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OPERATION
BREAKTHROUGH

U.S. Department
Housing and Urban
Development

PHASE II

PROTOTYPE
CONSTRUCTION
AND
DEMONSTRATION

VOLUME

4

OPERATION break-through

PHASE II : PROTOTYPE CONSTRUCTION AND DEMONSTRATION

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
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Preface

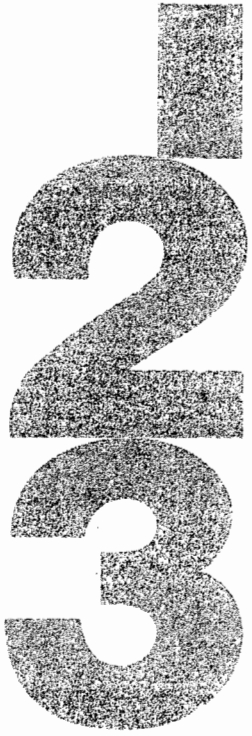
The Department of Housing and Urban Development launched Operation BREAKTHROUGH in 1969 to stimulate volume production of quality housing for all income levels. Factory building offered a logical means—then as it does now—for the housing industry to grow and progress. We set ambitious objectives for that growth.

BREAKTHROUGH tested many techniques of industrialization. Significantly, it began to measure the effect of such traditional restraints as building codes, zoning laws, labor practices, and transportation methods. The energy and imagination shown by thousands of people who participated in the program likely will stand as a milestone in our housing history.

This report, part of the Feedback series, covers an important period in that history. It describes various Phase II BREAKTHROUGH activities related to development of the nine demonstration sites, giving prominence to the role played by the Prototype Site Developers. Useful information is furnished for all professionals concerned with the future of factory building. But the book does more, giving the interested layman an appreciation of housing, of industrialized housing particularly, and of the government-private enterprise efforts to improve the housing process through Operation BREAKTHROUGH. Nowhere is the BREAKTHROUGH endeavor more visible than at the prototype sites, where the practicality of different systems has been tested, in settings that illustrate how well the land can be developed for a variety of dwellings and life styles.

Much can be learned from BREAKTHROUGH, which some have called "a unique laboratory for continuous research." By publishing this and other Feedback volumes, HUD seeks to bridge the gap between federally aided research and marketplace adaptation, thereby furthering the national goal of a decent home for every American.

Michael H. Moskow
Assistant Secretary
Office of Policy Development and Research



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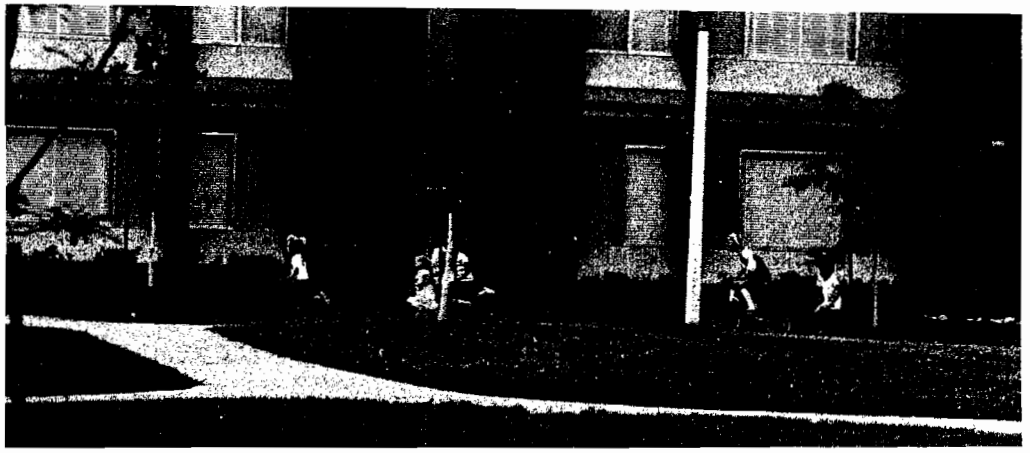


Fig. 1—At home with BREAKTHROUGH

General

The purpose of this report, part of the Project Feedback series, is to describe the nine Operation BREAKTHROUGH prototype sites and tell how they were built.

Operation BREAKTHROUGH is this country's first large-scale systematic housing demonstration program, featuring the public demonstration of innovative house designs and site plans. The U.S. Department of Housing and Urban Development (HUD) initiated BREAKTHROUGH to encourage more use of industrialized methods. It put these advanced ideas on trial, in prototype form, at nine locations. HUD chose the sites from among many nominated by local and state governments to represent a variety of market conditions. Urban, peripheral, suburban, and semi-rural neighborhoods are the settings for nearly 3,000 housing units built between 1971 and 1973. Development was the responsibility of eight Prototype Site Developers (PSDs), who were basically managers with a wide range of tasks, from land acquisition to marketing. Developers brought to this job an unusual array of capabilities; some of the management techniques applied in BREAKTHROUGH were new to the housing industry.

Ground was broken on the first prototype sites in late 1970. Since then, construction at all nine sites has been completed and most units are occupied and in private ownership. It may be early to draw final conclusions about Operation BREAKTHROUGH, but some results already are evident. The accelerating trend toward factory-built housing, in the words of HUD Secretary James Lynn, "is indicative of the impact Operation BREAKTHROUGH had on stimulating the growth of the industry by cracking some of the building, zoning, labor, and other constraints that traditionally restricted the acceptance of industrialized techniques."

Fig. 2—HUD Secretary James Lynn

BREAKTHROUGH has tested industrialized housing systems in assorted settings and a number of ways. Some designs are good and have entered successfully into the marketplace; others contained flaws exposed by the prototype stage. The corrective changes will inevitably improve the product.

Public awareness and acceptance of systems building have increased markedly, with a new recognition on the part of government agencies, labor unions, and the building industry. BREAKTHROUGH demonstrated alternative methods of transportation, and more favorable regulations and rate structures have been instituted. About 30 states have adopted laws that broaden the uses of factory-built houses and components, replacing the multiplicity of local codes with uniform statewide regulations. The Operation BREAKTHROUGH guide criteria prepared by the National Bureau of Standards further encouraged new materials and techniques; these technical performance standards can be used to evaluate innovative concepts that could not be considered under ordinary building codes.

Lessons are emerging from the developer function, too, particularly in the areas of project coordination and community relations. BREAKTHROUGH's principal participants have gained significant cost experience with site development and housing production; the information they have obtained shows that accurate estimates can be made of future applications for the various systems.

The publicity given to BREAKTHROUGH and the tangible fact of the prototype sites attracted attention to housing as a problem and to industrialization as one possible solution. Because they are so visible, the sites, in their general excellence, are among the most convincing accomplishments of the program. From design through to completion, these nine sites represent the best in land use concepts, architectural planning, and development.

Fig. 3—The nine prototype sites

The BREAKTHROUGH Program

Better housing is a national goal. To fulfill the promise made in the 1968 Housing Act of "a decent home and a suitable living environment for every American family," HUD estimated that 26 million more new or rehabilitated housing units would be needed in the 10 years beyond 1968. This target seemed out of the reach of the established housing industry, which had peaked at 2 million new unit "starts" in 1959 and had averaged 1.6 million units annually since then. Plainly, the pace of home building had to be increased (Fig. 4).

Many factors—financing, labor and material shortages, land costs, local codes, and others—limited production. HUD analyzed these and found that many of the restraints were artificial, the results of overly cautious leadership. HUD Secretary George Romney and his staff conceived the idea of "breaking through" these barriers; Operation BREAKTHROUGH was their suggested approach for encouraging volume production of housing.

The program was outlined early in May 1969 at meetings held by HUD with members of the building industry, labor unions, and state and local governments. Secretary Romney discussed the economic problems of housing production; Under Secretary Richard C. VanDusen spoke about funding, the past production record, and market aggregation; and Harold B. Finger, Assistant Secretary for Research and Technology, explained the technical details of Operation BREAKTHROUGH.

Although BREAKTHROUGH would stimulate a wide range of new ideas, house designs and land use received the main emphasis. Greater standardization of housing components, including prefabricated sections and modules, was expected. HUD proposed a

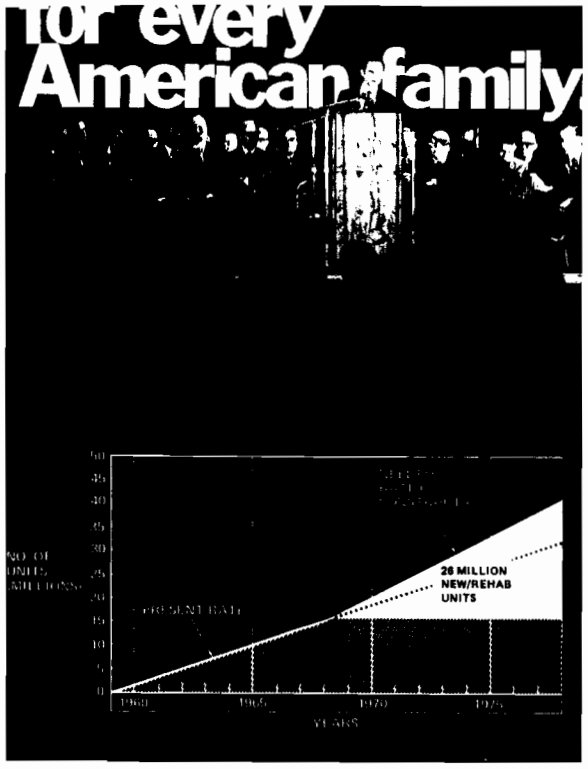


Fig. 4—Forecast of U.S. housing needs

Fig. 5—Former HUD Secretary Romney meets subcontractors

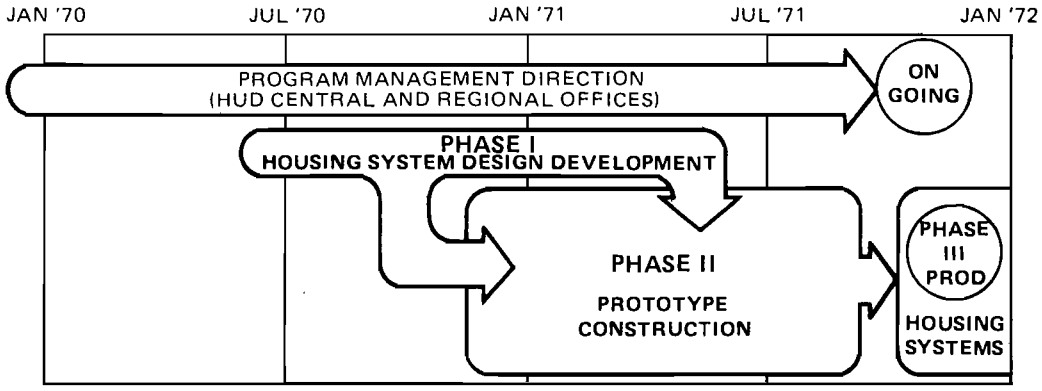


Fig. 6—Planned phasing of the BREAKTHROUGH program

competition for innovative housing system concepts, the best of which would be partially funded during design and evaluation.

Evaluation would be combined with prototype construction. There should be enough housing prototypes to check cost estimates on various production levels and to test a whole site environment. The prototypes also would demonstrate the marketability of innovative housing. Assistant Secretary Finger said:

> "Our plan is to have eight regional prototype sites, on which we would locate various housing concepts proposed to us, selecting those that are realistically suitable for various regions. The prototypes must be built in fairly large numbers. Each of the sites should have enough housing of a given general model or general production approach and environmental setting to evaluate the structure of the house, its durability, safety, attractiveness, and its marketability, as well as the general environmental arrangements.
>
> We would be mixing models in each of these prototype sites and, therefore, we have the problem of good site design. The site shouldn't look like an *ad hoc* mixture of different designs that doesn't give a fair test of the environmental aspect of each of them."

The sequence planned for the BREAKTHROUGH program was to start with a proposal preparation period followed by HUD's evaluation and selection of prototype designers and developers. Market aggregation data would be assessed to help define the prototype sites. After the locations were chosen for the prototype developments, there would be a design phase, followed by construction. Testing and evaluation of the building concepts would be continuous during these other activities. The National Bureau of Standards would prepare guide performance criteria against which the BREAKTHROUGH design calculations could be checked and key components physically tested.

Three steps to the implementation of BREAKTHROUGH were designated:

Phase I	Design and Development
Phase II	Prototype Construction
Phase III	Production

From an anticipated start in late 1969 or early 1970, HUD hoped that Phases I and II could be completed in two years (Fig. 6). The application of the newly proven concepts to high-volume production would take longer; how long, no one could predict. While under development, BREAKTHROUGH prototypes would not be cheaper than conventional units, but if these housing systems reached production, costs should come down. Most important, the capacity to build housing in the United States would be significantly increased.

Site Selection

In the summer of 1969, HUD invited state and local officials and private developers to propose locations for BREAKTHROUGH prototype sites. Sites were to range from 5 to 30 acres, be accessible to major transportation and hotel centers, have utilities —or provisions for them—near the site boundaries, and be zoned with sufficient flexibility to allow HUD to determine the land use plans appropriate for the demonstration objectives.

Proposals were solicited by a letter with an attached questionnaire to elicit essential facts about the site: general description, topography, land use, codes and regulations, community facilities, utilities, market conditions, taxes, and labor. Each site proposer was expected to have official endorsement and assurance of local cooperation from responsible agencies. The deadline for proposal submittal was September 19, and by that date, 218 proposals were received, nominating 141 localities in 37 states and the District of Columbia (Fig. 7).

A 30-member Operation BREAKTHROUGH Prototype Site Evaluation Board drawn from various HUD agencies and several other federal departments reviewed the proposals. The Director of Market Aggregation for Operation BREAKTHROUGH served as chairman.

Initial review and comments regarding each proposal came from the appropriate regional HUD office, backed by site inspections and evaluations by FHA engineers and appraisers. An initial screening eliminated 88 nominations that did not meet basic prototype site requirements. The remaining sites were then cataloged by general characteristics (geographical

census region, climate, natural exposure, metropolitan location, density, housing type, ethnic mix, economic mix), and an initial evaluation was made based on 26 weighted factors. The proposals were rank-ordered, and a report was given to the Assistant Secretary for Research and Technology on October 10.

Secretary Romney approved visits by survey teams to 73 sites located in six HUD regions. Seven teams were organized, and each was briefed by a regional office before visiting the sites in a particular region. Following these inspections, the board made a final evaluation. Based on the site visits, regional office comments, and proposal data, the board deleted 26 nominations and reranked the balance. A refined rating system with 34 weighted factors was used this time.

The next step was to consider the 47 survivors for grouping into two sets of 8 plus the 10 next best as substitutes, making a total of 26, and eliminating the rest. Despite the care with which guidelines were developed, the work still called for difficult judgments. The sets were assembled on the basis of scores and representational variety in climatic and market characteristics. The eight sites making up a set complemented one another in such a way that the total was a well-balanced combination of factors typical of the U.S. housing market. A broad geographical representation was achieved by distributing the eight sites throughout the HUD regions.

By November 12, the site evaluation board completed its task. It recommended 26 sites, deeming any one of the selections acceptable for prototype development:

(A) First set of eight:
- Jersey City, New Jersey
- Baltimore, Maryland
- Macon, Georgia
- North Chicago, Illinois
- St. Louis, Missouri
- Fort Worth, Texas
- Sacramento, California
- King County, Washington

(B) Second set of eight:
- Pittsfield, Massachusetts
- New Castle County, Delaware
- Greensboro, North Carolina
- Kalamazoo, Michigan
- Indianapolis, Indiana (prime site)
- Little Rock, Arkansas
- Denver, Colorado
- San Diego, California

(C) Third group of 10 substitutes:
- Reston, Virginia
- Dade County, Florida
- Memphis, Tennessee
- Battle Creek, Michigan
- Decatur, Illinois
- Indianapolis, Indiana (alternate site)
- Gary, Indiana
- Houston, Texas
- Albuquerque, New Mexico
- Tucson, Arizona

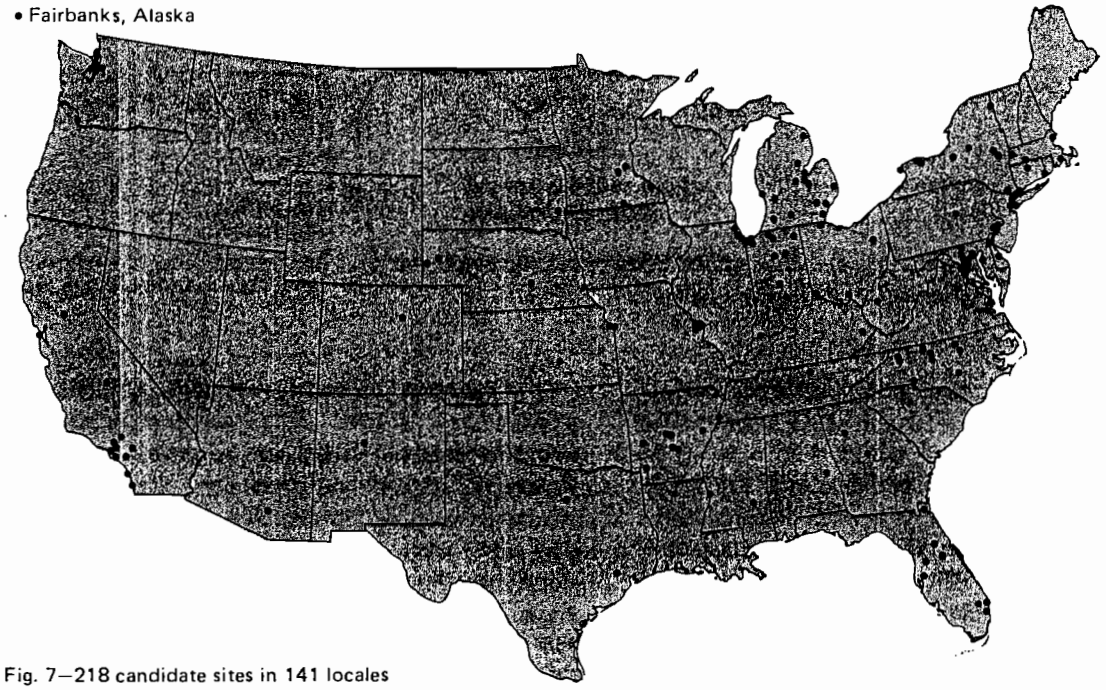


Fig. 7—218 candidate sites in 141 locales

The board reported its findings to Secretary Romney, who, during the next month, had responsibility for assessing all the evidence and making the final choices.

Local authorities were required to supersede earlier expressions of interest with firm commitments for cooperation. It was also necessary for the board to confirm that the properties were indeed available.

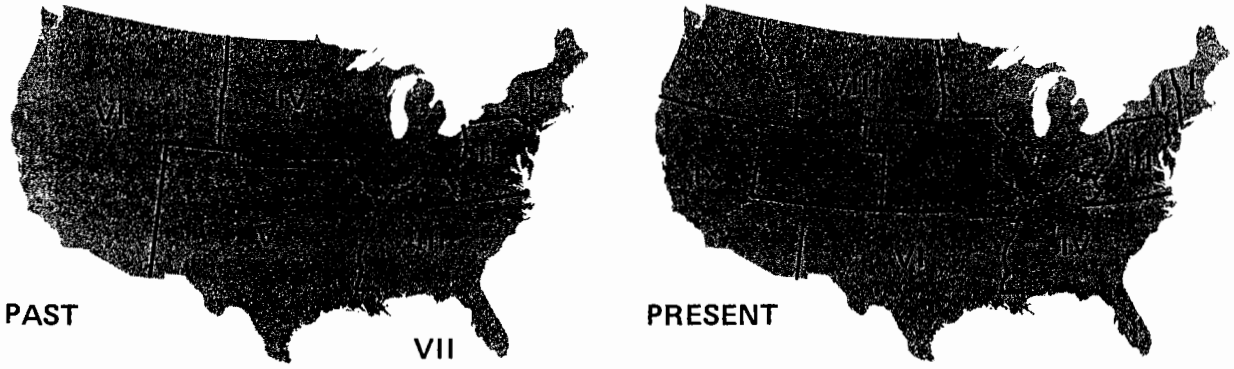


Fig. 8—HUD regional organization

At this same time, HUD was planning a major reorganization in which the regions would be realigned as well as increased from 7 to a total of 10 (Fig. 8).

On December 16, the Secretary announced that negotiations would be conducted with the proposers and local officials at Jersey City, Macon, St. Louis, Sacramento, New Castle County (Wilmington), Kalamazoo, Indianapolis, and Memphis. He stated that consideration was still being given to sites in the States of Texas and Washington.

Within the next month, Houston (Harris County) and King County were added to the list of prototype sites, which now numbered 10. Actually, there was an 11th location, Seattle, but at the outset it was regarded as an urban subsite of King County in order to allow a wider variety of housing types to be demonstrated in the Pacific Northwest.

In size, the sites range from under 2 to 50 acres. The urban sites, mostly in densely settled downtown areas, are part of existing urban renewal projects. Peripheral sites lie near the outskirts of major cities, adjacent to settled neighborhoods and established services. Suburban sites are at the edges of smaller cities or in unincorporated metropolitan county areas where residential subdivisions are developing.

Participants and Organization

Only a strong partnership of government and private enterprise could attempt the demanding job of designing and constructing prototype housing systems on Operation BREAKTHROUGH sites across the country. On June 23, 1969, HUD sent requests for proposals to several thousand companies that had shown interest in the competition for BREAKTHROUGH housing design contracts. Of these, 601 responded.

Meanwhile, proposals were also solicited for Prototype Site Planners (PSPs). Eighty-two firms replied by September 26, 1969, and 11 were chosen on December 16. The multidisciplinary teams selected for the site planning and design work were primarily architects, engineers, and landscape architects, with professional support from other areas. Principals and associates of each team were appropriately registered and held memberships in national professional societies.

Of course, the designers did not know the actual sites when they prepared their proposals. Announcements of sites and corresponding PSPs were made on the same day. On January 26, 1970, HUD named the 11 assignments (Fig. 9), including Seattle city, then gaining recognition as a separate site. The evaluation board chose teams generally in the same geographical region as the sites to which they were assigned; however, only the St. Louis and Houston sites were planned by firms in the same metropolitan areas.

PSPs were contractually required to accomplish four tasks:

- Task 1 covered site investigation and conceptual planning. As part of this task, the PSPs assisted HUD with making tentative assignments of housing producers to sites
- Task 2 was preliminary design, including analysis of the housing systems and preparation of plans showing different types of layouts of structures on the sites
- Task 3 consisted of developing working drawings for streets, utilities, and community facilities, including landscaping
- Task 4 involved inspection of site construction

Task 1 reports were due March 16, 1970. HUD reviewed the alternative conceptual designs suggested by the PSPs as well as selected site plan concepts. By that time, the 22 housing producers had been announced, and the matching of systems to sites began. Each producer was expected to build on more than one site, and each site was to include a variety of dwelling types, single family and multi-family.

After a thorough evaluation period, the Housing system Producer (HSP) finalists had been reduced to 37 in December, and selection of 22 HSPs was announced on February 26, 1970 (Fig. 10). HUD entered into Phase I contracts with these companies for a six-month design period.

