potter Smith, Pritchett, Hugg and Carter *Frankfort, Kentucky*	Architects, Engineers
Lee, Schnadelbach *Washington, D.C.*	Architects, Landscape Architects
Leo A. Daly Company *Omaha, Nebraska*	Architecture, Engineering Planning
Lutes and Amundson, AIA *Springfield, Oregon*	Architects, Planners
Crittenden Cassetta Wirum and Connon	Architects
Oda/McCarty	Architects
Clark & Groff	Engineers
Balzhiser & Colvin Engineering	Mechanical Engineers
Pederson & Associates	Cost Control and Management
Mitchell & McArthur	Landscape Architects, Planners
Manuossoff Associates *New York, New York*	Engineers, Architects
Miller, Wihry & Brooks *Louisville, Kentucky*	Landscape Architects, Engineers
Louis and Henry	Architects
Nathan C. Hale Associates *Bailey's Crossroads, Virginia*	Architects, Engineers
KRS Associates, Inc.	Planners
William H. Potts, Jr.	Landscape Architect
Parsons, Brinckerhoff, Quade & Douglas, Inc. *New York, New York*	Engineers, Architects Planners
Perkins and Will Architects *Chicago, Illinois*	Architects, Planners, Engineers
Rahenkamp Sachs and Associates, Inc. *Philadelphia, Pennsylvania*	Planners, Landscape Architects
Reynolds, Smith and Hills *Jacksonville, Florida*	Architects, Engineers, Planners
Richard E. Martin and Associates *Philadelphia, Pennsylvania*	Architects, Planners
Bennett Levin and Associates	Mechanical and Electrical Engineers
Site Engineers, Inc.	Soils and Civil Engineers
Wheelwright, Stevenson and Langran	Landscape Architects and Planner
The Mendell Group	Management Systems
Richard P. Browne Associates *Columbia, Maryland*	Engineers, Planners
Urban Research Design Associates	Architects, Planners
Martin Funnell	Landscape Architect
Heineman Associates	Management Services
Robert and Company Associates *Atlanta, Georgia*	Architects, Engineers
Robert Martin Englebrecht and Associates *Princeton, New Jersey*	Architects
Royston, Hanamoto, Beck and Abey *San Francisco, California*	Landscape Architects, Planners
RTKL, Inc. *Baltimore, Maryland*	Architects, Planners
Dewberry, Nealon & Davis	Engineers
M. Paul Friedberg & Associates	Landscape Architects
Rivkin/Carson, Inc.	Community Structure
Russell & Axon, Inc. *Daytona Beach, Florida*	Consulting Engineers
W.R. Gomon and Associates	Architects
DeWitt McGee & Associates	Planning & Development
Walter Snead, Jr.	Landscape Architect
Scruggs and Hammond, Inc. *Lexington, Kentucky*	Landscape Architects, Planners
Chrisman, Miller and Wallace	Architects
G. Reynolds Watkins, Inc.	Engineers
Bruce Kunkel and Associates	Engineers
Leggett and Irvan	Engineers
Simonds and Simonds *Philadelphia, Pennsylvania*	Landscape Architects
Skidmore, Owings & Merrill *Washington, D.C.*	Architects, Engineers
Marcou & O'Leary	Community Relations
Jesperson-Kay Systems, Inc.	Building Systems
Stonorov and Haws *Philadelphia, Pennsylvania*	Architects, Planners
Stottler Stagg and Associates *Hyattsville, Maryland*	Architects, Planners
Brevard Engineering Company	Engineers
Technical Planning Associates *New Haven, Connecticut*	Planning, Architecture, Engineering
Uniplan *Princeton, New Jersey*	Architects, Engineers, Planners
A.E. Bye Associates	Landscape Architects
Victor Shrem and Associates *Detroit, Michigan*	Architects, Planners
Siegal Avrin Associates, Inc.	Architects
Hubbell, Roth & Clark Inc.	Consulting Engineers
Eichstedt, Grissim, Young & Associates	Landscape Architects
Levin Kovacs & Associates, Inc.	Engineers
Vollmer Associates *New York, New York*	Engineers, Architects, Landscape Architects
William A. Gould and Associates *Cleveland, Ohio*	Architects, Planners
William A. Hall *New York, New York*	Architecture, Planning
William Morgan Architect *Jacksonville, Florida*	Architects
William S. Lawrence & Associates *Chicago, Illinois*	Planners, Landscape Architects
Wilsey and Ham *San Mateo, California*	Planning, Architecture, Engineering
Wong & Tung & Associates *Dallas, Texas*	Architects, Engineers
Turnbull, Inc.	Engineers
Woollen Associates *Indianapolis, Indiana*	Architects
Midwest Associates for BREAKTHROUGH	
Browning-Day Associates	Landscape Architects, Planners
Mid-States Engineering Company	Engineers
Wurster, Bernardi and Emmons, Inc. *San Francisco, California*	Architects
Lawrence Halprin & Associates	Landscape Architecture
Wilber Smith and Associates	Traffic Engineering
Gilbert-Forsberg-Kiekmann-Schmidt	Engineers
Dames and Moore	Soils Engineering
Larry Smith and Company, Inc.	Economics and Marketing
Dr. Cyril Roseman	Urban Sociology
G. Dean Smith, Inc.	Graphics and Public Information
Organon & Associates	Estimators, Planners
Y.C. Wong & Associates *Chicago, Illinois*	Architect