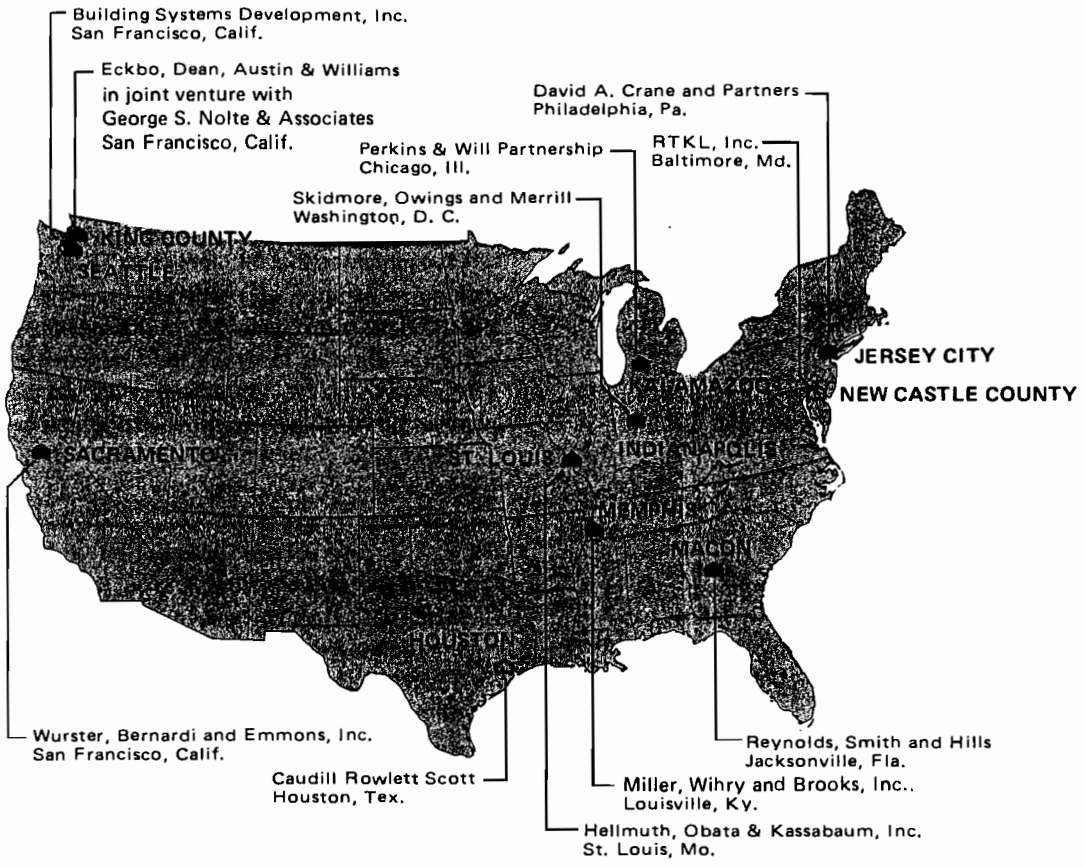


Fig. 9—Assignments of Prototype Site Planners

Actual development of the sites would be the job of developers under contract to HUD. A team of producers, planners, developers, and officials of HUD and the National Bureau of Standards was being assembled from industry and government to do what no participant could do alone.

Activity within HUD grew steadily as the scope of BREAKTHROUGH expanded. The program organization, under Assistant Secretary for Research and Technology Harold B. Finger (later under Assistant Secretary for Policy Development and Research Michael Moskow), included central and regional offices. At Operation BREAKTHROUGH—Washington, D.C. (OBW), as shown by Figure 13, five staff functions supported Program Director Alfred Perry (succeeded by Arthur Newburg in 1972 and Joseph Sherman in 1973). Government Technical Representatives (GTRs) on this staff had project responsibilities, directing the work of the site planners, housing producers, and site developers in accordance with contract terms.

Each HUD region where a prototype site was located had an Operation BREAKTHROUGH regional office (OBR) with a director and staff. OBR, assigned a Site Technical Representative (STR) to each site as a coordinator to provide continuous on-site representation. The STR, a professional engineer, had charge of inspection and acceptance of all

Aluminum Company Of America, Pittsburgh, Pa.
*Alcoa Construction Systems, Inc.

Ball Brothers Research Corporation, Boulder, Colo.
*Pantek Corporation

Henry C. Beck Company, Atlanta, Ga.
*Building Systems International

Boise Cascade Corporation, Boise, Ida.
*Boise Cascade Housing Development

Christiana Western Structures, Inc., Los Angeles, Calif.

Descon/Concordia Systems, Ltd., Montreal, Canada
*Descon Systems, Ltd.

Forest City Enterprises, Inc., Cleveland, Ohio
*FCE-Dillon, Inc.

General Electric Company, Philadelphia, Pa.

Hercules, Inc., Wilmington, Dela.
*Hercoform Marketing, Inc.

Home Building Corporation, Sedalia, Mo.

Keene Corporation, New York, N. Y.
*Townland Marketing and Development Corporation

Levitt Technology Corporation, Lake Success, N. Y.

Material Systems Corporation, Washington, D. C.

Module Communities, Inc., Yonkers, N. Y.
*CAMCI, Inc.

National Homes Corporation, Lafayette, Ind.

Pemtom, Inc., Bloomington, Minn.

Republic Steel Corporation, Youngstown, Ohio

The Rouse-Wates Company, Columbia, Md.

Scholz Homes, Inc., Toledo, Ohio

Shelley Systems, Inc., San Juan, Puerto Rico

Stirling Homex Corporation, Avon, N. Y.
(did not build)

TRW Systems Group, Redondo Beach, Calif.
*Community Technology Corporation

*Name of firm that carried out Phase II HSP role

Fig. 10—The 22 selected Housing System Producers

Fig. 11—Assistant Secretaries 1) Finger, 2) Moskow

Fig. 12—Program Directors 1) Perry, 2) Newburg, 3) Sherman

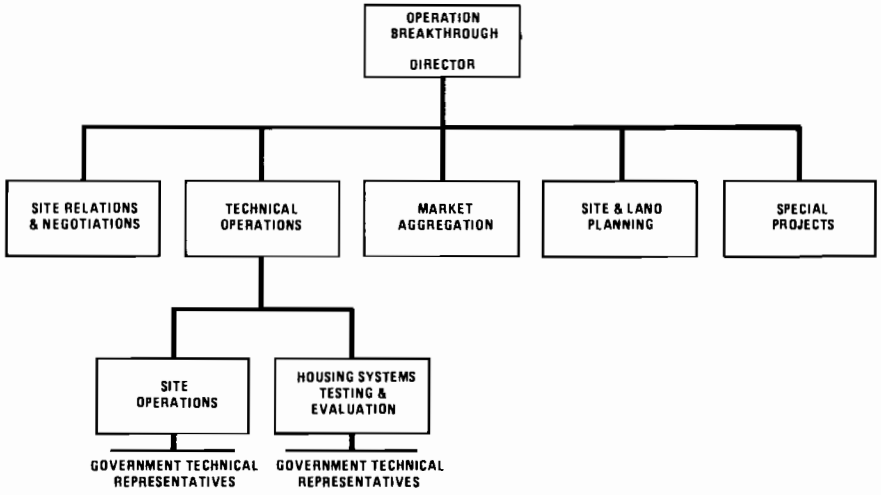


Fig. 13—Operation BREAKTHROUGH organization

work. He was the first-level supervisor of the developer's site activities, and was assisted by PSD inspectors who carried out day-to-day inspections.

Many OBR responsibilities were of a liaison nature based on "counterpart" direction from OBW, and relied for main support on existing regional HUD/Federal Housing Administration staffs. Each OBR consisted of a director, program assistant, market aggregation officer, STR, program control specialist, and contract administrator. The latter was the Administrative Contracting Officer (ACO) specified by public law, with authority delegated by HUD Central Contracts and Agreements Division to administer existing BREAKTHROUGH contracts with firms in his assigned area. His responsibility extended to new contractors with whom he negotiated as the program advanced.

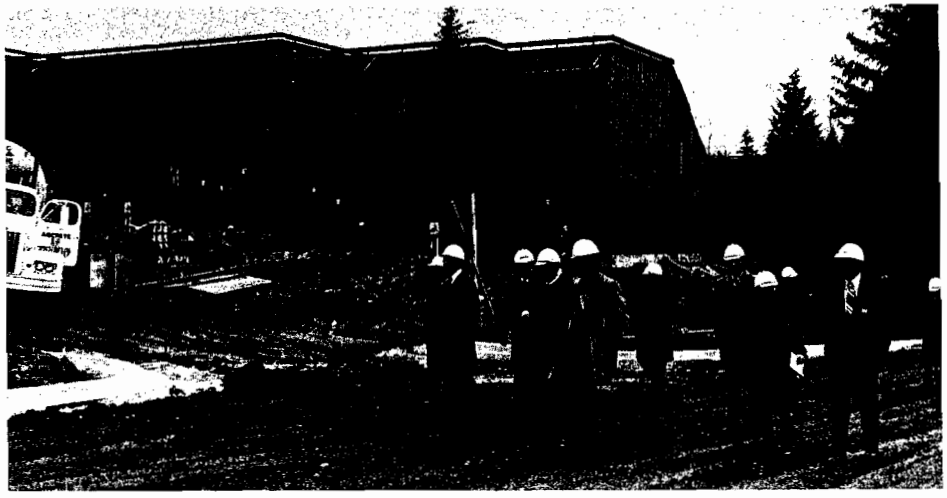


Fig. 14—BREAKTHROUGH officials at construction site

1 2 3 Prototype Site Developer Role

Prototype Site Developer Role

Fig. 1—Prototype Site Developer tasks

Origin

The role of the Prototype Site Developer as a manager of the on-site construction in Phase II of Operation BREAKTHROUGH was conceived in the late fall of 1969 as a mechanism to handle the overall construction and development of the Phase II prototype sites. At the time, HUD was completing selection of the Housing System Producers (HSPs) and Prototype Site Planners (PSPs). One of the functions of the PSPs was to design the general site plan, providing for specific local plans around each of the HSP areas. HUD had initially considered direct local contracting to complete the general site development, but as the various aspects of the prototype sites became more clearly understood, the need for a single point of responsibility became obvious.

The decision to utilize the PSD concept presented both advantages and problems to HUD. In addition to providing a single-point responsibility for contracting and coordination of the HSP construction, the PSD served as the marketing agent to dispose of the site on the open market. On the other hand, an entirely new form of Federal contract had to be developed whereby HUD provided the funding for the third-party contracts and was able, if necessary, to step in and relieve either the PSD or an HSP of responsibility under their respective contracts.

Proposals

The *Federal Register*, April 18, 1970, published an invitation for applicants for Prototype Site Developers (PSDs). It solicited developers for 10 prototype sites. (Seattle and King County were considered a combined site.) Interested companies were asked to apply within 15 days, giving their qualifications for the job at a BREAKTHROUGH site or sites of their choosing. The solicitation stated:

> "HUD is interested in obtaining the services of private developers for Housing Developments under 'Operation BREAKTHROUGH' at ten sites in ten states across the country. The developers will be responsible to HUD for overall development and coordination of activities from initial land acquisition through ultimate disposal. The contractor will be acting as Developer, Builder, Manager, Mortgager, Seller—except that his fee, allowance and function will be prescribed under a cost-plus-fixed-fee contract with HUD rather than under the rules applicable to mortgage financing or investment."

Provided with the invitation was a brief but thorough scope of work with explanations of program relationships, funding sources, and schedule plans. It also carried the following statement by HUD Secretary George Romney:

> "The public exigency requires immediate contracting for services of prototype site developers by negotiated contracts. In making the selection of prototype site developers, HUD will be looking primarily for the strength of the organization's professional ability in the fields referred to and its experience and reputation in the particular geographic area of the site for which the organization is applying. The applicant may apply for more than one site or HUD may ask the applicant to consider more than one site or to consider a site other than the one for which he has applied."

HUD received 68 responses to the invitation. Some firms were asked for more specific responses, keyed

to evaluation criteria, in mid-May. Two weeks later, finalists participated in oral interviews.

The PSD proposal evaluation board chaired by the BREAKTHROUGH director, made recommendations to the selecting source official.

Contract Awards

On July 6, HUD announced the award of the first PSD contract. The eight developers, named between then and August 19, were as follows:

- The Boeing Company—King County and Seattle
- Volt Information Sciences—Jersey City
- Urban Systems Development Corporation in association with the College Park Corporation—Indianapolis
- Alodex Corporation—Memphis
- Fickling and Walker, Inc. in joint venture with National Corporation for Housing Partnership (NCHP)—Macon
- Bert L. Smokler & Company in joint venture with NCHP—Kalamazoo
- Campbell Construction Company in joint venture with NCHP—Sacramento
- Millstone Construction, Inc. in joint venture with Millstone Associates, Inc.—St. Louis

Developers for two other sites—Houston and New Castle County—were never chosen because congressional budget cuts forced cancellation of the sites early in August.

The funding crises arose when Congress approved a total of $30 million for HUD research and technology in Fiscal Year 1971. For that period, President Nixon had requested $55 million, of which $35 million had been planned for BREAKTHROUGH. With the program funding reduced for Fiscal Year 1971, HUD made the difficult decision to sacrifice two sites but keep the rest of the program essentially intact.

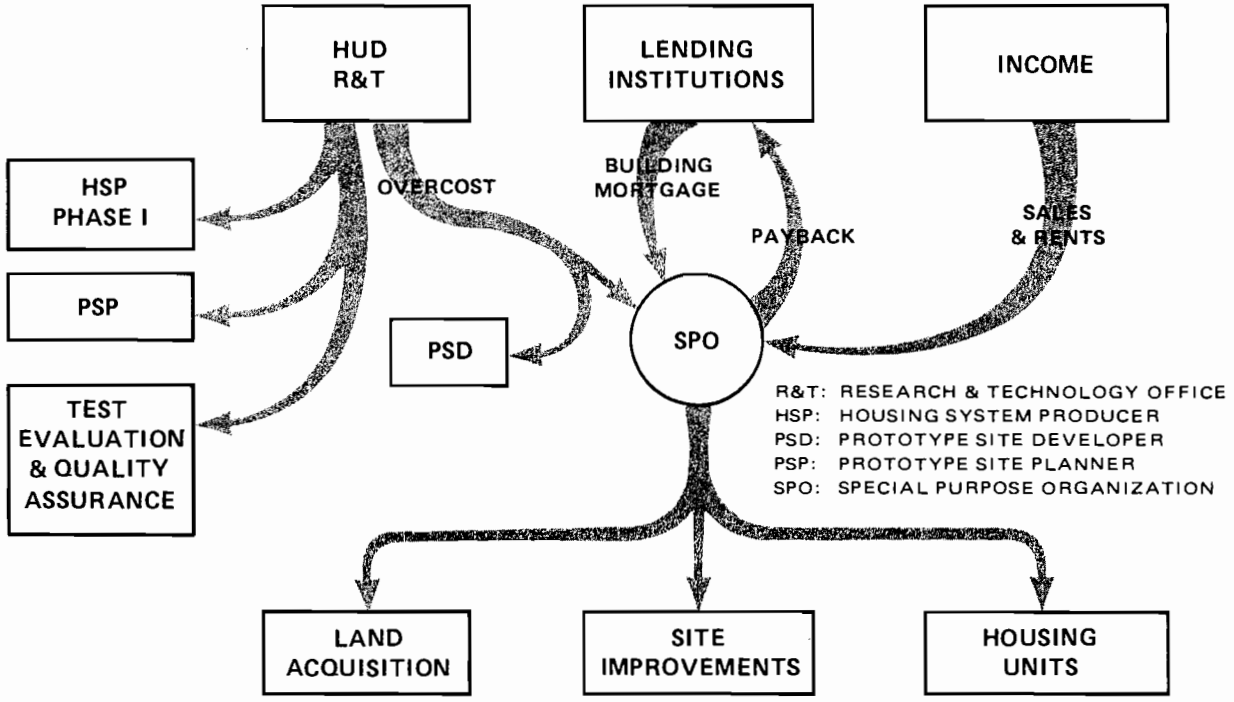


Fig. 2—Flow of program funds

The PSDs were awarded cost-plus-fixed-fee contracts by HUD for two years, HUD having options to extend.

Program Funding

PSD activities were paid for directly from HUD research and technology funds as well as "overcosts" —overcosts are the net difference between (A) the total allowable costs of the PSD contract, including but not limited to, debt service payments on loans when they become due and (B) amounts from construction loans plus rentals, proceeds of property disposition, and other receipts of the Prototype Development. About half of the money for BREAKTHROUGH, approximately $65 million, was financed through construction loans—much as any builder would do—and repaid or converted to permanent loans when the houses were sold (Fig. 2). Over half of the producers built or otherwise acquired factories, but received no HUD funds for them.

The Developers and Their Tasks

BREAKTHROUGH was a complex research and demonstration program. There was quite a variety among the PSDs. They included heavy construction companies, established residential developers, a

Task 1 – Financing
Subtasks:
1.1 Obtain financing
1.2 File applications for HUD program assistance
Task 2 – Site Development
Subtasks:
2.1 Acquire land title
2.2 Secure zoning and code approvals and exemptions
2.3 Arrange for utility and street extensions
2.4 Site plan development
2.5 Site development construction
2.6 Visitor center and community facility construction
2.7 Survey of property improvements
2.8 Construction of housing systems
2.9 Coordination of site construction
Task 3 – Public and Industrial Relations and Equal Opportunity
Subtasks:
3.1 Community participation
3.2 Public information
3.3 Equal Opportunity activities
3.4 Labor relations
Task 4 – Site and Housing Operation and Maintenance
Subtasks:
4.1 Safety and security program
4.2 Maintenance
4.3 Operations
4.4 Homeowners' association
Task 5 – Program Management
Subtasks:
5.1 HUD/NBS testing program
5.2 Data collection and reporting
5.3 Marketing activities
5.4 Community and local government cooperation
5.5 Program cost accounting system
5.6 Program plan
5.7 As-built drawing controls
5.8 On-site program control room
Task 6 – Disposition of Developed Prototype Site

Fig. 3–Typical PSD contract task outline

broadly based real estate firm, a diversified major corporation, and two multi-disciplined organizations. It was apparent that HUD had acquired a wide range of capability and experience.

The PSD contracts with HUD were basically identical. Six tasks were specified, and these are outlined below:

- Task 1, financing, involved borrowing funds for the development and applying for mortgage insurance, interest subsidies, or other federal support
- Task 2, site development, called for arranging, directing, and coordinating all processes from land acquisition through construction. This included acquiring fee simple title to the site; arranging for all zoning, building, and occupancy permits and exceptions to local regulations as necessary for development and occupancy in consonance with the ordinances of cooperation; arranging for local officials to extend utilities and streets to the site; cooperating with the PSP and HSPs in the planning and design of each site and its housing units; accomplishing the grading, site preparation, and provisions for services; subcontracting for visitor and community facilities; furnishing surveys of all site improvements; awarding and administering subcontracts to HSPs for manufacture and erection of the assigned units; directing the work of subcontractors to assure completion on time; and evaluating and resolving (or presenting to HUD) all issues that might arise, such as changes or coordination problems
- Task 3, public and industrial relations and Equal Opportunity, required the formulation and carrying out of a program for effective community participation in the site development and its management, operation, and disposition. In performing this task, the PSD was required to act as a central source for public information and staff a visitors center; prepare and implement an affirmative action plan for Equal Opportunity in employment, subcontracting, and housing; and coordinate the application of such plans by HSPs and other subcontractors
- Task 4, site and housing operation and maintenance, called for the PSD to assure compliance with all health and safety rules and standards for employees and visitors; protect the property; plan for and maintain the site and all structures, including completed housing units accepted from the HSPs; secure warranty services as appropriate; rent or sell units as directed by HUD; and develop a plan for establishing permanent resident organizations
- Task 5, program management, required the developer to prepare a program plan for construction and development; establish a cost accounting system, collect, and maintain all control data specified by HUD and provide and operate a control room at the site; coordinate with local authorities to ensure the carrying out of ordinances of cooperation; participate in the National Bureau of Standards program of testing and evaluation, providing for redesign as required; update all site drawings; and coordinate PSD and HSP marketing activities in Phase II, including model homes and other visitors facilities and displays

- Task 6, disposition of the developed prototype site, charged the PSD with selling, leasing, or otherwise conveying the site to recipients approved by HUD upon completion of the demonstration period

Program Management

Control of the Operation BREAKTHROUGH program depended upon strong interrelationships among the participants. Most direction came incrementally from different offices within OBW. Developers received the basic program definition and schedule objectives from OBW, and then prepared program plans for accomplishing the work. These plans all emphasized the urgency of the BREAKTHROUGH timetable.

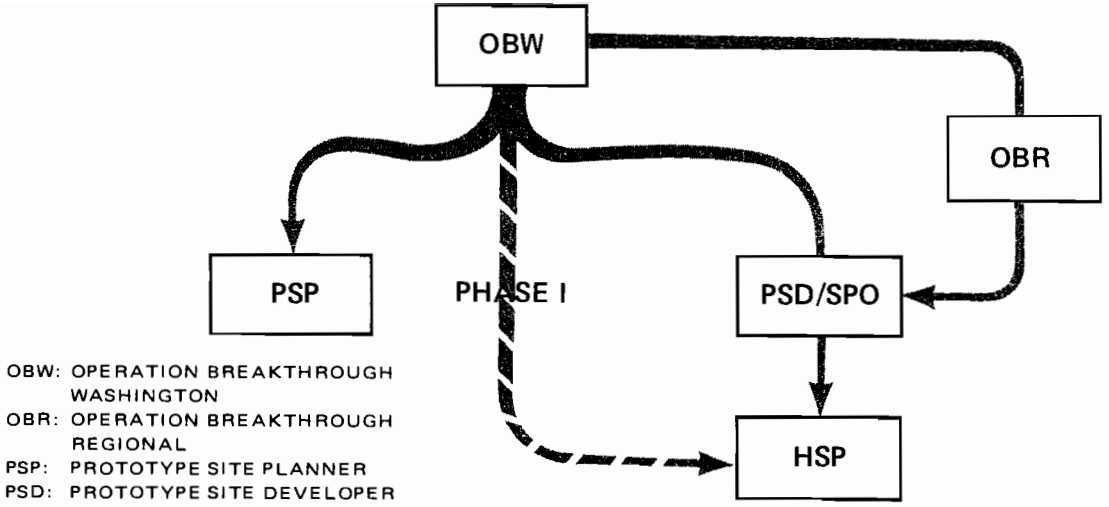
Early coordination between PSP/HSP and PSDs left much to be desired. PSPs and HSPs had Phase I contracts with HUD. The necessary information flow was achieved through standardized reporting systems developed by OBW. These systems were well established by 1971, the time of greatest need.

When the HSPs were placed under contract to the PSDs for Phase II, each PSD had, for the first time, a direct relationship with the producers assigned to the particular site.

The overall BREAKTHROUGH contractual arrangement, to be successful, demanded strong leadership with timely decisions and directions from OBW. Some PSDs were satisfied with the operation, but others were frustrated by the diffusion of power, the remote position from which some OBW direction issued, and the decision-making process involved.

Each PSD was required to submit monthly reports to OBW which included a narrative covering progress of all contract tasks, funding status information, and performance evaluation.

A critical path method (CPM) network was main-



OBW: OPERATION BREAKTHROUGH WASHINGTON
OBR: OPERATION BREAKTHROUGH REGIONAL
PSP: PROTOTYPE SITE PLANNER
PSD: PROTOTYPE SITE DEVELOPER
SPO: SPECIAL PURPOSE ORGANIZATION
HSP: HOUSING SYSTEM PRODUCER

Fig. 4—Contract relationships

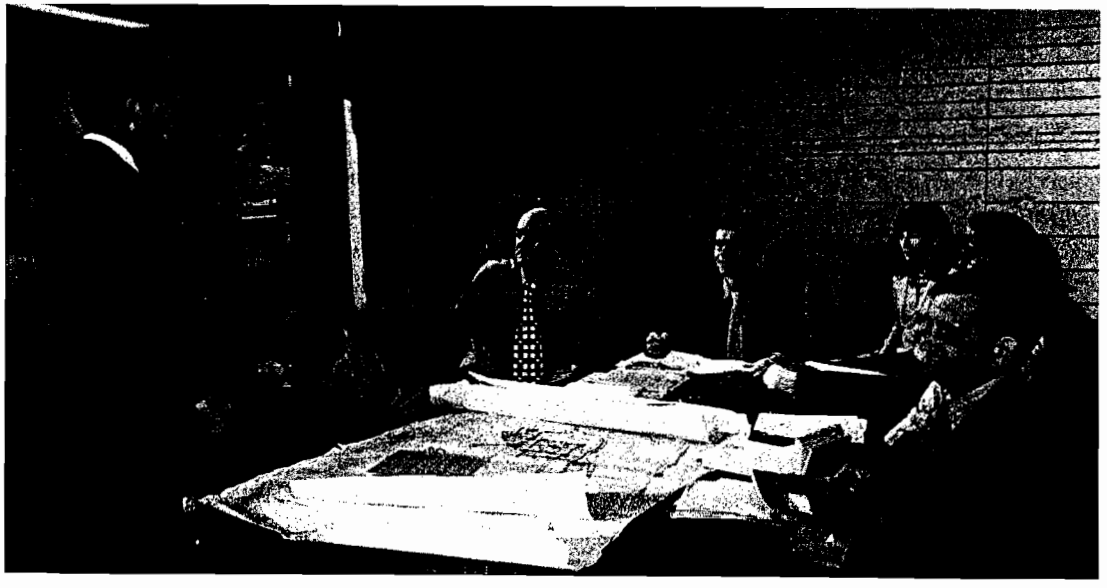


Fig. 5—Working session in OBW control room

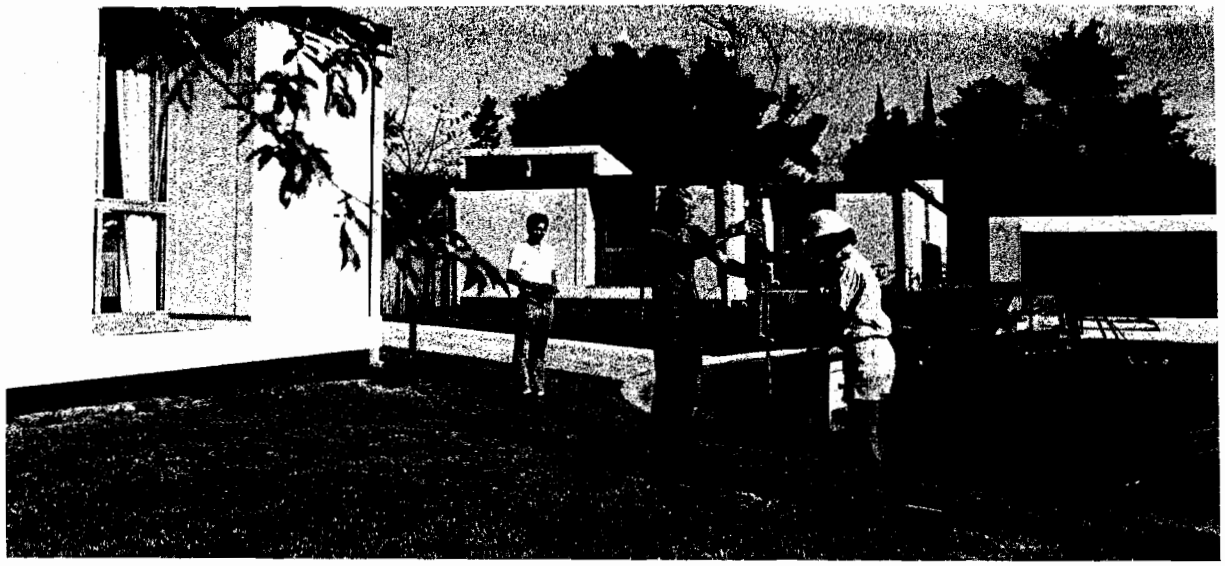


Fig. 6—Finishing by Master Site Developer subcontractors

tained to show major activities, and copies were furnished to OBW. CPM was essential as a planning tool, because the work of many contractors and many tasks could be coordinated when properly scheduled. PSDs employed the activity-oriented CPM technique for this purpose, however, OBW came to prefer an event-oriented network. PSDs, therefore used one CPM for planning and another for reporting.

The characteristics of the BREAKTHROUGH program—the complex contracting structure, the polyphased activities, the masses of information—created a problem that was controlled by a method called "system management." The core of the systems management operation was the OBW program control room in Washington, D.C., a visual display of data necessary for decision making (Fig. 5). The information allowed one to track program activities and related developments.

Other similar rooms were set up at the OBR offices with an emphasis on market aggregation. All control rooms were used for meetings, teleconferences, and management reviews. OBW held monthly program reviews in Washington, D.C., attended by the PSD program managers. These reviews covered summary activity schedules, PSD costs and fees, site development costs, action item status, and critical problems. The PSDs also had control rooms in which to display site project data in format similar to those in the OBW control room.

Master Site Developer

By the end of 1972, it was determined that consolidation of all site operations under one Master Site Developer would increase efficiency and reduce costs. OBW then selected a single developer to assume the remaining contract tasks of all eight PSDs. In January, 1973 the Boeing PSD contract was modified to assume responsibilities from PSDs at the various sites.

3 The Prototype Sites

The Prototype Sites

Synopsis

Operation BREAKTHROUGH developed nine sites that provide a national demonstration of industrialized housing systems and serve as showcases for innovative methods and materials. They also demonstrate how, with advanced land use concepts and sensitive planning, solutions can be found to solve complicated site design requirements.

This complexity may be judged by some statistics. On the nine prototype sites are 2,938 housing units, 2,794 representing BREAKTHROUGH systems. Of the 22 original BREAKTHROUGH producers, 21 built units (Stirling Homex did not). Those producers, assigned to 44 separate parcels or micro-sites, erected a variety of single family and multi-family dwelling types. There are 45 different combinations of producer and type; 75 of producer-type-location.

BREAKTHROUGH blended these diverse factors, in center city and semi-rural areas, creating sites that show remarkable unity. The cohesiveness with surrounding neighborhoods and the community feeling so evident at the sites result from careful, competent design and development. Such an accomplishment holds much promise for the future use of our urban and suburban land resources.

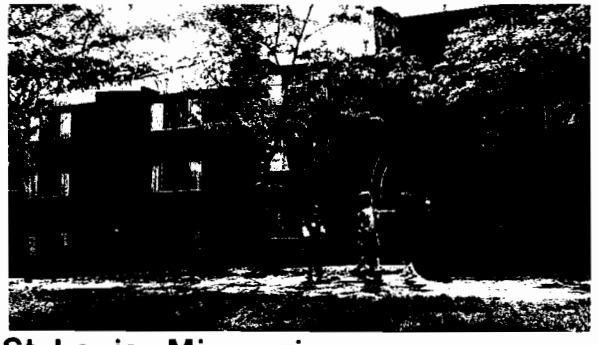
Kalamazoo, Michigan

New Horizon Village

33.8 acres **245 units by seven producers**

This site is on the northeastern outskirts of Kalamazoo. It was designed by Perkins & Will and developed by Bert L. Smokler with the National Corporation for Housing Partnerships. Density is 7.25 units per acre.

The housing systems are FCE-Dillon (52 MFMR), Hercoform (39 SFA, 12 MFLR), Levitt (51 SFA, 32 MFLR), Material Systems (10 SFD), National Homes (15 SFA), Republic Steel (4 SFD), and Scholz (22 SFA, 8 MFLR).



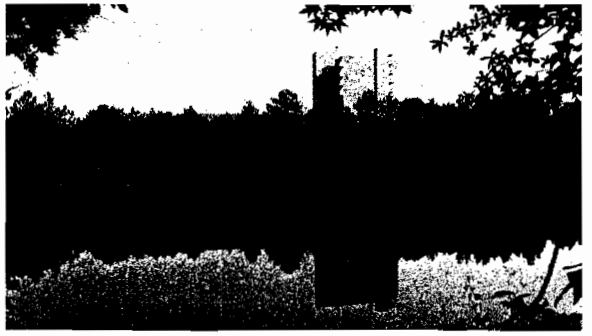
St. Louis, Missouri

LaClede Town

15.5 acres **464 units by four producers**

LaClede Town is within the Mill Creek Valley urban renewal area of St. Louis. The BREAKTHROUGH development is split into two near-equal parcels (separated by several blocks) with a density of 30 units per acre. Hellmuth, Obata & Kassabaum designed the site; Millstone developed it.

Rouse-Wates (34 MFLR, 123 MFMR, 84 MFHR) is the only housing system on the east parcel. Home Building (75 SFA), Descon (14 MFLR, 24 MFMR, 90 MFHR), and Material Systems (20 MFLR, built by Wallace Construction Co.) are on the west parcel.



Macon, Georgia

Crystal Lake

49.6 acres **287 units by six producers**

Crystal Lake is a suburban site with a density of 5.8 units per acre, at the southwestern edge of Macon. The site was designed by Reynolds, Smith and Hills, and developed by Fickling and Walker with the National Corporation for Housing Partnerships.

Housing systems are Alcoa (40 SFA, 12 MFLR), Boise Cascade (31 SFA, 18 MFLR), Building Systems International (24 MFMR, 56 MFHR), Christiana (26 SFA), Hercoform (38 SFA, 12 MFLR), and Material Systems (6 SFD, 24 SFA).

Sacramento, California

Greenfair

30.4 acres **407 units by seven producers**

Greenfair is near the southeastern periphery of town and occupies part of the former State Fairgrounds. Density is 13.4 units per acre. The site was designed by Wurster, Bernardi and Emmons and developed by Campbell Construction Co. with the National Corporation for Housing Partnerships.

Housing systems are Alcoa (4 SFD, 24 SFA, 24 MFLR), Boise Cascade (47 SFA, 28 MFLR), Christiana (45 SFA, 28 MFLR), Community Technology Corporation (6 SFD, 14 SFA), FCE-Dillon (112 MFHR), Material Systems (10 SFD, 20 SFA), and Pantek (29 SFA, 16 MFLR).

King County, Washington

Lendemain

35.9 acres **178 units by four producers**

Lendemain is a suburban site in an unincorporated part of King County, 20 miles northeast of Seattle. Density is 5 units per acre. The site was planned by Eckbo, Dean, Austin & Williams/George S. Nolte and developed by Boeing.

Housing systems are Alcoa (62 SFD, 24 SFA), Christiana (4 SFD, 34 SFA, 16 MFLR), Levitt (20 SFA, 8 MFLR), and Material Systems (10 SFA).

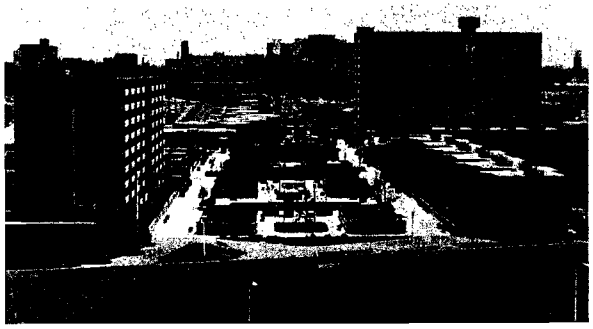
Seattle, Washington

Bryant Manor

1.8 acres **58 units by one producer**

This in-city site is part of the Yesler-Atlantic Neighborhood Improvement Project, a central Seattle urban renewal area. Density is 33 units per acre. Building Systems Development designed the site and Boeing developed it.

The housing system is a Townland design (38 SFA, 20 MFLR), built by Boeing.



Memphis, Tennessee

Edison Park

15.9 acres **518 units by four producers**

Edison Park is within the Court Avenue urban renewal area bordering downtown Memphis. Density is 32.6 units per acre. It was designed by Miller, Wihry and Brooks, and developed by Alodex.

Housing systems are Boise Cascade (69 SFA, 51 MFLR), FCE-Dillon (206 MFHR), General Electric (48 MFLR), and Adult Student Housing—a non-BREAKTHROUGH system (144 MFHR) replacing Stirling Homex.

Indianapolis, Indiana

Park Lafayette

42.9 acres **295 units by eight producers**

Park Lafayette is on the northwestern periphery of Indianapolis. The site was designed by Skidmore, Owings and Merrill and developed by Urban Systems Development Corporation. Density is 6.9 units per acre.

The housing systems are FCE-Dillon (36 MFMR), General Electric (48 SFA, 8 MFLR), Home Building (45 SFD), Material Systems (18 SFD, 32 SFA), National Homes (14 SFA), Pantek (40 SFD), Pemtom (20 SFA), and Scholz (26 SFA, 8 MFLR).

Jersey City, New Jersey

Summit Plaza

6.4 acres **486 units by three producers**

This in-city site is part of the St. John's renewal area in downtown Jersey City. Density is 77 units per acre. David A. Crane designed the site, and Volt was the developer.

The housing systems are CAMCI (153 MFHR), Descon (12 MFLR, 24 MFMR, 105 MFHR), and Shelley (192 MFHR).

Houston, Texas

The Texas site was to have been located south of Houston on 15 acres in suburban Clear Lake City, an unincorporated town in Harris County.

New Castle County, Delaware

The Delaware site was to have been on 35 acres in a suburban setting near Wilmington.

Terminology

SFD	–	**Single Family Detached**
SFA	–	**Single Family Attached**
MFLR	–	**Multi-Family Low Rise**
MFMR	–	**Multi-Family Medium Rise**
MFHR	–	**Multi-Family High Rise**

Full descriptions of these terms appear in the Appendix.

Kalamazoo, Mich

Kalamazoo

Site Location: Gull Road & Inverness Lane

Prototype Site Developer: Kalamazoo BREAKTHROUGH Housing Venture (KBHV)

Prototype Site Planner: Perkins & Will

Housing System Producers: FCE-Dillon, Hercoform, Levitt, Material Systems, National Homes, Republic Steel, Scholz

Total Housing Units: 245

Introduction

The New Horizon Village BREAKTHROUGH site is located on a main business route approximately 3 miles northeast of downtown Kalamazoo, home of Western Michigan University and several large industrial plants. Unlike some other BREAKTHROUGH locations, this site enjoyed from the beginning the complete support of the community and the city government, which aided the orderly and effective development of the project.

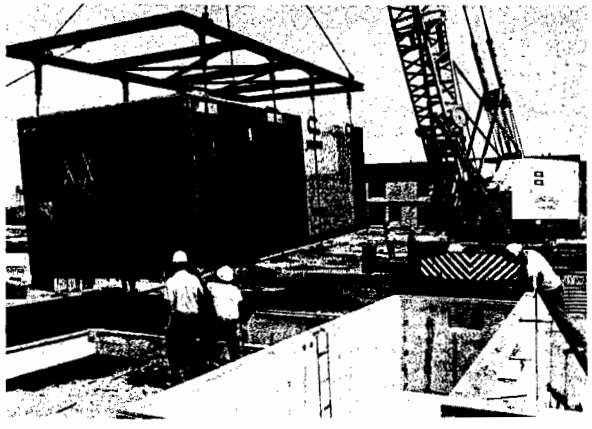
New Horizon Village is a cooperative; each member of Kalamazoo BREAKTHROUGH Consumer Housing Cooperative owns one voting share in the community and living rights to a home. Each member pays to the cooperative a monthly carrying charge equal to his share of the sum required by the co-op to meet expenses. Operation BREAKTHROUGH helped fill Kalamazoo's needs for low to middle income dwellings and housing for the elderly. The first residents moved in on March 11, 1972, and the co-op became viable in June 1973.

Located midway between the major metropolitan centers of Chicago and Detroit, Kalamazoo served as an attractive and popular demonstration site for Operation BREAKTHROUGH.

The 33.8-acre site, on the northeastern edge of town, overlooks Spring Valley Park. Many units have a sweeping view of the regional park and lake. From the outside, the development gives a low-profile impression.

When site work started at the close of 1970, the first big job was the storm drainage system. This installation protects the slope areas from erosion and the adjacent lake from silting and pollution.

KBHV, a joint venture of Bert L. Smokler & Company and the National Corporation for Housing Partnerships, executed the development plan well. Kalamazoo gained the distinction of being the first BREAKTHROUGH site to be substantially completed (May 1972).



Most of the housing producers used wood box module systems. Each module arrived from the factory completely finished, inside and out. Several modules then were joined to form a townhouse or low-rise apartment.

Cover:

Two- and three-story dwellings predominate at New Horizon Village, which has an average density of 7.25 units per acre. The seven housing producers were assigned to separate micro-sites, each with its own particular characteristics, offering a variety of styles and choices.

The road pattern allows good access but prevents through traffic. Feeder roads dead-end in the parking lots. Full circulation is provided for emergency vehicles, however.

Residents, particularly the elderly occupants of the medium-rise apartment building (most of whom do not own cars), enjoy the convenient public transportation service.

Pedestrian walkways make an efficient internal circulation network. Attractive, well-furnished lanes connect housing clusters and community facilities without interference from automobiles.

The community center, with its swimming pool, is a focal point for the site's nearly 600 residents. Other site amenities include numerous play areas, basketball courts, and a baseball diamond.

Co-op employees or subcontractors perform all maintenance on the homes.

Background

Kalamazoo, Michigan, is midway between Detroit and Chicago on Highway I-94, a major east-west interstate highway (Fig. 1). It is a typical midwestern community with a broadly based industrial economy. Employment for the 86,000 population (1970 census) is provided mainly by pharmaceutical firms like Upjohn, automobile assembly plants such as Fisher Body Company, paper products (The Brown Company), and educational institutions, largest of which is Western Michigan University.

The Kalamazoo City Council and City Manager had just completed a comprehensive analysis of the local housing situation when HUD issued requests for proposals for Operation BREAKTHROUGH demonstration sites. This housing analysis showed that the city had ample dwelling units to support its population but inadequate distribution to meet the needs of all. The unwillingness of large home builders to enter a static housing market aggravated the situation. A housing void was left in the lower to middle income market, where students, single parent families, and the small Kalamazoo minority population most felt the need.

BREAKTHROUGH therefore offered Kalamazoo the opportunity to relieve pressure on an important segment of the local population. City Manager James Caplinger, recognizing this potential, asked the council for authority to submit a BREAKTHROUGH proposal to HUD. The request was granted on June 15, 1969, whereupon a proposal was prepared nominating five alternative sites. The proposal was submitted in September 1969 and included a resolution of cooperation from the city council confirming the city's support for the Operation BREAKTHROUGH program and its willingness to cooperate.

The Kalamazoo proposal was one of 13 submitted by Michigan cities. In December 1969, HUD selected this particular site (Fig. 2) because it best met

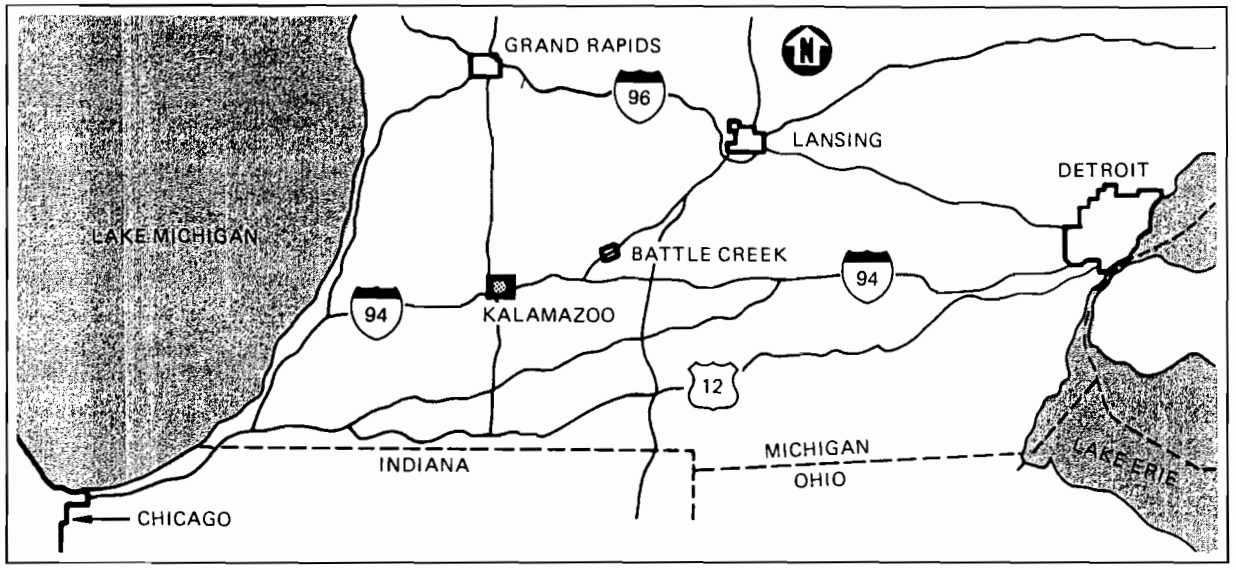


Fig. 1—Kalamazoo in southwestern Michigan

HUD selection criteria. Its advantages included:

- Central location between two major metropolitan areas
- A demonstrated market need
- Semi-isolated market for controlled analysis
- Community support
- Availability of utilities
- Good access to urban and rural amenities
- Adjacent park areas
- Close proximity to several major housing system producers

The site is on a plateau overlooking Spring Valley Park and Spring Valley Lake to the north. Entry is gained from a main traffic arterial, Gull Road, which provides ready access to Highway I-94 via Sprinkle Road. The site is well served by schools, neighborhood shopping, hospitals, and police and fire protection. Kalamazoo's public transportation system, noted as one of the best in the Midwest, provides direct service from the site to the central business district, Western Michigan University, and major employment areas.

Pre-Development Activity

On January 12, 1970, HUD retained the Perkins & Will Partnership, a Chicago architectural and planning firm, as Prototype Site Planner (PSP) to perform the site planning and design task for Operation BREAKTHROUGH at Kalamazoo. In broad terms, contract H-1202 gave the PSP responsibility for site investigation and conceptual planning, site design, development of working drawings, and monitoring site construction.