(Received under Operation BREAKTHROUGH Request for Proposals No. H-9-70, U.S. Dept. H.U.D., August, 1969.)

appendix VI

APPLICANTS FOR CONTRACTS AS SITE DEVELOPERS

Alodex Corporation, Memphis, Tenn.
Applied Information Industries, Moorestown, N.J.
AVR Development Corporation, Yonkers, N.Y.
Mrs. Jody Baker, Chevy Chase, Md.
The Bay Company Milwaukee, Wisconsin
Bechtel Corporation, Vernon, Calif.
The Boeing Company, Seattle, Wash.
M.J. Brock & Sons, Inc., Sacramento, Calif.
Brown, Gildenhorn & Statland, Washington, D.C.
Brown & Kauffmann, Inc., Palo Alto, Calif.
Callas Contractors, Inc., Hagerstown, Md.
Campbell Construction Company, Sacramento, Calif.
Century Construction Company, Seattle, Wash.
CEC (Computer Engineering Corporation), Cape Kenedy, Fla.
H.L. Coble Construction Company, Greensboro, N.C.
College Park Corporation, Indianapolis, Ind.
Double "S" Construction Company, Philadelphia, Pa.
Draper and Kramer, Chicago, Ill.
ECCO, Columbus, Ohio
Engineering Marketing Assn., San Jose, Calif.
Falender Homes Corporation, Indianapolis, Ind.
Federal Projects, Inc., Sacramento, Calif.
Fickling & Walker, Inc., Macon, Ga.
Friendswood Development Co., Houston, Texas
Gentry Development Co., Danville, Calif
Stanley Glantz, St. Louis, Mo.
Goldrich & Kest, Los Angeles, Calif.
Healy Brothers, Inc., Tacoma, Wash.
Housing Development Company, Cleveland, Ohio
Investors Mortgage Service, Inc., Memphis, Tenn.
Jaxon Construction Co., Cincinnati, Ohio
J.D. Construction Corporation, Cresskill, N.J.
Johns Manville Products Corporation, Manville, N.J.
Kayfield Construction Co., Great Neck, N.Y.
Kennedy-Brown-Trueblood Architects, Indianapolis, Ind.
Larwin Company, Beverly Hills, Calif.
League Housing Foundation, Detroit, Mich.
G.R. Leischner Construction Co., Seattle, Wash.
Lippman Associates, Indianapolis, Inc.
MACRO-Housing, Alexandria, Va.
McGrath Corporation, Bellevue, Wash.
Frank Mercede & Sons, Inc., Ft. Lauderdale, Fla.
Mid-City Developers, Inc., Washington, D.C.
Midwest Research Institute, Kansas City, Mo.
Millstone Construction, Inc., St. Louis, Mo.
Mission Viejo Co., Mission Viejo, Calif.
MON Plaza, Inc., Pittsburgh, Pa.
National Corporation for Housing Partnerships, Washington, D.C.
Norman Enterprises, Inc., Houston, Texas
OGO Associates, Los Angeles, Calif.
Pacific Cascade Properties, Inc., Seattle, Wash.
Phoenix Concepts, Phoenix, Ariz.
Sheldon L. Pollack Corporation, Los Angeles, Calif.
Robert C. Powell Properties, Sacramento, Calif.
Redevelopment Associates, Inc., Iselin, N.J.
The Rust Engineering Company, Birmingham, Ala.
Robert Sellers & Associates, Garden City, N.Y.
Bert L. Smokler & Co., West Southfield, Mich.
Soble Construction Co., Pleasantville, N.J.
Sproul Construction Corporation, Orange, Calif.
Taylor-Mazza, Inc., Sacramento, Calif.
Tenmen Enterprises, Inc., St. Albans, N.Y.
URS Systems Corporation, Washington, D.C.
USDC (Urban Systems Development Corporation), Arlington, Va.
VIS (Volt Information Sciences, Inc.), Washington, D.C.
Leon N. Weiner & Associates, Inc., Wilmington, Del.
Weir Development Co., Inc., Dayton, Ohio
The Whiting-Turner Contracting Co., Baltimore, Md.

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appendix VIII

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