By March 1, the planner had completed a thorough investigation of the site's physical, cultural, social, and neighborhood characteristics, from which a land use program and conceptual site plan were developed. A computer mapping technique was employed to evaluate 21 characteristics of the site, ranging from soil content to community receptivity. The composite of these factors indicated the most suitable areas for development, one of several basic design criteria.

Ecological considerations were paramount in the decision to place the site in its present location rather than on the hillside sloping down to Spring Valley

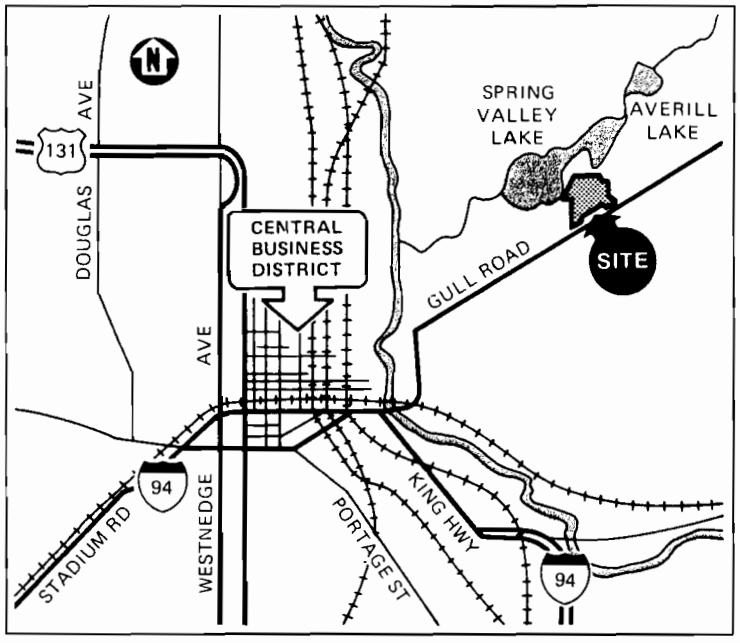


Fig. 2—BREAKTHROUGH site location

Fig. 3—Spring Valley Park

Lake. There was concern about slope erosion and consequent silting of the lake during construction. The following land use pattern was developed, and it became the foundation for preliminary design:

- The hillside slope facing the lake would be left as park land and a visual boundary to the site
- The area adjacent to the existing single family homes called for low-density development
- Outdoor activity areas were needed for various age and interest groups
- A central community/administrative facility was needed
- Additional land should be acquired between Gull Road and the site for a much-needed second access to the site
- The initial market analysis established a preliminary unit distribution that included single family homes, townhouses, and apartments

During this planning process, Perkins & Will worked closely with representatives of the local community. This cooperation influenced the site design and helped to allay fears regarding the "government housing project." For example, after it became apparent that high-rise apartments would not be popular in the neighborhood, the planner limited all buildings to four stories.

The preliminary unit mix established in March consisted of 70 low-rise apartments, 144 townhouses, and 36 single family detached units. On March 13, HUD announced the tentative assignment of seven Housing System Producers (HSPs) to Kalamazoo. These were Hercules, Levitt, Material Systems Corporation, Pemtom, Republic Steel, Scholz, and Stirling Homex. The next step for the planner was to consider the particular characteristics of the housing systems and the producers' desires to demonstrate a variety of housing types, sizes, and styles.

On July 22, 1970, the developer joined the program and subcontracted for a new market analysis. This resulted in some changes in the approach, emphasizing practical marketing objectives. The preliminary site plan began to take shape rapidly with the introduction of the HSPs and the developer into the planning process. It was then possible to establish the total number of units and the mix and obtain concurrence on the conceptual plan. Perkins & Will also reviewed HSP designs for compatibility with the overall scheme and held a series of meetings with other participants to reconcile these details. Much care was taken to understand the individual system distinctions, and place HSPs in appropriate parts of the site. For example, the planner assigned the northwestern micro-site to Pemtom because the Pemtom townhouses could be fitted to the ridge line with a great degree of architectural sensitivity.

The site mix was refined continually as the design progressed. By September 4, the original total of 250 units had been reduced to 202; then the developer established that more units would be necessary to make the proposed cooperative economically feasible. As a result of negotiations between HUD and the HSPs, the total was revised to 223 units. Even later, in March 1971, with Perkins & Will well along in the preparation of final plans and site construction actu-

ally under way, two HSPs were deleted from the Kalamazoo assignment—Pemtom and Stirling Homex—and replaced by National Homes and FCE-Dillon. Adjustments were made to the plan (notably a significant increase in the number of Levitt units), resulting in a new total of 245 units.

Site Plan

Despite later HSP changes, the land use distribution and area assignments developed in the preliminary design set the pattern for the final site plan.

A major area of green space bisects the community in a north-south direction. Levitt, as producer of the highest priced townhouses, occupies a preferred position on the northern edge of the site overlooking Spring Valley Lake. It was felt that this location would help sales. The one-floor single family detached dwellings of Republic Steel and Material Systems are situated along the eastern boundary to provide a transitional zone between the site and the existing single family dwellings in the neighboring community. Also an access road separates the SFDs from the two- and three-story townhouses and apartments on the more densely developed interior micro-sites assigned to Scholz, Hercoform, and National Homes. The urban character of the Hercoform micro-site, featuring narrow, rambling lanes and related details, is in deliberate contrast to the other townhouse areas (Fig. 19). The FCE-Dillon four-story apartment building was placed on the south end of the site, adjacent to the community center, because the proximity of these activities was considered a convenience to older people and a market asset.

To provide a buffer against a neighboring apartment complex and give a feeling of spaciousness upon entering the site, a large recreational field was located in the southwest corner along the west entry road. Midway between the two entry roads is the community center, at the south end of the central green

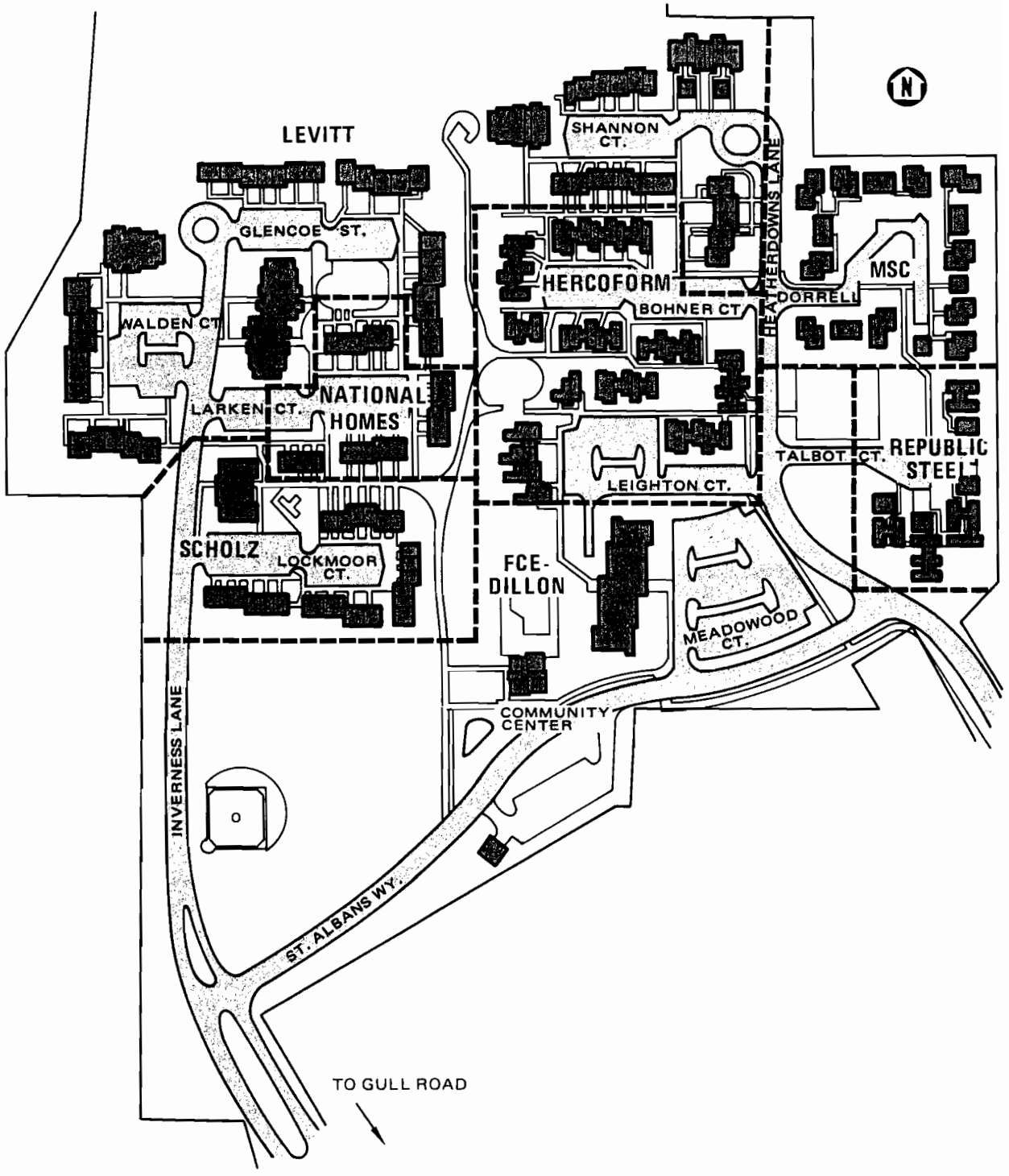


Fig. 4—Site plan as built

	FCE-DILLON				HERCOFORM				LEVITT				MATERIAL SYSTEMS				NATIONAL				REPUBLIC STEEL				SCHOLZ			
	1 BR	2 BR			1 BR	2 BR	3 BR	4 BR	1 BR	2 BR	3 BR	4 BR			3 BR	4 BR		2 BR	3 BR			3 BR	4 BR	5 BR		2 BR	3 BR	4 BR
SFD (14)															9	1						2	1	1				
SFA (127)						18	17	4		12	27	12						7	8							18	2	2
MFLR (52)					4	4	4		16	16																8		
MFMR (52)	51	1																										
Totals (245)	52 UNITS				51 UNITS				83 UNITS				10 UNITS				15 UNITS				4 UNITS				30 UNITS			

Fig. 5—Housing unit mix

space. This position allowed the center to house the sales office and serve as a visual focal point for the central green space, in addition to its other functions. The site has two distinct patterns for circulation, one for pedestrians and one for automobiles. The pedestrian system uses the central greenway as a principal throughfare, with connections to Spring Valley Park on the north and to the community center and recreation area on the south. At the approximate midpoint of this spine, two paths extend to the east and two to the west, terminating in neighborhood "tot lots" set between townhouse clusters.

The vehicular system is an "H" pattern with two north-south access roads entering the site from Gull Road. An east-west connecting road parallels the south perimeter. Although the two access roads appear to be dead ends, they are connected by an unpaved but well-marked emergency vehicle lane, which satisfies a fire department requirement for a second connection across the top of the "H." Feeders to the "H" all dead-end in parking areas, discouraging unnecessary traffic.

The drainage system is well designed to protect the environment. The soil, being highly permeable, permits the use of dry well manholes with overflow connections to the drainage system. In this way, most of the rainwater is carried naturally, below grade, into Spring Valley Lake.

Housing Systems

The seven HSPs built a total of 245 units—single family detached, townhouses, low- and medium-rise apartments. Levitt Technology Corporation, a subsidiary of ITT, produced the largest number of units on the site with a total of 83, comprising two-story apartments and townhouses. The system consists of wood-framed volumetric modules finished in the factory, complete with electrical wiring, plumbing, appliances, interior painting, carpeting, and exterior siding. Levitt manufactured the units in its new, fully automated Battle Creek, Michigan, plant using conventional materials. The finished product successfully avoids the boxy appearance usually associated with modular construction. Innovative features include hinged eaves to facilitate transport, single stack plumbing, and plug-in electrical connectors. The modules were set on poured concrete basements at the site, joined, and connected to the utility systems.

Hercoform Marketing, Inc., a subsidiary of Hercules, Inc., had the second largest HSP assignment at Kalamazoo with 12 apartment units and 39 townhouses. The Hercoform system consists of wood-framed volumetric modules containing all electrical wiring, plumbing, appliances, painting, and carpeting. Two exterior finishes were provided: a contemporary style with factory-applied plywood siding and wood

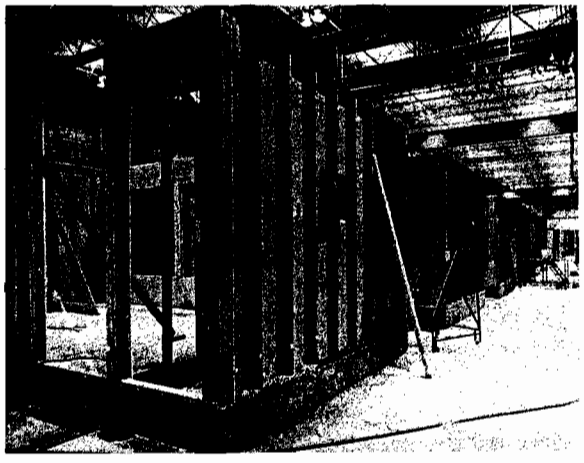


Fig. 6—Levitt modules on production line

trim, and a traditional style with site-applied aluminum siding and wood trim. Hercoform manufactured the units in a Bloomsburg, Pennsylvania, plant—one of the first designed specifically for industrialized housing. Modules were built of conventional materials on a movable conveyor. The process was fully mechanized to save labor. Innovative features were primarily in the design of a tower (an upright module) and a private patio layout. As with Levitt, the modules were joined at the site on poured concrete basements and connected to site utilities.

Scholz Homes, Inc., and Stiles-Hatton, Inc., engaged in a joint venture at Kalamazoo. During the course of the program, Scholz became a subsidiary of Inland Steel. The Scholz townhouse and apartment units are wood-framed volumetric modules, factory-built of conventional materials at the Stiles-Hatton plant in Grand Rapids, Michigan. The interiors were completely finished except for carpets, but the on-site application of a variety of materials and finishes to the exterior permitted considerable architectural flexibility. All eight townhouse units were placed on full basements.

The Republic Steel Corporation system employed steel-skinned panels with paper honeycomb filler for walls, floor, and roof. A unique foundation, consisting of steel box-section grade beams set on concrete piers, serves as an HVAC duct and wiring raceway as well as the main building support. Panels were erected on-site to form the basic structure, with kitchen-laundry and bathroom core units added. Each finished SFD has two separate living areas connected by an entry hall. Republic Steel manufactured the panels at its Youngstown, Ohio, plant. The Tappan Company, Mansfield, Ohio, made the kitchen-laundry subsystem, and the Architectural Products Department of American Standard, Inc., made the bathroom modules. Innovative features include the use of factory-built utility modules, preassembled electrical wiring networks (harnesses) for interior power distribution, and completely finished closed panels.

Material Systems Corporation (MSC) produced the most unusual dwellings on the site from the standpoint of innovative materials and fabrication methods. The MSC system uses a plastic composite material formulated from polyester resins, reinforcing fibers, and additives in a proprietary blend that resists weather, retards fire, and is odorless. The basic construction element is a panel manufactured by MSC at Escondido, California. Panels are made of composite skins chemically bonded to corrugations of the same substance, and are self-framing, full-load-bearing structural members. Insulating material fills the vertical cavities between corrugations to provide the desired levels of fire resistance and thermal insulation. Panels were assembled into three-dimensional modules at the company's Indianapolis plant. Conventional wood joists and plywood were used for the floor system. Wiring, plumbing, and appliances were installed in the modules at the factory, and the modules were joined at the site to form single family detached units.

FCE-Dillon, Inc., built the four-story medium-rise apartment building, using a system that combines pre-cast concrete components and poured-in-place concrete to form a monolithic structure. The major feature is the factory-built "heart module," a pre-plumbed kitchen-bathroom service and utility core, which effectively reduces on-site labor and construction time. The pre-cast components, including panels, the heart modules, and an elevator shaft module, were manufactured at Akron, Ohio.

The National Homes Corporation system consists of steel-framed volumetric modules with aluminum-faced plywood panel siding and rough-sawn cedar trim, fabricated at the National plant in Lafayette, Indiana. Electrical wiring, plumbing, appliances, and carpeting were factory installed. The modules were joined on-site in a conventional fashion to form 15 townhouse units in three structures. The main innovation was the use of steel floor joists and wall studs in conjunction with wood nailers for intermodular connections.

Prototype Site Developer

In April 1970, HUD solicited proposals for Prototype Site Developers (PSDs). Discussions followed between Bert L. Smokler & Company and the National Corporation for Housing Partnerships concerning a joint response.

Bert L. Smokler & Company is one of the largest and most respected developers in the Michigan-Ohio-Minnesota area, with home offices in Southfield, Michigan, near Detroit. Its real estate involvement covers land acquisition and development, residential construction, and mortgage financing. In 1971, Smokler became a subsidiary of the Dreyfus Corporation of New York City, which was sold in 1973 to the Lennar Corporation of Florida.

In the 1968 Housing Act, Congress authorized the formation of the National Corporation for Housing Partnerships (NCHP) of Washington, D.C., with the objective of involving private enterprise in low and moderate income housing.

Smokler and NCHP signed an agreement to form Kalamazoo BREAKTHROUGH Housing Venture (KBHV) and submitted a proposal to develop the Kalamazoo site. On July 15, 1970, HUD announced that KBHV was the successful proposer. Contract H-1385 was signed one week later.

KBHV had responsibility to manage the overall development by arranging financing for both construction and long-term mortgages, managing contracts for site improvements and HSP on-site construction, and marketing the product. Smokler did all management tasks, and NCHP provided coordination with HUD's Operation BREAKTHROUGH offices in Washington, D.C. (OBW).

Smokler assigned a program director to the project

and staffed the balance of the KBHV organization largely with newly hired personnel. Initially, KBHV located its operation in the Smokler office at Southfield, which served as headquarters until the contract was completed and handled all PSD accounting and OBW reporting activities. A local administration office was established in a converted home adjacent to the site in November 1970. KBHV also set up a construction trailer on the site to house public relations and marketing functions.

The developer's program director had charge of all site activities and, through his on-site staff, supervised scheduling, construction, and inspection. In addition to the KBHV staff, which peaked at 32 in August 1971, a subcontractor, FCH Services, assigned several people to the site for marketing and sales purposes. HUD's Site Technical Representative was responsible for overall surveillance of the developer's performance.

Due to the complex nature of the construction and the involvement of seven HSPs, a multi-tier critical path method schedule control system was used at the site. This proved to be an effective management tool throughout the program.

Following completion of the KBHV contract, the Boeing Aerospace Company, in its role as Master Site Developer for the entire BREAKTHROUGH program, assumed the Kalamazoo PSD responsibilities. At that time (January 1973), all the housing systems were still under warranty. The major items of work remaining for Boeing to complete included administering the warranty program, performing the required FHA quarterly inspections, and supervising repairs to units classified experimental under FHA Section 233.

Land Acquisition

The selected site was part of the 200-acre Spring Valley Park. This particular parcel was on a plateau overlooking most of the park and the lake, and had not been developed as a more active part of the park. It had been left to motorcycle and snowmobile riding and other uses by a segment of the population. Therefore, when the city proposed to sell this property and replace it by acquiring other park land in a better residential area of town, no significant opposition was encountered. A few people living near the proposed site objected to possible low-rent housing and construction of high-rise buildings adjacent to a single family neighborhood. These concerns were allayed when Perkins & Will explained the plans for the BREAKTHROUGH project.

The city, with HUD's help, received a grant from the U.S. Department of Health, Education, and Welfare for park development. In January 1970, the city obtained, for $350,000, a one-year purchase option on 160 acres of land as a replacement for that to be taken from Spring Valley Park.

In March 1970, HUD and the city entered into a purchase agreement for 40 acres. However, this was adjusted to 30 acres to exclude the hill slope and the soccer field (northeast corner of the site), which were left intact as part of the park.

In the final negotiations, the City of Kalamazoo transferred 33.8 acres to HUD on December 15, 1970. The selling price was $336,000. To assist the developer, Smokler had obtained from the title insuring company an indemnity agreement to clear the title encumbrance of existing power transmission lines. The timely endorsement of the agreement permitted the land transfer to take place. The city was able to pick up its option on the new 160 acres within the one-year period and thus retained the federal grant for park improvement.

This arrangement satisfied all participants, as was well stated by Park Commissioner Van Hoaften: "We are losing 30 acres of Spring Valley Park, but we are gaining 160 acres of parkland at no expense to the city." The city had obtained the entire 200-acre Spring Valley Park site in 1955 at a cost of $107,000.

Financing

Both HUD and the developer studied the means of obtaining funds for site construction. After many sessions, two decisions were reached: the Kalamazoo project would be a cooperative, and FHA would insure the mortgage under Section 233, pursuant to Section 236 of the National Housing Act.

The developer's financial analysis of the cooperative as planned showed that the intended quantity of 202 units would not produce enough income to make the co-op viable. In the discussions that followed, the quantity was increased to 233 units. This became the Kalamazoo baseline late in 1970. (The total was later changed once again to 245 units, the number ultimately constructed.)

In November, KBHV began negotiating with the Michigan State Housing Development Authority (MSHDA) to provide construction and permanent financing in one package. However, due to uncertainties relating to its bond financing charges in effect at project completion, MSHDA declined to commit itself for the permanent loan, especially since it is not an eligible deliverer to the Government National Mortgage Association (GNMA).

After months of negotiations, a financing format was worked out whereby Standard Mortgage Corporation, a Smokler subsidiary, would make the initial closing of the FHA mortgage to Kalamazoo BREAKTHROUGH Consumer Housing Cooperative, a special purpose organization formed by the developer. Standard Mortgage would then assign the mortgage to MSHDA, which would provide the construction financing. Later MSHDA would reassign the mortgage to Standard for final closing and delivery to GNMA.

In December 1970, Kalamazoo BREAKTHROUGH Consumer Housing Cooperative was incorporated as a nonprofit organization in the State

of Michigan. It became the owner and mortgagee-designate of the 33.8-acre property.

On December 11, the FHA regional office issued an initial mortgage commitment, which was subsequently amended on May 11 and June 18 of 1971. In March 1971, OBW released a memorandum instructing the regional and local FHA offices on the method to be used for processing and insuring Section 236 projects in Operation BREAKTHROUGH. In essence, this directive permitted the FHA to insure draws for the co-op until the regular HUD guidelines could be met through sales to co-op members. The initial mortgage closing was held on June 30, 1971, and KBHV made the first draw on July 8.

The last draw was advanced on December 29, 1972. After final closing, Standard Mortgage packaged the site mortgage and delivered it to GNMA.

Site Preparation

Actual on-site construction began about six weeks after groundbreaking ceremonies on December 18, 1970. Prior to this time, the City of Kalamazoo had started to extend utility service lines to the BREAKTHROUGH property. Its work was completed in January 1971. The city's original schedule for completion by September 1970 could not be met because definitive data regarding the ultimate configuration of the site were not available.

Perkins & Will was responsible for providing completed plans and specifications for site construction, including the grading, roads and paving, utility systems, community center facilities, fencing, landscaping, and other work as required. The release of these plans had to be phased to support the overall site construction schedule. For example, the developer determined that soil characteristics would permit the winter installation of underground utilities, and that this early start would shorten the overall construction schedule by three months. It was essential to complete the underground utility system, clearing, and grading and to have a base course on the roads and parking areas before the HSPs' construction forces began arriving on the site.

The release of utility plans before complete information was available on the HSP designs created interfacing problems. In March 1971, with the preparation of final site plans almost done and some work well along, major HSP reassignments directly affected both operations. Detailed cost studies indicated that it would not be feasible to construct Pemtom and Stirling Homex units at Kalamazoo; accordingly, these two HSPs were replaced by assigning additional units to Levitt and by adding two new HSPs—National Homes and FCE-Dillon. FCE-Dillon took over the medium-rise apartment complex originally assigned to Stirling Homex with only minor changes because of the close similarity of plan configurations.

National Homes and Levitt moved onto the Pemtom site. This substitution was more difficult to accommodate, since it required a redesign of the underground utilities and some rework in the field. Republic Steel ended up with only four units instead of the original eight, and this involved further redesign and field changes.

These HSP reassignments were made at this critical juncture for valid reasons. A cost analysis of the Pemtom system indicated that it would be too expensive for Pemtom to build at Kalamazoo, with a per-unit cost several thousand dollars higher than the other modular systems. The Stirling Homex concept was best adapted to high rise configurations, and the four-story building limitation pushed Stirling's per-unit cost into an unacceptable price range.

By April, the developer was ready to place a base course of asphalt paving on the roads and parking areas. This was completed May 22, 1971, when the first HSP (Levitt) arrived.

As work progressed and the HSPs began to appear on-site, scheduling interferences were encountered. In

Fig. 7—Sanitary sewer construction during snowfall

Construction Conditions

The natural features of the Kalamazoo site were ideally suited for construction of this project. The gentle rolling terrain, with elevations ranging from approximately 840 feet to 860 feet, was covered with a moderate growth of weeds, brush, and trees. A layer of dark brown sandy topsoil, averaging 9 inches in thickness, blanketed the site. With fertilizers added, this material was usable for general landscaping purposes. Underlying the topsoil, the predominately granular, well-drained soil was suitable for the support of moderate loads. Groundwater was well below the surface and would not be encountered during construction. No special precautions were required to protect piping and other underground utilities from corrosion or electrolysis. Earthwork operations could be conducted in the winter, although some interference could be anticipated from heavy snowfall and extreme cold. The frost line is 3-1/2 feet deep.

some instances, utilities had to be installed out of sequence, which resulted in damage to pipes and cables when a late-arriving HSP excavated for foundations. All housing producers erected their units in reasonably good time, but the modular HSPs took much longer to finish than had been planned. The installation of sidewalks, patios, fences, and landscaping became a discontinuous effort, as these operations had to be fitted to the construction activities of the various HSPs.

During construction, measures were taken to prevent the runoff caused by operations from polluting Spring Valley Lake. Had this not been anticipated and dealt with effectively, long-term silting and pollution damage to the lake would have resulted.

The developer actively coordinated the efforts of HUD, Perkins & Will, and the HSPs to ensure continuing progress of the development. HUD and the HSPs were negotiating contracts and making planning changes at the same time that KBHV was moving forward with site preparation. A local engineering firm was retained to record and report construction status to the planner, facilitating orientation of the HSPs to actual site conditions.

There were other problems to overcome. In January 1971, the Consumers Power Company declined to install gas mains until the building foundations were completed. The power company was observing a requirement of the State Utilities Commission, but after a hearing before the commission, a waiver of this requirement was obtained. In this case, the City of Kalamazoo and the power company joined forces and helped obtain the waiver in time to allow orderly site utilities construction.

On May 12, 1971, the employees of the Consumers Power Company went on strike, jeopardizing completion of electric power installations needed before the arrival of the HSPs. KBHV and Consumers Power arranged a solution, agreeing that the developer would contract directly with the power company's approved contractor, Clifton Engineering Company, for the gas and electric installation while the power company would perform all necessary construction management and engineering coordination.

The community center building encountered several design iterations. All bids on the original design were rejected because they exceeded the budgeted amount. KBHV later readvertised a reduced scope, and ultimately awarded the job on August 26, 1971. The scheduled completion date for the center was extended to the end of October that year.

The building itself is a two-story structure, with a concrete block first floor facing the pool. The redwood-sided second floor includes the office and provides space for social activities, marketing, and related functions. A maintenance garage is included in the center's facilities but was constructed under a separate contract, as was the swimming pool.

Community Relations

From the beginning, the local community and the City of Kalamazoo looked upon Operation BREAKTHROUGH with favor. To the city, the BREAKTHROUGH site offered attractive advantages. The proposed location would make possible a new, larger, and better equipped park, while more housing for a neglected market would be provided at no real cost to the city. Kalamazoo's support and cooperation were especially valuable during the initial stages of the project. Utility services were being extended to the site before the official groundbreaking. The city participated extensively in that ceremony, which included Mayor Hamilton's introductory speech.

In April 1971, Ordinance 847 was passed, waiving the pertinent codes and ordinances for the BREAKTHROUGH site.

The *Kalamazoo Gazette* also supported BREAKTHROUGH and carried many news articles about it throughout the life of the project.

Starting in October 1970, KBHV made extraordinary efforts to involve minority participation. The developer worked with the Douglas Community Association and both the Kalamazoo and Battle Creek chapters of the NAACP to increase minority contractors and workers. Only the Douglas Community Association responded, and that response was not very effective, probably because there were so few minorities employed in the local building trades.

In keeping with OBW's hopes for making BREAKTHROUGH a significant demonstration, KBHV planned a vigorous visitors program. However, budget restrictions substantially reduced the scope of the December 1970 plan by the time on-site visits commenced in April 1971. Kalamazoo's location between two major metropolitan areas contributed to a large volume of visitors, averaging 350 people a week. The developer set up facilities for them in a trailer on the site until a display area was ready in the community center. Three college students, hired on a part-time basis, conducted the visitors program effectively, using a bus for tour groups. Further funding cuts prevented the program from continuing at this level, and it was abandoned within a year. The HUD Site Technical Representative then took primary responsibility for community relations, with KBHV participating as time allowed.

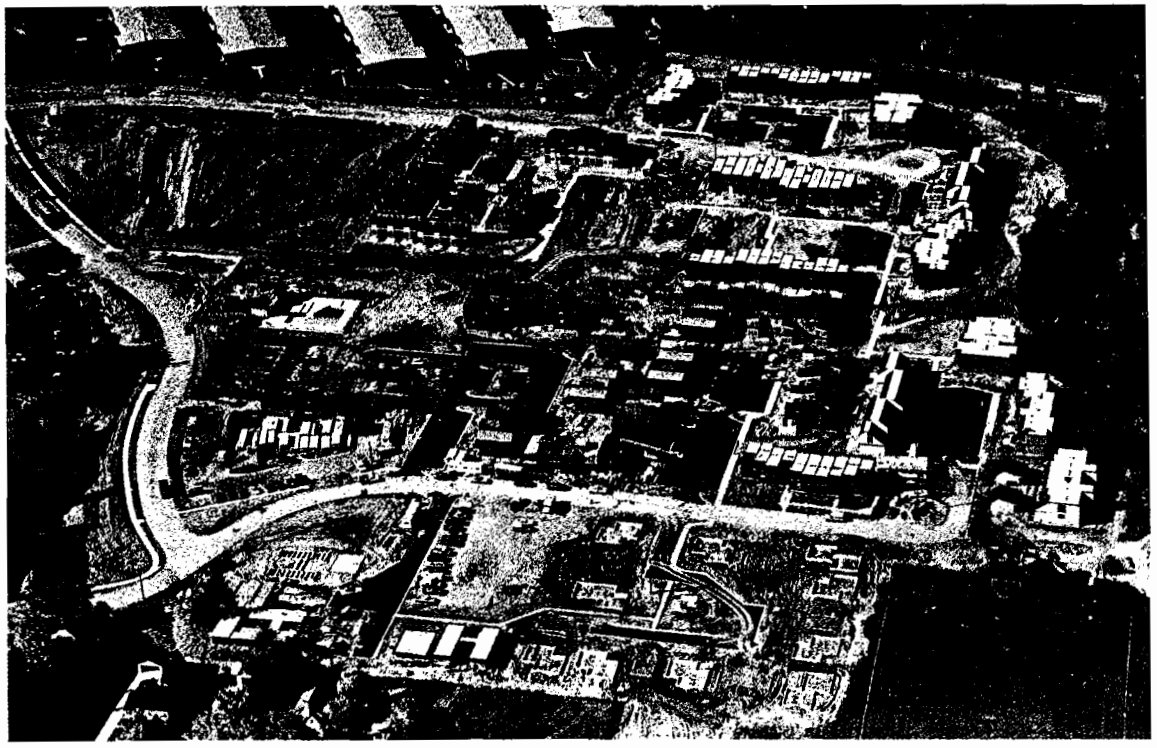


Fig. 8—View to southwest, October 1971

Housing Erection

In April 1971, the City of Kalamazoo passed the ordinance that suspended building, zoning, and housing codes for the Kalamazoo BREAKTHROUGH project. The ordinance did require that plans and specifications be submitted and the necessary permits obtained, while the city agreed to perform inspections. Municipal cooperation was a key to meeting the erection schedule.

Levitt, the first HSP to begin site work, commenced on April 13, 1971, followed closely by Hercoform. Through the summer and early autumn, the other producers also started their foundation work. The weather was good, site improvements were ready when needed, and no substantial delays were encountered. By September, Levitt was placing the last of its modules, while three more producers (Hercoform, Scholz, and Republic Steel) were into the erection stage. All HSPs except Material Systems completed erection before the end of the year. Thus, many of the finishing operations could be done under cover during the winter season.

The Levitt modules were transported from the Battle Creek plant to the site, a distance of approximately 25 miles, on specially configured, company-owned trailers. The trailers were expandable, making it possible to retract the unit to legal length and width for the return trip to the factory. No serious problems were encountered in maneuvering on the flat, graded, well-compacted site.

During shipment, a removable plastic covering, held by wooden strips, protected the tops and unfinished exterior walls of the modules. Some damage to the drywall (a common problem with modular systems transported to the site) and to other miscellaneous items was noted upon delivery. Because of the damage suffered by the units during transportation and erection, an unusual amount of time was spent on both interior and exterior repairs.

A 45-ton mobile crane with an 80-foot boom lifted modules directly from the transporter to the

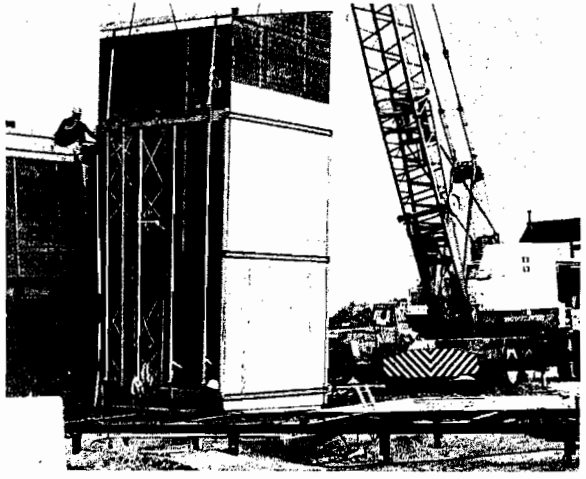


Fig. 9—Erection of Hercoform tower module

Fig. 10—Republic Steel grade beams

foundation. Best setting time for one crew was 12 boxes per day. Size of the module was not a determining factor.

Hercoform modules were transported approximately 560 miles from the Pennsylvania plant on specially configured trailers that could be expanded for module shipment and contracted for return to the factory, allowing two trailers to be hauled as one unit. Most of the Hercoform modules had to be double handled because it was not possible to control arrival times. Trucks had to travel through three states, each requiring a separate permit. Problems in obtaining permits caused delays of a day or more per trip. Another problem, never satisfactorily solved, involved protecting the boxes adequately during transit. Canvas covers finally were used, but even that method resulted in abrasion to the wood siding due to blowing and flapping of the canvas and rope ties.

Setting the modules was more complex and time-consuming than for other systems because of the double handling. The modules were jacked up from their temporary supports and repositioned on a yard trailer, then lifted from the trailer and placed on the prepared foundation with a 45-ton mobile crane using a 60-foot boom. The initial setting rate of 6 boxes per day was ultimately increased to 11 per day.

Hercoform's contemporary-style units, which had factory-applied plywood siding, required very little exterior work. The construction of stairwells on apartments was the most time-consuming outside finish task on that style of building. The intermodular connection on the roof was covered with flashing in a conventional manner. Shingles were applied to the fold-down eaves. Interior finishing involved the usual covering of intermodular joints on walls, floors, and ceilings, and making utility connections.

Hercoform's "zip-up" operations—on-site detail finishing and field repair of such items as drywall cracks—extended well past the time scheduled. KBHV attributed much of this to inadequate factory quality control. At the site, the developer's inspectors closely monitored HSP work.

Truck-trailers moved the Scholz/Stiles-Hatton modules about 25 miles from the plant. Each trailer consisted of two independent dolly sections bolted to a module. In spite of the long unsupported distance between front and rear dollies, little damage resulted in transit. Exterior damage was not significant because the design called for siding and trim to be site-applied. Interior damage from the weather was minimal due to the effective use of metal covering on top of the units (this remained as a part of the finished building). The trailers, with attached modules, were held in a staging area until time for placement. When returning to the plant, the rear trailer dolly was placed on top of the front section.

Some minor preparations were made at the staging area, then the modules were shifted near the foundations by tractor. The lifting frame consisted of two horizontal steel beams, one above the other, joined by steel vertical members or webs. Cables at seven points on the bottom beam connected in turn to steel bars spanning the width of the box, which was attached to the lifting frame with steel straps fastened to the module at the factory. The system did not provide for adjusting the position of the module during placement. While the module was being rigged for lifting, intermodular openings were cut in the plywood skin. A 45-ton mobile crane with a 60-foot boom lifted the module. The rate of placement varied between six and eight per day. Exterior finishing consisted primarily of the field application of reverse-batten fiberboard siding and wood trim. These covered any transit damage and ensured a better match of finish and alignment with a greater variety of color. The apartment house used a tilt-up roof, while the townhouse units had the roofs attached. In both cases, shingles were field-applied to the entire roof. Interior work consisted of the usual covering of intermodular connections, utility connections, and instal-

lation of carpets. Very little rework was needed.

The Scholz site superintendent was responsible for the implementation of the on-site quality assurance program, and he trained an assistant to help inspect the modules on arrival. In addition, a quality assurance representative was on the site during the entire erection and finish process to monitor work performed by subcontractors. Deficiencies noted by the KBHV inspectors were corrected without incident.

Common carriers using standard size trailers delivered the Republic Steel panels and subsystems to the site. Delivery schedules were well coordinated, and materials were properly positioned to accommodate the erection sequence. A delivery inspection of the panels was not possible because they were stacked on pallets, precluding visual check before erection. The few panels that were found to be missing or improperly cut did not cause work stoppage; instead, work was diverted to another area of the building. Erection of the basic structure differed from a modular system. Four men quickly assembled the grade beam and placed it on the concrete piers (Fig. 10). Floor panels were next placed on the grade beams, and the kitchen and bathroom subsystems were set using a 12-ton crane. Two men bolted the exterior panels to the grade beams. Most panels were similar, thus eliminating the need for locating specific panels. A forklift raised the roof panels into position.

Exterior finishing consisted primarily of installing a roof facade. On three of the units, a quasi-mansard facade was installed around the perimeter to enhance appearances. The other dwelling had a modified hip roof (made of a wood frame covered with plywood and shingled in a conventional manner) built above the regular roof panels. Interior finishing consisted of covering the walls with the decorator finishes specified. The installation of closets, hanging of doors, covering of HVAC ducts and electrical raceways, connection of utilities, and installation of lighting fixtures and carpets were the major items of interior work remaining to be accomplished.

Republic Steel followed its site quality assurance plan closely during erection. A quality assurance representative was on-site during the erection and finish of three of the units.

Company-owned trailers and tractors transported the National Homes modules 218 miles from the plant. Trailers, a non-expandable type, were normally returned by the tractors that brought them to the site. Weather damage was minimal because National used a snug-fitting canvas cover that encased the entire module. Drywall cracks were most evident in the first unit emplaced. The last building had fewer cracks, indicating that effective measures were taken to correct the problem. The site superintendent performed a delivery inspection.

National Homes did not require a staging area because deliveries were properly scheduled. This producer erected its units by means of a 60-ton mobile crane with a 60-foot boom. The lifting frame used was distinctly different from those of other HSPs. It employed a 3-inch-diameter steel rod as a spreader, attached to the crane hook by a cable running from each end through a ring. Cables hung from the ends and were connected to removable steel rods inserted through the steel rim joists at the end of the module. This configuration was probably the best at the site from the standpoint of ease of operation and control. Disposal of steel straps was not a problem, and the lifting device was easily transportable.

The requirement for on-site interior finish was held to a minimum. Cased openings and wood moldings provided intermodular connections at doorways and stairwells. The heating unit was installed in the basement. Most of the interiors had to be painted to achieve uniform texture on the walls. Exterior trim work consisted of covering the modular joints with 1" x 10" rough-sawn trim. Exterior porch roofs were also field-installed. The trim and porch roofs were shipped to the site as a trim package, eliminating any

Fig. 11—Finishing operations, National Homes

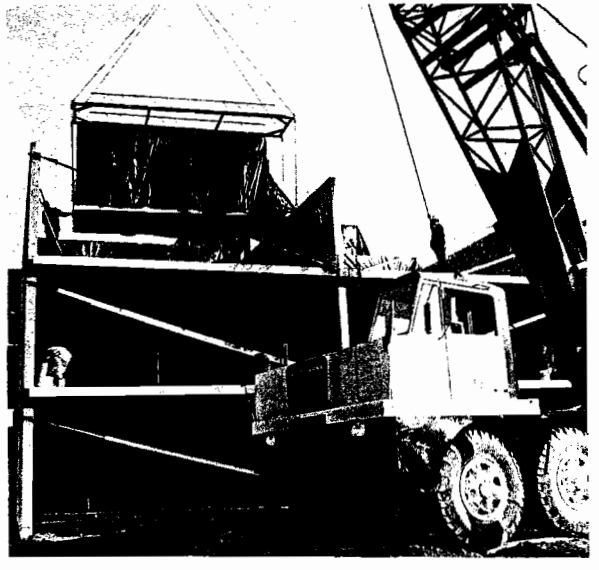


Fig. 12—Lifting FCE-Dillon kitchen component

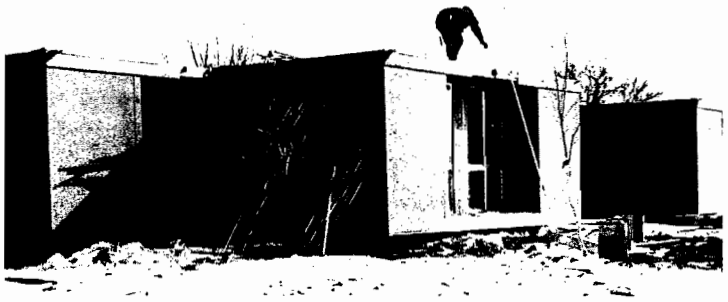


Fig. 13—Material Systems units early in 1972

problems of matching local materials with factory-applied materials. The roof was put on at the factory, leaving for site work only the covering of the modular connections with a ridge vent. This could be done shortly after the module was set, thus providing maximum protection.

National Homes' site superintendent administered its quality assurance program. Deficiencies called to his attention by the KBHV inspectors were corrected.

Contract carriers delivered the FCE-Dillon panels and components to the site from the factories in Akron, Ohio, a distance of approximately 300 miles, on standard flatbed trailers. The service or "heart" modules, as FCE-Dillon calls them, were carried on trailers telescoped to 55 feet to accommodate two modules per trailer. Wall panels were unloaded and positioned as close as could be to the point of use. Heart modules were unloaded directly into the final position, whenever possible, to avoid double handling. The delivery schedule was tight, and some construction delays were experienced when trucks were late. Floor/ceiling panels were identical, permitting them to be stockpiled and used as required.

FCE-Dillon had its own 115-ton mobile crane, equipped with a 100-foot boom and a 30-foot jib, to place panels, position heart modules, pour concrete, and perform other construction tasks. A steel frame spreader was used while lifting heart modules. The erection sequence consisted of first placing the heart and elevator modules in position, next the wall panels, and finally the ceiling panels. The next floor was begun by placing the heart and elevator modules, supported by the corresponding modules below. The floor slab was then poured, the wall panels installed, and the sequence repeated. Pre-cast concrete stairs were installed as each floor was placed.

The concrete panels required no finishing. Installation of curtain walls, the main exterior work, involved framing the opening with steel studs and installing sliding glass doors. The remainder of the exterior wall was covered with aluminum-clad plywood panels. Railings were installed for all balconies. The concrete slab roof was covered with built-up roofing. For each unit, interior finishing included putting in a wall to separate the living room and bedroom, and placing drywall on the inside of the curtain wall. Baseboard electrical circuits were installed and plumbing connections were made from the service modules to a mechanical chase on the hall side of the unit. Each living unit was connected to the distribution system for the heating and air conditioning plant, located on the roof of the building. Concrete walls were sized and painted with latex paint. Carpets were installed last.

The site superintendent, also the quality assurance representative, followed a formal quality assurance plan. Incoming material was carefully checked for damage in transit.

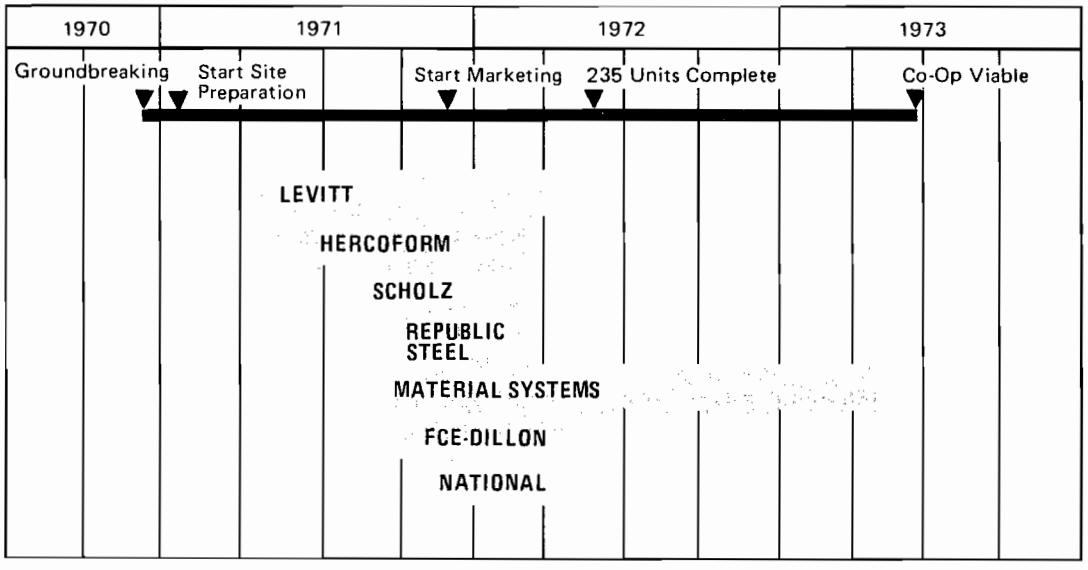


Fig. 14—Progress of housing construction

FCE-Dillon achieved significant savings in on-site labor through use of the service modules, which were relatively easy to connect.

Common carriers transported the Material Systems modules 230 miles from the assembly plant at Indianapolis on specially configured company-owned trailers. The trailers were expanded to accommodate the various sized modules and retracted and stacked for return to the factory. The first modules were covered in transit by plastic sheeting, which blew off and allowed some weather damage. Later, when canvas covers protected shipments, damage from weather and road hazards was eliminated, but the canvas tended to rub off paint in some areas. Modules were unloaded temporarily on concrete blocks near their intended foundations by means of house-mover's jacks, thus avoiding the need for a crane at that time.

To place the modules, MSC used a 60-ton mobile crane with an 80-foot boom. The conventional rectangular steel lifting frame had five sliding connectors on each side of the frame that could be positioned to accommodate various sizes. Reusable steel lifting bands attached the box to the frame, but straps caused some damage. Initially, the modules were placed with enough clearance between them to permit removal of the lifting straps. Epoxy was applied to the mating surface, and the modules were pulled together with "come-alongs" (jacking devices). Since this was time-consuming, the procedure was modified by cutting notches in the boxes to facilitate removal of the straps, even with a tight fit. Epoxy was applied before the modules were swung into position, and the setting time was reduced significantly. A four-man handling crew appeared to be the optimum number for setting the units.

Exterior finishing work centered around minor repairs to the skin surfaces, where wrinkles and indentations left from the manufacturing process detracted from the appearance. Initially, MSC applied drywall spackle covered by a heavy, thick paint, but the paint manufacturer and the National Bureau of Standards did not recommend this procedure, and after the units were in place a short time, the paint started to blister and had to be removed.

Other major exterior finish items consisted of installing redwood trim, connecting gutters and downspouts, and putting the skylight structure on certain units. On the roofs, the intermodular joints had to be sealed. Some problems were experienced with the mastic used to seal the elastomeric roof. Roof leaks persisted.

Interior finish required somewhat less effort than for other modular systems, except for the necessary cosmetic covering of interior plastic surfaces. Intermodular joints were sealed and utility hookups made in routine fashion. The factory-installed furnace in the center module required few connections, and the external air conditioning compressor accounted for most of the time needed for HVAC hookup.

MSC's site superintendent acted as on-site quality assurance representative. The quality assurance plan devised for factory and site work proved inadequate to meet the problems associated with fabrication and erection of this unusual system. A combination of factors caused the continuing major leak problem. Water stood in depressions on the flat roofs due to improper drainage. The resulting "head" or pressure enabled the water to find its way through small holes in the roofing material. This was corrected by rebuilding the roofs from the inside, using conventional wood joists and plywood fitted by sections under the original top skin. A built-up roof was then added to complete the fix. Exterior wall skins, also suspect, were covered with plywood, which in turn was coated with Tex-cote, a product resembling stucco that gives a textured, weatherproof-type finish.

Starting late, Material Systems set its last module in place in March 1972. Although most producers were finished on the site that spring (Hercoform, Scholz, and Republic Steel as early as February), MSC did not finish until May 1973. The problems met could be attributed directly to the experimental nature of the design, which was truly novel and untried in most aspects.

KBHV was able to prepare a realistic schedule at the outset. As each housing producer encountered its own particular problems, KBHV and HUD coordinated the changes and adjusted schedules. The measure of success was that Kalamazoo was the first BREAKTHROUGH site to be substantially complete, 235 of the 245 units being finished by May 1972.

Operation and Maintenance

There were two aspects to housing maintenance at the site. First, each HSP contract required the builder to warrant all work performed and materials furnished against all defects for a period of one year from the date of final acceptance by the developer. Second, the cooperative plan entitled each member to have all maintenance and repairs performed by the co-op as part of the normal cost of membership.

By the time the cooperative became viable in June 1973, all the HSP warranties except that of Material Systems had long since expired. This meant that, during the interim—approximately one year—HUD assumed the costs of warranty-type repairs as well as the required maintenance and operating costs, and the developer had the responsibility for performing the work.

Local subcontractors retained by the producers took care of most of the HSP warranty work. The notable exception was Levitt, which handled its warranties from the factory in Battle Creek. In general, warranty response was not as desired.

After the Kalamazoo BREAKTHROUGH Consumer Housing Cooperative was established, HUD selected FCH Services, Inc., a subsidiary of the Foundation for Cooperative Housing, to manage the co-op until its members could assume that role. (FCH was

Fig. 15—Servicing solid-waste compactor

Fig. 16—Mowing the lawn on open space near Scholz units

also the marketing agent and co-op manager at the Macon, Georgia, BREAKTHROUGH site.) In mid-1973, the co-op executed a new management contract with Consumer Systems, Inc., of Ann Arbor.

The greatest number of maintenance complaints involved the mechanical systems in the homes, particularly appliances, heating, and air conditioning. Also roof leaks have been a problem.

Marketing

From the beginning, the Kalamazoo site was considered best suited for a subsidized housing development, and no formal studies of alternative markets were made. KBHV brought Bert L. Smokler & Company's wide experience with cooperatives and condominiums into the planning process. A cooperative under FHA Section 236 fit in with the wishes of the City of Kalamazoo as well as with the overall objectives of BREAKTHROUGH. Since there was no comparable subsidized housing in the Kalamazoo area, it was felt that a Section 236 project would not adversely affect the local market, and subsequent developments have confirmed this opinion.

The co-op owns the land and improvements and solicits subscriptions (applications) to the living units. A qualifying subscriber may become a member of the co-op, with exclusive occupancy rights (like a lease) to a specific unit. For his undeferrable share, the member makes regular monthly payments (averaging—through a wide range—about $150) to the co-op. In turn, the co-op provides utilities (except electricity), fire and extended-coverage insurance, maintenance, and repairs, and it pays the site mortgage and taxes. The FHA Grand Rapids office determined all housing prices on the basis of comparable rates, and the site mortgage is the amount approved by HUD. Amenities in each unit include the range, oven, refrigerator, dishwasher, and air-conditioner. About half the units have basements.

As agents of Kalamazoo BREAKTHROUGH Consumer Housing Cooperative, FCH Services and later Consumer Systems managed sales for New Horizon Village under the overall direction of KBHV. Earlier, in April 1971, KBHV had retained an advertising agency to handle promotions. That contract covered all news releases, advertising, brochures, TV and radio spots, signs, and some of the displays.

OBW proposed beginning the sales program in September 1971, prior to completion of the community center and with only part of the site ready. After numerous discussions between the developer, OBW, and FCH, sales started on November 21. One of the main marketing aids was the demonstration of four fully furnished model homes. By year's end, 40 units produced by Levitt, National, Scholz, Hercoform, and Republic Steel had been leased, 15 of them at market (unsubsidized) rate.

Although the first "sale," a Levitt unit, was made in November 1971, the first move-in did not occur until March 11, 1972. Two factors caused the delay: FHA rejected the co-op's proposed operating budget, and HUD's approval committee withheld certificates of occupancy pending HSP compliance with the National Bureau of Standards testing program. FCH had to hold applications for three months while the problems were worked out; during this period, more than half of the original applicants withdrew. By June of 1973, shares representing more than 90 percent of the units—235 out of 245—had been sold, and the co-op became viable. At that time, the co-op took over its own operations and maintenance.

A main objective of the marketing program was to achieve a good economic mix, using as a criterion the percentage of market-rate sales compared to the total. In June 1973, this figure reached 17 percent, much better than anticipated. By 1974, turnovers in occupancy reduced the number to 12 percent, which still is considered satisfactory.

Another marketing goal was the establishment of a

racial mix; however, minority participation started slowly. During the early phases of the marketing program, sales to minorities fell short of the goal, i.e., minority representation on-site approximately equivalent to that of the City of Kalamazoo, or 14 percent. Initially, the New Horizon Village racial proportion was about half that of Kalamazoo, but by March 1974 the minority population at the site had increased to 19 percent.

Levitt units had the best market appeal; in fact, people waited to move to them from other units. Although most of the system's innovations were in the factory methods used to produce the modules, an interesting and popular variety of interiors was achieved by the use of 11 different floor plans. Levitt designs provide large, open rooms, with pleasant interior arrangements (Fig. 18).

Fig. 18—Interior of Levitt townhouse

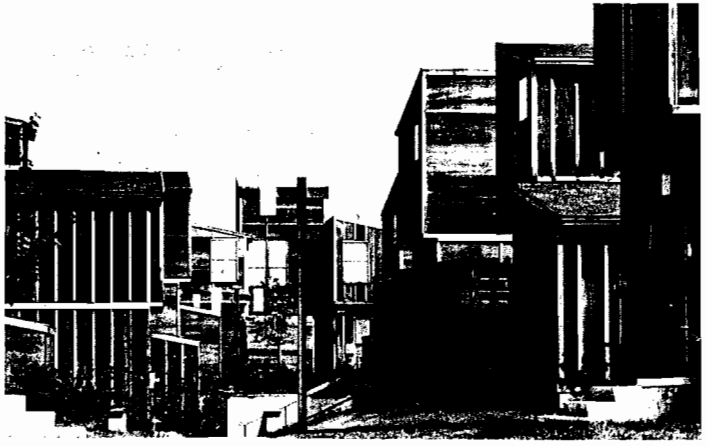


Fig. 19—Hercoform "European Street"

Fig. 17—Welcome for first residents

Fig. 20—Contrasting appearance of Hercoform "Cape Cods"

Fig. 21—Republic Steel single family detached unit

The Hercoform dwellings are distinctive, especially in the "European Street" setting (Fig. 19). However, they are least popular, due to interior arrangements and the outside appearance of some units. Those with redwood-stained plywood siding weathered and had to be repainted. The traditional Cape Cod style, with aluminum siding, has withstood the elements well.

The Scholz units are conventional in appearance. They offered no distinctive features which would give them a marketing advantage over the direct BREAKTHROUGH competition.

Consumer acceptance of the Republic Steel system was excellent. All four units were sold within one week at market rate.

The FCE-Dillon system is almost in a separate category because the building was provided to fill a special need—housing for the elderly. A local shortage of such facilities virtually assured a good reception; moreover, the structure is well conceived and functional. The FCE-Dillon building has been fully occu-

Weather and Comfort

New Horizon Village is open to the gusty westerly winds that sometimes sweep through the area. Annual rainfall is 31.2 inches. Kalamazoo is subject to the weather extremes common in the Midwest. It is the coldest BREAKTHROUGH site, with mean low winter temperatures in the low 20s. Snowfall can be heavy, averaging 78.7 inches annually. On the other hand, summers are warm, with average high temperatures in the mid 80s. All BREAKTHROUGH housing units are therefore equipped with air conditioning and adequate heating systems, and all except Hercoform's are fitted with insulating glass. National Homes applied storm doors to its units.

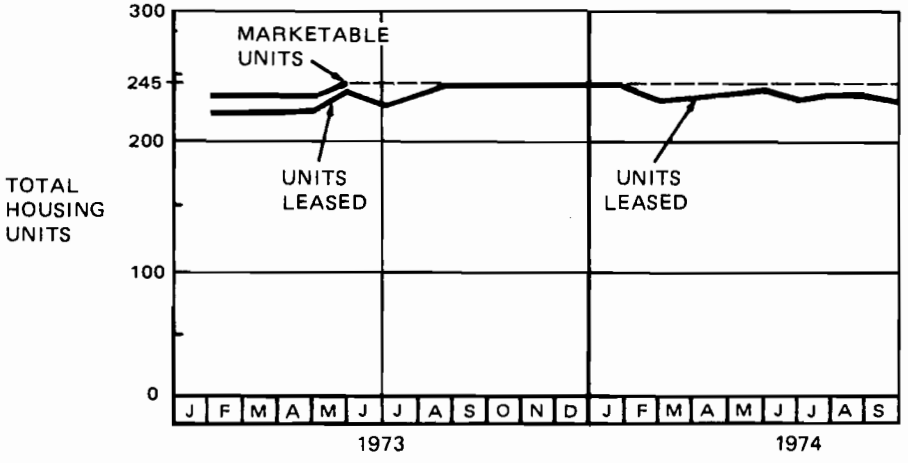


Fig. 22—Marketing and occupancy record

pied since it came on the market, with a waiting period of more than a year for prospective residents. The co-op management believes that two more such buildings could be filled.

The National Homes units were well received. The design was somewhat inflexible in that it limited the options for joining modules to form different floor plans in any one townhouse structure.

The Material Systems units, being the last completed, did not enjoy the marketing impetus that the others had. However, by April 1974 all ten SFDs were occupied.

New Horizon Village achieved its marketing goals, and for many months was fully occupied (Fig. 22). The occupancy level has seldom been below 95 percent since establishment of the co-op.

NEW HORIZON VILLAGE

GTR for site development – J. Rothenberg
GTR for planner – M. Chateauneuf
STR – W. Maule
ACO – J. Dilley
Director of OBR – J. Sabella

HSP COSTS
(dollars in thousands)

Producer	Cost
FCE-Dillon	$ 920.5
Hercoform	1,137.1
Levitt	1,939.2
Material Systems	258.5
National Homes	358.4
Republic Steel	200.0
Scholz	483.7
Total	$ 5,297.4

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM July 1970:	Start site preparation	12-70
	Start housing construction	4-71
	Finish housing construction	10-71
	End demonstration/marketing	7-72
Interim CPM April 1971:	Start site preparation	12-70
	Start housing construction	4-71
	Finish housing construction	10-71
	End demonstration/marketing	7-72
Actual Performance:	Start site preparation	1-71
	Start housing construction	4-71
	*Finish housing construction	5-72
	**End demonstration/marketing	6-73

*MSC complete rework 5-73
**Declare co-op viable

Fig. 23–Kalamazoo site costs and schedules

HOUSING SYSTEM PRODUCER SCHEDULES

FCE-DILLON, INC.	52 Multi-Family Medium Rise	
Phase II Contract:	Start foundations	6-71
	Start erection	7-71
	Complete erection	9-71
	Finish units	10-71
Actual Performance:	Start foundations	9-71
	Start erection	11-71
	Complete erection	11-71
	Finish units	3-72
HERCOFORM MARKETING, INC.	39 Single Family Attached 12 Multi-Family Low Rise	
Phase II Contract:	Start foundations	4-71
	Start erection	6-71
	Complete erection	9-71
	Finish units	10-71
Actual Performance:	Start foundations	5-71
	Start erection	7-71
	Complete erection	10-71
	Finish units	2-72
LEVITT TECHNOLOGY CORPORATION	51 Single Family Attached 32 Multi-Family Low Rise	
Phase II Contract:	Start foundations	4-71
	Start erection	5-71
	Complete erection	8-71
	Finish units	9-71
Actual Performance:	Start foundations	4-71
	Start erection	5-71
	Complete erection	9-71
	Finish units	5-72
MATERIAL SYSTEMS CORPORATION	10 Single Family Detached	
Phase II Contract:	Start foundations	5-71
	Start erection	7-71
	Complete erection	9-71
	Finish units	10-71
Actual Performance:	Start foundations	8-71
	Start erection	12-71
	Complete erection	3-72
	Finish units	5-73

NATIONAL HOMES CORPORATION	15 Single Family Attached	
Phase II Contract:	Start foundations	6-71
	Start erection	8-71
	Complete erection	9-71
	Finish units	10-71
Actual Performance:	Start foundations	10-71
	Start erection	10-71
	Complete erection	11-71
	Finish units	4-72
REPUBLIC STEEL CORPORATION	4 Single Family Detached	
Phase II Contract:	Start foundations	5-71
	Start erection	6-71
	Complete erection	7-71
	Finish units	8-71
Actual Performance:	Start foundations	8-71
	Start erection	9-71
	Complete erection	11-71
	Finish units	2-72
SCHOLZ HOMES, INC. & STILES-HATTON, INC.	22 Single Family Attached 8 Multi-Family Low Rise	
Phase II Contract:	Start foundations	5-71
	Start erection	6-71
	Complete erection	7-71
	Finish units	8-71
Actual Performance:	Start foundations	7-71
	Start erection	9-71
	Complete erection	9-71
	Finish units	2-72

SITE IMPROVEMENT COSTS

(dollars in thousands)

Item	Cost
Storm and sanitary sewers	$ 212.6
Community facilities	175.4
Streets, fencing, site lighting	252.2
Utilities	66.4
Walks, patios, steps, graphics	96.5
Site clearing, surveying, finish grading	173.4
Landscaping	126.5
Total	$1,103.0

3-31-75

St. Louis, Mo

St. Louis

Site Location: Ewing Ave. & Market St. (east parcel); LaClede Ave. & Compton Ave. (west parcel)

Prototype Site Developer: Millstone Construction

Prototype Site Planner: Hellmuth, Obata & Kassabaum

Housing System Producers: Descon, Home Building Corporation, Material Systems Corporation (Wallace Construction Co.), Rouse-Wates

Total Housing Units: 464

Prior to redevelopment, the Mill Creek area was grim, deteriorated, and largely vacant.

A highlight of the Mill Creek renewal project is LaClede Town. The key people responsible for its creation and management next became closely involved with the BREAKTHROUGH project.

Introduction

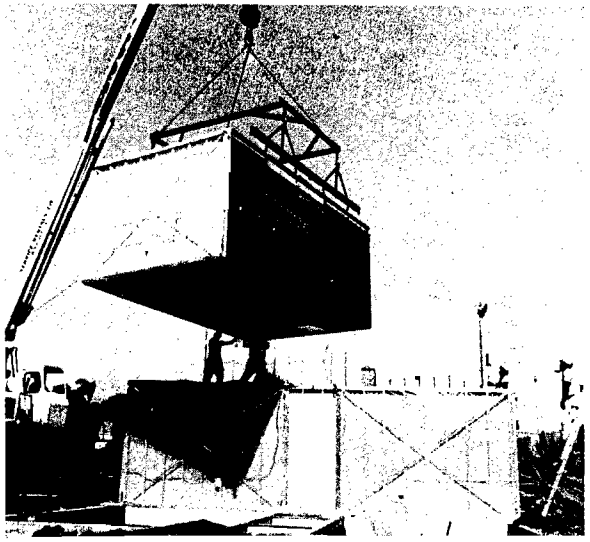
St. Louis BREAKTHROUGH is an in-city residential project, located approximately a mile west of downtown in the heart of the Mill Creek Valley Redevelopment Area. It is a valuable demonstration of industrialized housing in this urban context while furthering one of the most successful renewal programs in the United States.

The 464 BREAKTHROUGH units, completed in January 1974, occupy two separate parcels: 7.9 acres to the west of LaClede Town and 7.6 acres to the east. They are an important addition to the 800 medium-density townhouses and apartments built there in the sixties.

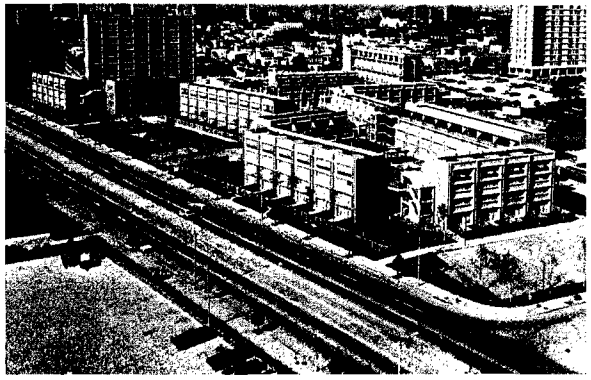
Site preparation started in November 1970 and, strengthened by the broad participation of minority and non-minority businesses, housing construction was well under way by the end of 1971.

Cover:

Strong community spirit, neighborliness, a history of success . . . all make this an ideal place for an Operation BREAKTHROUGH demonstration.

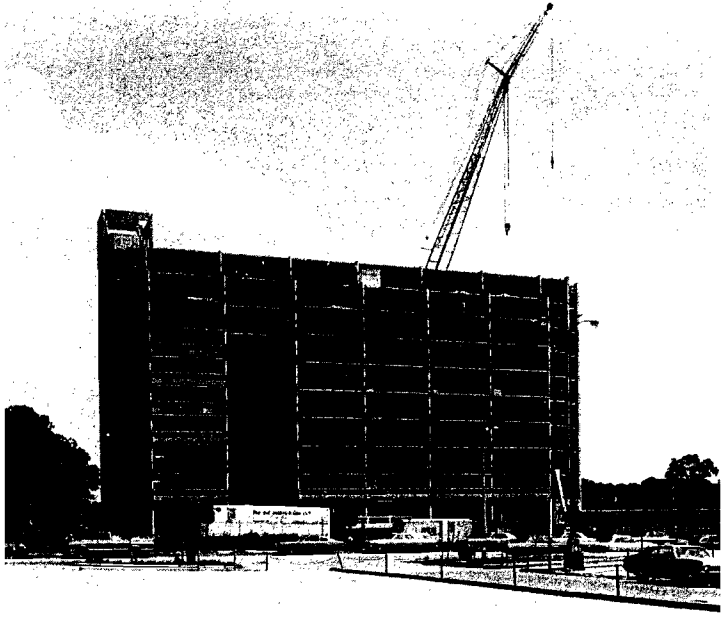


Home Building Corporation (HBC), assigned to the west parcel, rapidly erected modular townhouses, which were the first BREAKTHROUGH units to be completed and occupied—by the spring of 1972.



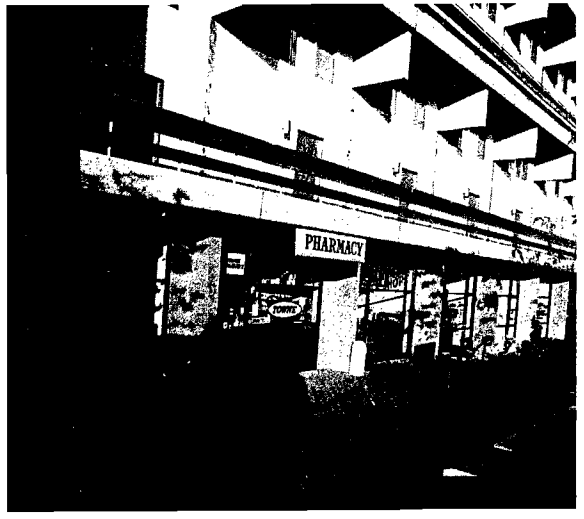
The east parcel has high and medium rise configurations of the Rouse-Wates system. On both parts of the BREAKTHROUGH site, the buildings are carefully placed to create interior spaces for pedestrian activities—parking is on the perimeter. Overall site density is 29.8 units per acre.

A new community center adjacent to the site provides meeting space, game rooms, food service, day care, and special programs for all LaClede Town.



Descon constructed a high rise as well as medium- and low-rise structures of concrete panels. The Descon units share the west parcel with HBC townhouses and Material Systems garden apartments.

LaClede Town Redevelopment Corporation, which purchased the BREAKTHROUGH project, marketed it in a way to achieve a socioeconomic mixed community. The units are rented at market rates or through FHA Section 236 or HUD's rent supplement program.



The 1,200 BREAKTHROUGH residents enjoy several on-site community facilities, including commercial space, a swimming pool, tot lots, and separate maintenance buildings.

Background

St. Louis is an American city with dramatic examples of urban decay and center city residential deterioration. Having lost over 200,000 population in the last two decades, faced with racial tensions, aging buildings, and the many problems of the urban poor, the city recently launched a crucial program of urban redevelopment.

Administered by the St. Louis Land Clearance for Redevelopment Authority, Mill Creek Valley is one of the largest official redevelopment areas in the country. With both private and public investment, it has prospered steadily since its early planning stages in the 1960s.

Ten years ago, Mill Creek Valley was 460 acres of old houses, empty lots, and run-down buildings on the western edge of central St. Louis. The area contained 2,100 structures, 99 percent of which needed major repair. Eighty percent of the dwelling units had no bath or toilet; many lacked even running water. The redevelopment plan called for mixed urban land uses, thus some areas were scheduled for industrial building and others for residential structures. The plan also designated nearby institutions and facilities for expansion. The project got a good deal of public criticism after the old structures were removed, and while the land stood vacant the area was nicknamed "Hiroshima Flats" (Fig. 2). But today—with over $200 million in private investment, substantial federal funding, and a large public effort—the Mill Creek Valley project is nearly completed. Its new uses include an extension of St. Louis University, several light industrial areas, commercial developments, and many residential communities. Mill Creek Valley stands as testimony to the success that urban renewal programs can achieve.

LaClede Town and LaClede Park were developed as new in-city living areas within Mill Creek Valley. Successfully attracting residents in integrated patterns

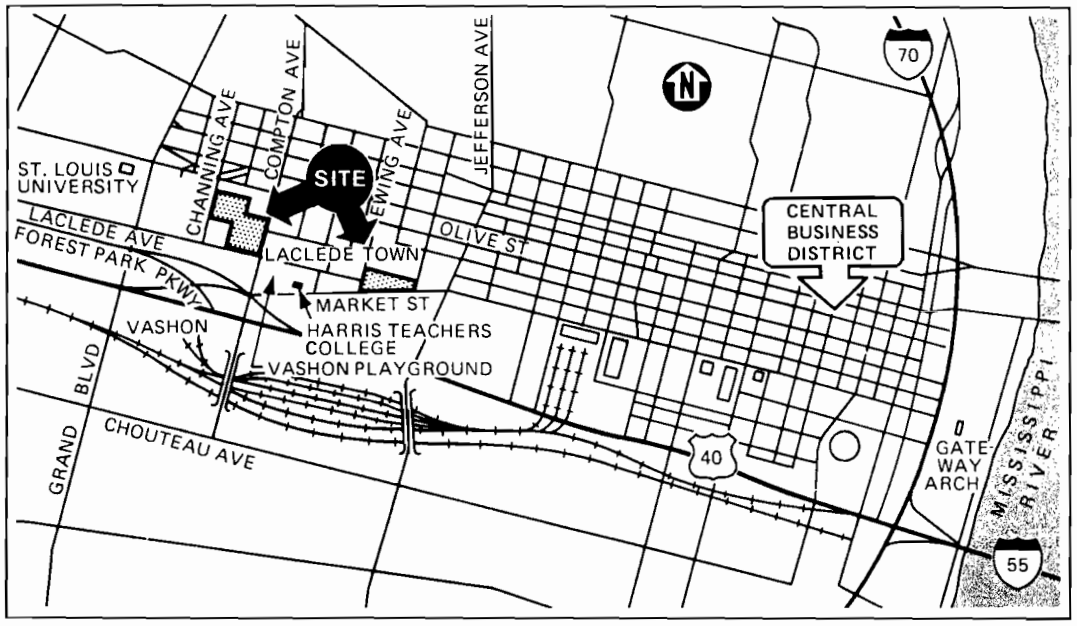


Fig. 1—BREAKTHROUGH site location in St. Louis

of race, income, age, education, and employment, these communities have received national recognition. Residents are in family groups; less than 10 percent are single. There are older, retired people and young people in college and medical school, but most residents are of family-raising age. The population is not transient although the students are quite mobile. There are now stable white families to join the stable black families who have lived in this area for a number of years. Recent estimates reflect racial integration, with 40 percent black, 50 percent white, and 10 percent other minorities. The combination of market units and subsidized housing results in a broad economic mix; the recipients of public assistance and middle class professional workers live side-by-side. Middle income people desiring downtown housing pay market rates for it. Subsidized dwellers are not necessarily forced out as their incomes increase; the federal government has raised income limits on several occasions. Some previously subsidized stay on at increased rates as their personal fortunes improve.

As stated in an article in *Architectural Forum*:

> "The mix at LaClede Town goes further: it includes right-wing segregationists and Black is Beautiful people; it includes nurses, interns, laborers, librarians, firemen, policemen, construction workers, bus drivers, brewery workers, teachers, assemblyline workers, bartenders, public agency workers, cub reporters, painters, musicians, writers, poets, city planners—and bums. Political signs in the windows and nameplates on the doors identify LaClede Town's diversity and its collective pride in its individualities."

This success has resulted in strong community spirit, neighborliness, lowered crime rates, and an

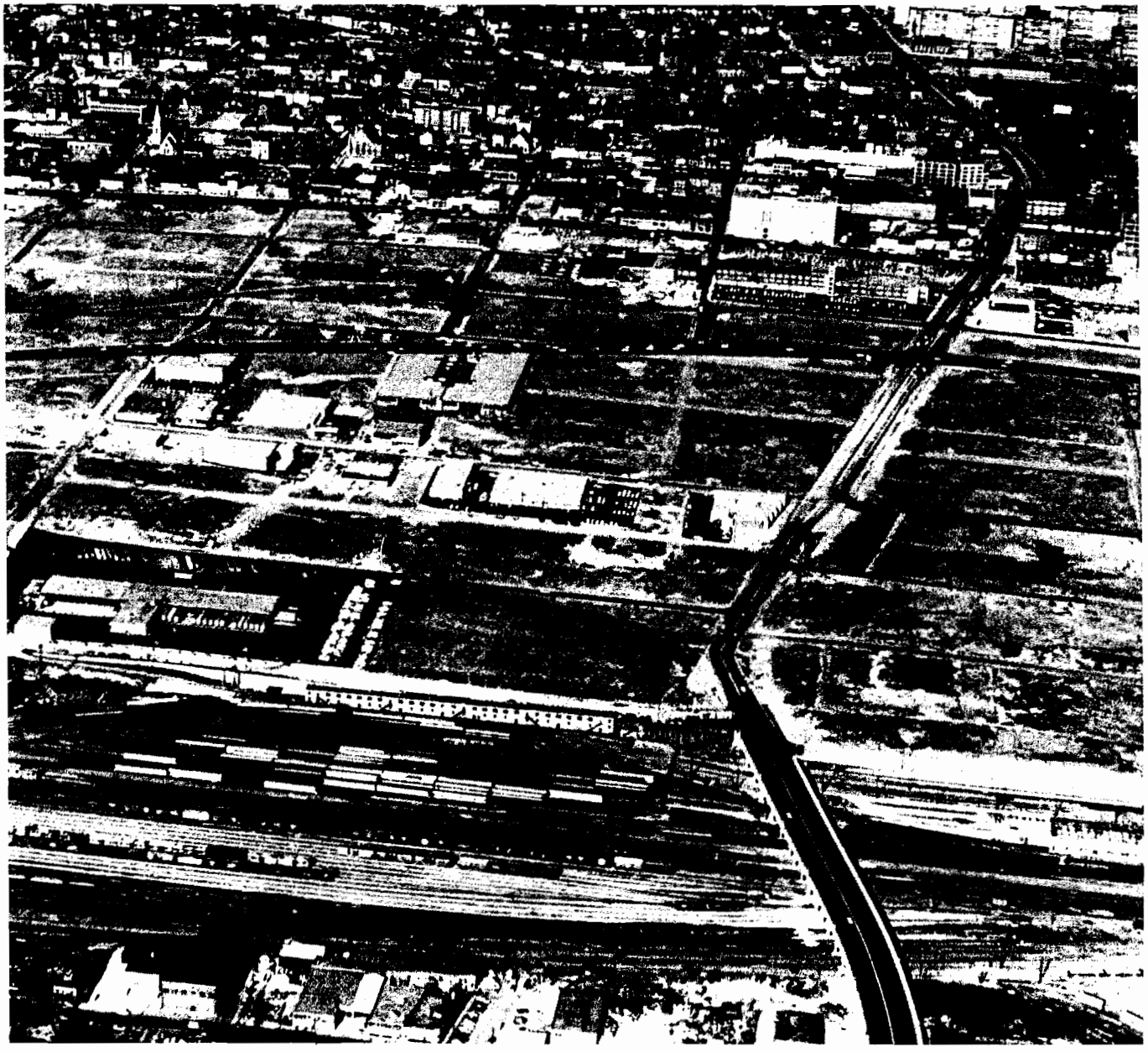


Fig. 2—Mill Creek Valley at Jefferson Ave., c. 1964

attractive, lively place to live in St. Louis.

The availability of several vacant parcels adjacent to LaClede Town presented the opportunity for a mutually beneficial project for BREAKTHROUGH and Mill Creek Valley redevelopment. After the national announcement of Operation BREAKTHROUGH, HUD solicited prototype site applications from local and state governments. Deeply involved in city redevelopment and housing programs, St. Louis Mayor A. J. Cervantes and other local officials saw BREAKTHROUGH as an opportunity. In order to meet a goal of satisfactory housing for all citizens, the city had set an objective of 45,000 new homes in the decade of the seventies. With BREAKTHROUGH, St. Louis was able to participate in an important housing program while providing another much needed city residential redevelopment. Mayor Cervantes instructed the city plan commission to select potential sites and prepare an application to be a part of the BREAKTHROUGH program.

The city explored a joint application with St. Louis County, but reconsidered when the county expressed fears over public housing projects. The city, in September 1969, submitted its proposal specifying a primary site that contained two parcels bracketing the LaClede Town development—one to the east and one to the west—and an alternate site in the northeast part of the city.

The East-West Gateway Coordinating Council and the State Department of Community Affairs supported the city's application as did the Regional Council of Government Agency which filed a market aggregation report. The application made a convincing proposal for a prototype demonstration in an urban, in-city setting. Thus HUD chose the St. Louis primary site as one of the nine BREAKTHROUGH prototype locations. (The alternate, not needed due to the excellence of the LaClede Town site, was subsequently developed as a complex for the elderly

Fig. 3—Mill Creek before renewal

Fig. 4—Social activity in LaClede Town

under another program.)

In July 1970, after a period of initial controversy and an unsuccessful vote, the St. Louis Board of Aldermen passed Ordinance #55661, "authorizing" the city's BREAKTHROUGH project. The ordinance recognized BREAKTHROUGH's special circumstances. It provided for variances from local requirements relating to land use, construction, and occupancy of buildings, with the stipulation that HUD acknowledge the acceptability of the housing, as being in compliance with the performance standards developed by the National Bureau of Standards (NBS) and validated by the National Academies of Science and Engineering. The ordinance designated the city plan commission as coordinating agency for BREAKTHROUGH and listed the following responsibilities: establishing an affirmative action program, developing guides and standards for tenant selection and project housing unit design, and making periodic progress reports of the coordinating function and project development to the board of aldermen. (The requirement for reporting proved to be a very useful element of the ordinance.) Expressly providing the legal flexibility necessary for BREAKTHROUGH, the St. Louis code variance provision exemplified the strong local commitment to the project.

The area around the two LaClede parcels contains varied land uses. To the north, marginal commercial enterprises occupy older buildings that have changed uses many times. Partially occupied, deteriorating residential dwellings are mixed with retail and wholesale businesses. Much of this area is scheduled for revitalization as part of the city's "New-Town In-Town" program. East of the site is a recently developed business district containing a variety of low-rise office buildings, a church, and a 16-story

Fig. 5—Redevelopment includes industries

apartment building. It is adjacent to the major open space leading to downtown, terminating at the riverfront Gateway Arch. To the south, an extensive commercial and light industrial area has been developed in the last seven years (Fig. 5). Harris Teachers College is also located south of the site, as are the Grand Forest and LaClede Park residential neighborhoods. The area to the west contains the recently constructed addition to St. Louis University. This extension of the campus has a variety of contemporary buildings and abundant open space.

Pre-Development Activity

During selection of the BREAKTHROUGH sites, HUD issued a request for proposal on August 28, 1969, to get the services of professionally qualified firms or consortia to undertake the unique site planning activities required for the prototype sites. Selected and assigned to the St. Louis BREAKTHROUGH site was Hellmuth, Obata & Kassabaum (HOK), a large St. Louis architectural-engineering-planning firm, with considerable experience in the design of subsidized housing. HOK signed contract H-1200 with HUD for prototype site planning on January 9, 1970, and began site investigation and analysis work.

The natural features of the 15.58-acre site presented no substantial constraints. There were opportunities in the flat, accessible nature of the parcels and their prime location in a residential redevelopment area close to public facilities and services. The project benefited from city planning for the redevelopment of Mill Creek Valley, of which it was a substantial part.

During coordination meetings with city code departments, however, the planner encountered some concern over the ordinance agreement to relax local codes. The St. Louis Building Commissioner expressed apprehension regarding fire protection and public safety. He warned that code flexibility might invite land use violations (e.g., commercial activities in residential zones) by tenants. Finally, there was a general uneasiness by the commissioner and officials of public utilities about the "innovative ideas" that might be implemented in BREAKTHROUGH. Some of the specific uncertainties were: adequate access to and egress from buildings and public gathering places, fire lanes, fire rating of building materials, construction techniques, control of unauthorized activities, level of maintenance, and the policy of replacing or repairing damaged structures. The most specific problem was the use of plastic pipe, which the commissioner, as well as local trade unions, considered inadequate if not dangerous.

Although this local concern continued throughout BREAKTHROUGH, respect for the work of the National Bureau of Standards and close coordination by the planner and the developer greatly assisted in resolving these matters.

HOK developed site design objectives based upon BREAKTHROUGH goals, the desires of the city, and characteristics of the existing community. Alternative conceptual plans were assessed on their conformance to these objectives, which included keeping automobile traffic to a minimum, making public spaces safe, providing high-visibility play areas, and reducing objectionable sights and noises as much as possible.

HUD initially assigned Rouse-Wates, Inc.; Descon/Concordia Systems, Ltd., later known as Descon Systems, Ltd.; Home Building Corporation (HBC); and National Homes Corporation to St. Louis. The planner's analysis, strongly influenced by the philosophy of the successful LaClede Town community, determined that residential development should be to medium urban densities, with a combination of housing unit types, from low urban density single family townhouses to medium-rise tower apartments. At first, there were 260 units scheduled for the west parcel: 124 multi-family low- and medium-rise apartments from Rouse-Wates, 124 multi-family low rise and single family attached from National Homes, and 12 single family attached from HBC. The east parcel was scheduled for 237 units, with Descon providing 149 single family attached and multi-family medium rise; and another 88 multi-family low rise and single family attached from National Homes. This total of 497 was subsequently lowered to 464 by a reduction of 37 units from the west parcel and an addition of 4 units to the east. When National Homes withdrew from the St. Louis project in early 1970, HUD assigned Material Systems Corporation to produce 20 units on the west parcel and the mix of other systems was rearranged. Rouse-Wates was increased from 124 to 241 units and reassigned as the sole system on the east tract. Descon was reduced from 149 to 128 units and reassigned to the west. Home Building's participation on the west parcel was increased from 12 to 75 units.

Upon review of the housing allocation, the Housing and Urban Development Committee of the St. Louis Board of Aldermen asked for more four-bedroom units. This change was made without affecting the total number of units, but it did introduce more population, particularly children, as a site planning consideration.

The planner, after each housing reassignment and configuration change (some of these were substantial), modified the emerging preliminary site plan. Revisions had been anticipated in the planning process, so they caused no big problems.

In the Task I Report, presented on April 16, 1970, HOK recommended a general design concept that became the basis for detailed site planning. This concept integrated design objectives, allocated residential areas and configurations for assigned housing systems, and designated other land uses, including commercial, recreational, and parking areas. The planner also recommended a visitors center be developed on available land adjacent to the east parcel.

Site Plan

The final site plan, completed by HOK in November 1971, follows concepts evolved in the preliminary designs. The buildings are arranged facing inward toward a pedestrian street, which is developed with a series of connected courtyards. Vehicular traffic and parking are on the edges of each parcel with cars completely separated from the pedestrians.

Many community facilities are located on the pedestrian street. There are play areas for children of all ages, sitting areas, water fountains, paved areas for cycling, small amphitheaters for special events, wisteria-covered arbors, and numerous large shade trees. Both parcels include a swimming pool, wading pool, and bathhouse.

A wide range of dwelling types is demonstrated: attached townhouses, two-story garden apartments, stacked townhouses three and four stories in height, and medium- and high-rise apartment buildings. Arrangement of these building types on the site respects both views and privacy for every unit.

The site plan benefited from a review by representatives of the American Institute of Architects, the American Society of Landscape Architects, the American Institute of Planners, and the American Society of Civil Engineers. For its BREAK-THROUGH work, HOK later received the first place award in the 1973 City of St. Louis Beautification Contest.

Housing Systems

The four St. Louis Housing System Producers (HSPs), using a variety of configurations, demonstrate several system types, with pre-cast concrete panel structures and factory-built wood box modules as well as conventional on-site construction.

The Rouse-Wates pre-cast concrete panel system, shown only at St. Louis, is intended primarily for high-, medium-, and low-rise multi-family structures.

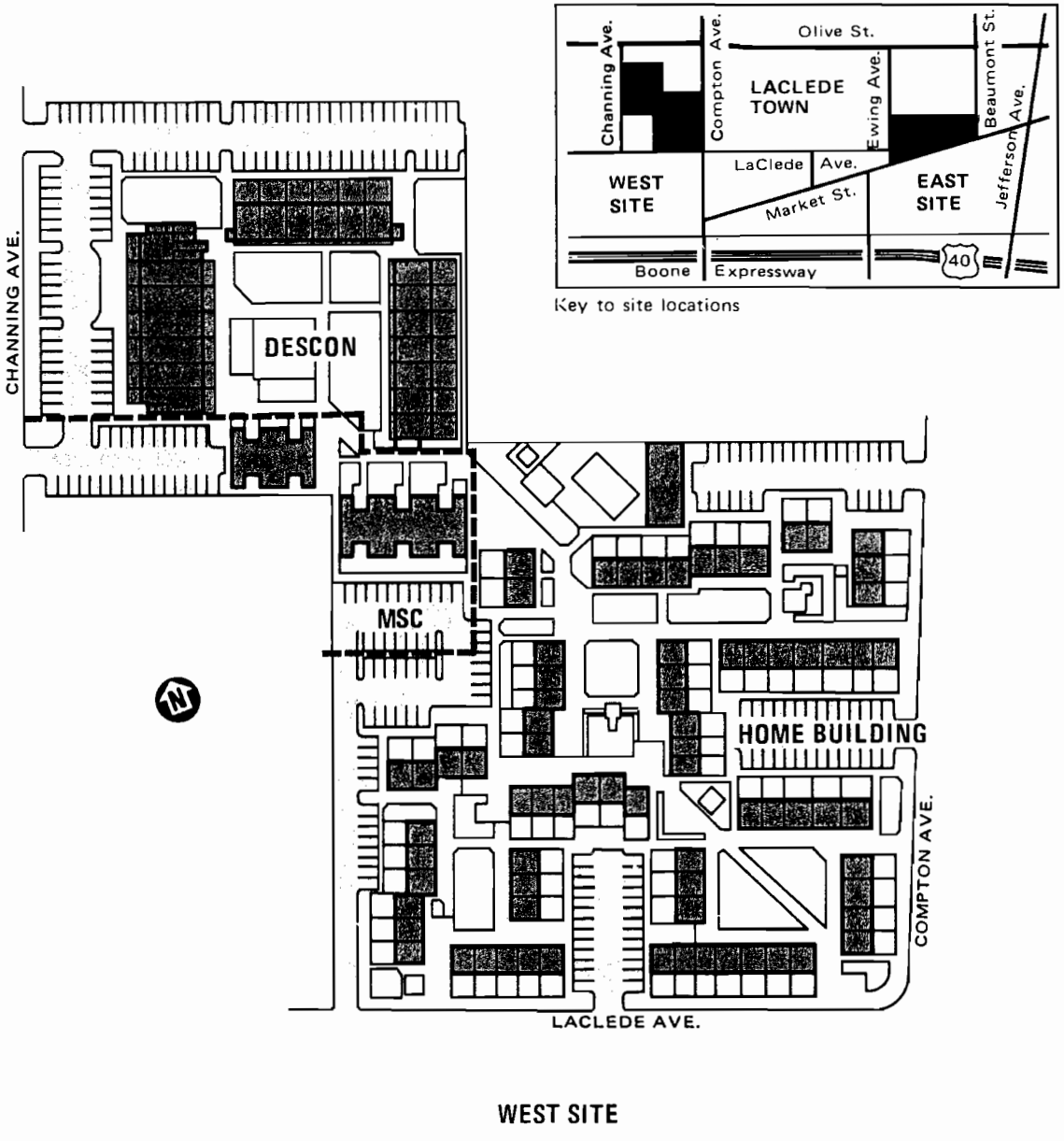
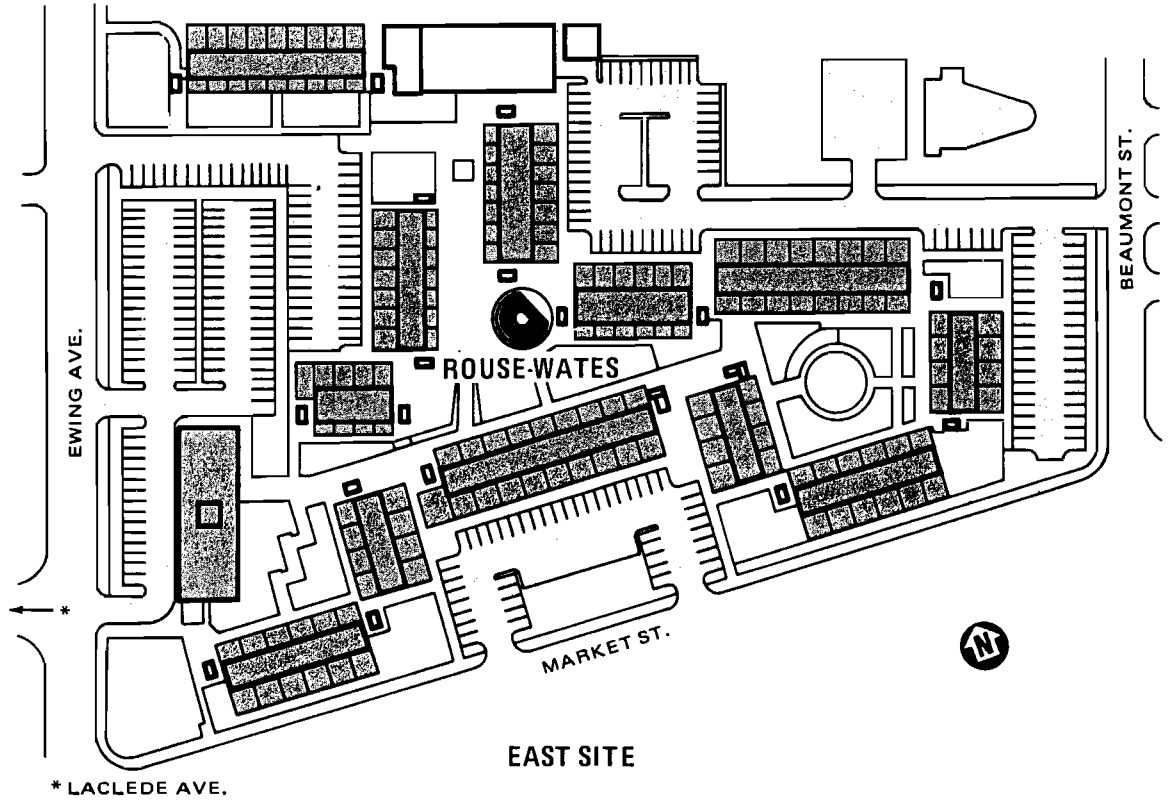


Fig. 6—Site plan as built

	DESCON				HOME BUILDING				MATERIAL SYSTEMS				ROUSE-WATES			
	EFF	1 BR	2 BR			2 BR	3 BR	4 BR		1 BR	2 BR		EFF	1 BR	2 BR	3 BR
SFA (75)						10	21	44								
MFLR (68)			14							10	10		17		17	
MFMR (147)	12		12										9	7	66	41
MFHR (174)	5	45	40										20	20	40	4
Totals (464)	128 UNITS				75 UNITS				20 UNITS				241 UNITS			

Fig. 7—Housing unit mix



Modified from its parent system developed in England, the Rouse-Wates system is made up of pre-cast concrete walls, floors, and roof panels, clad with non-load-bearing facade panels. The system is joined together with patented connections which are filled with cast-in-place concrete to provide rigidity. Several premanufactured subsystems are included to aid on-site finishing: prehung door units, heating-ventilating-air conditioning and plumbing core units, and prepackaged kitchen and bathroom modules.

The Descon system was designed primarily for multi-family medium rise and high rise applications. It was planned and organized to permit franchise operation by small entrepreneurs using local, existing fabrication facilities. Descon contracted with local sources to manufacture and assemble the components. The system is made up of pre-cast concrete walls and floor panels, joined by mechanical connections and sheathed by nonstructural curtain walls. Also included are several premanufactured modules and subassemblies: a plumbing, ventilation, and electrical module; service, kitchen, and bathroom modules; and door, weatherscreen (curtain walls), and interior partition subassemblies.

Home Building Corporation demonstrated 75 two- and three-story townhouses. The system consists of factory-built, preroofed and wired, self-supporting wood-framed box modules. They were trailered from Home Building's factory in Sedalia, Missouri, to the site and lifted onto prepared foundations, with 3 feet between each module. The gap lengthwise between the modules defined a so-called "extra modular" hall, which was then enclosed by a few simple premanufactured components. Glue was used extensively for both structural and nonstructural purposes. A 4-foot wide panel is the basic component of the walls. The floors are stressed-skin and the roofs use a beam system for cathedral ceilings.

Material Systems Corporation (MSC) planned to build 20 garden apartments at St. Louis, using a sys-

tem based on a unique man-made material. Panels made of resins, reinforcing fibers, and special additives, were to be assembled in a factory, and shipped to the building site. Another version of this system, employing the same components factory-assembled into box modules, was used for single family dwellings at five other BREAKTHROUGH locations. But, due to technical problems encountered with those units, the HUD Operation BREAKTHROUGH—Washington, D.C. office (OBW) decided to have the St. Louis MFLRs built by conventional methods. Wallace Construction Company of St. Louis, substituting wood for the composite material, stick-built the units according to original MSC floor plans.

Site Developer

On August 19, 1970, HUD awarded the St. Louis Prototype Site Developer (PSD) Contract No. H-1399 to the joint venture of Millstone Construction, Inc., and Millstone Associates, Inc. This joint venture brought together experience and capability in construction management, market analysis, land development, urban redevelopment, and overall project management, along with a strong leadership in minority hiring and training and other areas of Equal Opportunity. A senior level supervisor who had wide experience with Millstone was assigned as on-site project manager. His assistant brought similar credentials, as well as an interest in industrialized housing in this country and abroad. In the course of the project, the management and technical capabilities of the developer and established working relationships with both the planner and LaClede Town management proved helpful in accomplishing complex coordination and in reducing the impact of unanticipated project delays.

Upon contract award, Millstone prepared its project management system, including the use of techniques directed by OBW. Required program plans were drawn for key program elements such as land acquisition, financial accountability, subcontracting and labor relations, Equal Opportunity, planning control and reporting, and others. In an on-site office in LaClede Town, Millstone set up a project control room, which was used for approximately 20 months.

The PSD contract covered only project development and management, not providing for site or building construction by Millstone. All construction work was performed on the basis of competitive bids by site contractors under contract to the developer. All contract awards (except HSPs) and purchasing were performed in accordance with the OBW-approved contract procurement policy prepared by Millstone on October 29, 1970. This method required listing and soliciting of minority group subcontractors and consultants, and established procedures for competitive bidding, contracting, and documentation. The HSPs performed building construction work under contract to the developer, following negotiations between OBW and the HSP. Millstone reported the progress of site development at monthly OBW reviews, by means of personal appearances, written reports, and associated cost charts.

The Millstone contract expired in February 1973, at which time Boeing, in its role as master developer, assumed the responsibility to complete the site.

Land Acquisition

Prior to the inception of BREAKTHROUGH, Millstone Construction, Inc., had purchased the east parcel, and held the west parcel under option from the St. Louis Land Clearance for Redevelopment Authority. On November 5, 1970, title to both was placed with University Heights Breakthrough Redevelopment Corporation, a nonprofit special purpose organization (SPO) set up by the developer to hold title and assume financial responsibility for St. Louis BREAKTHROUGH development.

At the same time, the SPO bought a 1.9-acre area adjacent to the east parcel, also from the land clearance authority. Although this property was not covered by the BREAKTHROUGH ordinance, it was recognized as a key location for the critically needed community center, which became an important project, successfully implemented in parallel with the site development.

Financing

On September 14, 1970, Millstone submitted a complete marketing and feasibility analysis to OBW. Prepared by LaClede Town Company, it described the community profile, established the optimum housing unit distribution and mix, and included a socioeconomic profile of Mill Creek Valley. The analysis was particularly thorough and convincing because it was based upon almost a decade of experience in LaClede Town and was nearly devoid of speculation. Of course, in an area of critical housing demand, speculation on "need" is reduced; however, there is little question that the considerable experience of the developer and its consultant from LaClede Town Company did lend a level of "fine tuning" to the analysis.

OBW undertook several negotiations with the Federal Home Loan Bank Board and the St. Louis Association of Savings and Loan Organizations in an attempt to obtain single-source funding for all of the BREAKTHROUGH developments. When these discussions lagged for several months over a number of details, the developer was given the option of exploring other local financing sources. Millstone obtained construction financing (under FHA Section 233 pursuant to Section 236) from St. Louis Mercantile Trust Company.

Fig. 8—The east site—view west before construction

Fig. 9—The west site—view north before construction

Construction Conditions

As part of Mill Creek Valley redevelopment area, both east and west parcels had been cleared of structures. Several trees, ground cover, minor debris, and asphalt and concrete roadways existed on the relatively flat land. The surface elevations vary from 98 to 104 feet. The soil is primarily a silty clay that is very sticky when wet and is underlain with limestone.

Site Preparation

The market analysis had established the housing system distribution, mix, and density and proposed ancillary improvements for final site planning. To complete planning and financing, Millstone coordinated initial on-site development with HOK and the HSPs. Millstone also worked closely with the planner in coordinating the plans for the micro-site areas assigned to each HSP for construction.

The developer's written understanding with the St. Louis Board of Public Works and close coordination with the various utilities assisted completion of site planning. Millstone also obtained commitments from the city for public facilities and services critical to BREAKTHROUGH. These included provisions for schools, trash collection, playfield improvements, and traffic control.

Preparation of final site plans and working drawings had many of the same difficulties common to other BREAKTHROUGH sites. Millstone described some of the problems in its final report:

> "The complicated and confusing process of attempting to coordinate HSP drawings with the planner's drawings has resulted in many conflicts which have resulted in delays to the project and additional costs to the various parties. Even though the developer was responsible for coordination of these efforts, the procedure of NBS and HUD Central reviewing and approving final HSP drawings before the developer received same has led to many complications. All of the designers for the HSPs were not based in St. Louis, as was the planner, and the communication processes with the out-of-town HSP designers for total design coordination with the planner's designs were extremely difficult and resulted in all parties having HUD-approved drawings which did not always complement each other."

Probably as a result of the proximity and previous working experience of the developer and planner, site planning did proceed logically and well—in fact, within schedule constraints. The final plan was completed, working drawings prepared, and bid packages released with relatively minor problems in the context of BREAKTHROUGH development. The delays encountered were expected because of the demonstration nature of BREAKTHROUGH.

Groundbreaking ceremonies were held at the site on November 12, 1970. With featured speeches by the mayor of St. Louis, the HUD Regional Director, and the HUD Assistant Secretary for Research and Technology, the theme of the day was the hope and promise of national BREAKTHROUGH and the advanced state of the St. Louis project. The ceremony was well covered by local media, as were other events since the inception of the program. Actual site development began with rough grading work on November 16, and by spring substantial site work was well under way on both parcels.

By early summer 1971 all heavy water main work was completed, along with the sewer work on the east parcel. Sewer work was under way on the west parcel and scheduled to be completed by the end of June. The developer anticipated that underground electric, telephone, and site lighting work would begin by mid-July. Though progressing, site preparation consistently lagged behind initial estimates. The uncompleted west sewer work continued, with completion rescheduled for the end of July. The construction of the underground electric, telephone, and site lighting on the east parcel was rescheduled and subsequently begun in mid-August. Although these site improvement delays ran contrary to the desired fast construction schedule, they did not create serious project delays. The changes from the original schedule, caused by the HSP Phase II contract negotations with OBW, made the site preparation problem tolerable in terms of the overall program. The problem presented was not so much preserving the integrity of the original schedule—site work could be and was ongoing—but was the interface risk taken by site preparation in the absence of 100 percent drawings from the HSPs.

The water system work on the west parcel began in October and continued, simultaneous with the gas distribution network and the construction of the pool, bath house, and maintenance building that had been started in November. In December, the sewer work was completed except for the final connections. Also in December, new concrete driveways were constructed on the east parcel. The pool, bath house, and maintenance building were started in January 1972.

Home Building Corporation was out front in on-site construction and housing erection, actually preceding some of the site preparation work. The HBC units were completed and occupied more than a year before the units of the next housing producers. Because of this, the remaining site preparation, such as outdoor lighting, paving, and landscaping, was staggered, with work completed on a priority basis to accommodate occupancy of the units.

A highlight during move-in was the opening of the swimming pool during the Fourth of July weekend. All site work was completed following the finish of Wallace Construction's stick-built versions of the MSC units in January 1974.

Housing Erection

One of the initial and difficult tasks facing the housing producers, as they developed final drawings, was the process of conforming to local codes. The city BREAKTHROUGH ordinance enabled a process of flexibility and waiver based upon performance standards—the *Guide Criteria for the Design and Evaluation of Operation BREAKTHROUGH Housing Systems* developed by OBW and NBS.

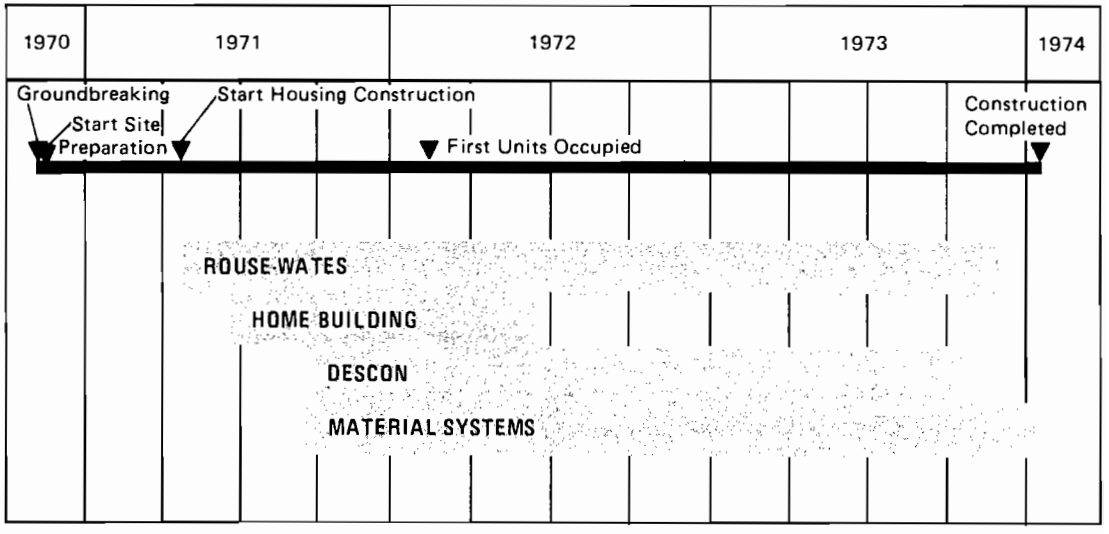


Fig. 10—Progress of housing construction

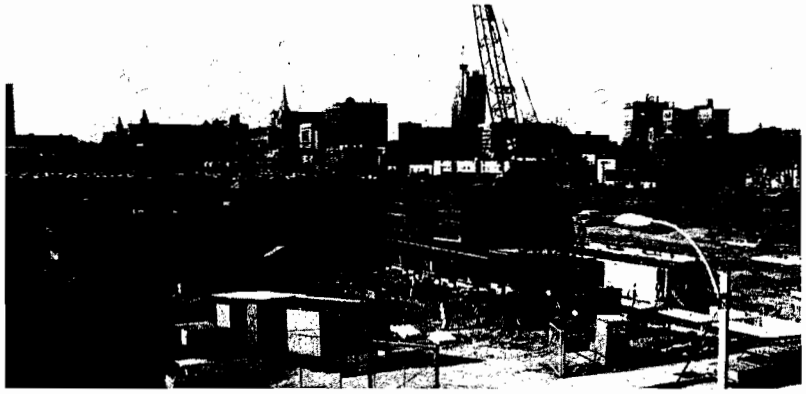
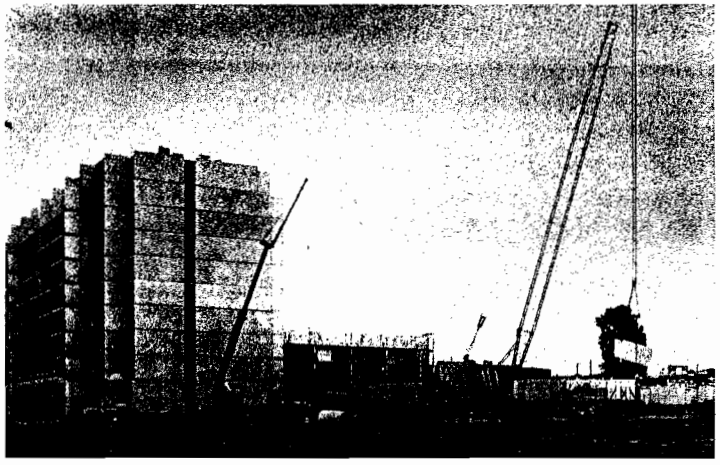


Fig. 11—Erection of HBC townhouse modules



. 12—Erection of the concrete panel Descon system

. 13—Conventional MSC units under construction

Fig. 14—Only Rouse-Wates built units on the east site

Although the ordinance provided for code exemption, city departments carefully reviewed the questioned housing system drawings. Considering that the local officials have continuing responsibilities beyond any one specific project, this attitude of caution was appropriate and certainly to be expected in such a demonstration program. At the same time, it should be recognized that this process also gave them an opportunity to analyze and challenge local codes that they thought needed such analysis and challenge.

Before any plans were made, OBW reminded the HSPs that they were to examine the codes and ordinances, make lists of the variances each system required, and submit them to OBW and the local agencies. Home Building Corporation informed OBW and the developer that its only required variance was the fire wall rating. In March 1971, the St. Louis Building Commission staff completed review of HBC plans and specifications, finding a lengthy list of variances. These included fire wall rating; the rating for floors, roofs, and beams; a number of other fire code issues related to configuration of wood frame constructions; roof structural load; foundation thickness; light and ventilation; and several problems in electrical and plumbing specifications. This list exemplifies the thoroughness of the building commission's review.

OBW replied to the St. Louis Building Commissioner with comments resolving the code differences based on BREAKTHROUGH guide criteria. In the cases where OBW concurred with the building commission, the HSP was required to amend the plans and specifications, which resulted in additional cost and, in some cases, delays in completing work. In many cases, however, the guide criteria were used to support new specifications for "prototypical and investigative" purposes.

Rouse-Wates began excavating for foundations on April 28, 1971. Pre-cast elements began to arrive shortly thereafter and were stored on-site. Erection started in November, dramatized by the presence of a 200-foot crane used for placing the pre-cast elements. All foundations for the remainder of the structures were completed by the end of the year. By late spring of 1972, erection of pre-cast concrete panels and other building elements was nearly completed for 4 of the 13 buildings, including the 12- and 6-story structures.

In midsummer, St. Louis BREAKTHROUGH had another unanticipated delay with a labor strike. An

earlier nation-wide elevator installers' strike only caused minor work postponement, but on August 9, the St. Louis area ironworkers struck, restricting all site work. By September 15, 1972, most of the other trades began to cross the picket lines, allowing limited trade activities to resume. The ironworkers returned to work on October 9, but it required months to bring the ironworker and composite crews back to full production. The momentum was lost and the restart encountered bad weather.

Late in the fall, all 13 Rouse-Wates buildings were nearing completion with only interior finishing and site work to be finished. In January 1973, additional finishing had been done, parking areas were paved, and the pre-cast stair towers, which had gone through two redesign efforts, were being put in place. The stair towers were completed in June as the units approached occupancy readiness. Following substantial work to achieve weather tightness, the developer accepted the units in December 1973.

The early and rapid system producer on the St. Louis site was HBC. It erected 75 two- and three-story townhouses of factory-built wood box modules, producing structures similar in exterior appearances to the existing homes of LaClede Town. HBC began excavating for foundations on the west tract in June 1971, received OBW approval of its 100 percent drawings in August, and began on-site erection of modules in September (Fig. 11). Erection was rapid and without major incident. With most construction at the factory, on-site erection included only a limited number of tasks. The modules were secured to prepared foundations and attached together with the extra modular halls enclosed. Electrical, plumbing, and other mechanical connections were made between modules and to below-ground utility connections. Site landscaping and paving followed, begun during the winter. Starting in February 1972, 18 townhouses were occupied, the first occupancy of BREAKTHROUGH units anywhere. Some were furnished for display and one was used for an office. The remainder were completed in May 1972 and occupied during the summer.

Descon began excavating for foundations on September 27, 1971. This quite complex system was considered one of the most innovative. It was expected to be the last completed with early estimates calling for completion by the fall of 1972. Descon received OBW approval of 100 percent drawings on May 4, 1972, and five days later began pre-cast erection, still hoping for late fall completion. However, the work proceeded more slowly than anticipated, due to several technical problems as well as the labor strikes and bad weather. The pre-cast components were erected and the weather envelope completed in November 1972, except for several windows and some roof detail, completed in December. Finishing the units and working off the "punch list" (items to be repaired or completed) required a substantial amount of time. Negotiations and work centered around leaks, and making the units watertight was a major factor delaying completion. Descon turned the units over to the developer in October 1973.

Material Systems Corporation was scheduled to use prefabricated molded panels, made of fiber-reinforced resins, assembled as garden apartments. MSC began excavating for foundations on September 22, 1971, and completed that work on November 8. However, due to technical difficulties already encountered with MSC units at other BREAKTHROUGH sites, OBW decided and MSC agreed not to construct factory-built units at St. Louis. But, because the MSC foundations were already done, and in order to follow and complete the original site plan, similar structures were stick-built in place. MSC provided drawings for conventional construction of the garden apartments and OBW released these drawings to Millstone in February 1973. A local architect incorporated city review comments and a St. Louis builder, Wallace Construction Company, won the bid to construct the units, which were completed in January 1974.

Community Relations

The community relations at St. Louis BREAKTHROUGH were comparatively smooth and successful, while the Equal Opportunity program, well-planned and affirmatively implemented, was exemplary. The success of these efforts can be credited to the social and political environment of St. Louis, as well as the capability and experience of the program participants, notably Millstone and LaClede Associates.

St. Louis, with vast urban redevelopment experience, does not seem to contain the strong currents of fear and apprehension toward "housing projects" or

Fig. 15—The community center

Fig. 16—Vashon Playfield

"government programs" that opposed BREAKTHROUGH in other cities. Several small groups did display concern over BREAKTHROUGH, but they did not oppose the program. Rather, they needed, and sought, information, which subsequently was provided. Probably because St. Louis has had considerable experience with federal-local ventures in housing, little anti-project reaction came from the extensive media coverage during the early months. Editorials were supportive, and program review articles were thorough, factual, and well-timed. Local television and radio also gave periodic news coverage, aiding general public knowledge of the total program.

In the course of site analysis, the planner held informational meetings with a number of local groups to establish community liaison. In the local community, BREAKTHROUGH created little misunderstanding and elicited no alarm. Local churches, educational facilities, clubs, and organizations supported the project, welcoming it as an important contribution to Mill Creek Valley redevelopment.

During the first year of the project the participants often discussed a permanent LaClede community center, the need for which had been well stated in Millstone's market analysis. HUD had intended the developer to build this facility using non-BREAKTHROUGH funds from an open space grant. However, Millstone and OBW agreed that the PSD contract did not cover the work.

The community center then became a lively local issue. Newspaper editorials appeared in favor of the facility. Many neighborhood groups and individuals held meetings, made contact with various authorities, and sent a petition to HUD Secretary Romney. This campaign was friendly, in that officials associated with BREAKTHROUGH acknowledged the need for the center. The problem was to find a funding source and program under which it could qualify. Ultimately, an increase in the BREAKTHROUGH mortgage provided the money for the site owner to construct the building, a valuable addition to all LaClede Town (Fig. 15).

Another community effort insured a replacement for Vashon Playfield, then located adjacent to Harris Teachers College on land needed for school expansion. City officials helped with this campaign, which documented the heavy use and strong local support for such a facility. (The BREAKTHROUGH market analysis had also pointed out a need for playgrounds near the family-oriented west parcel.) Through an exchange of Millstone, board of education, and municipal properties, the city acquired 5 acres west of BREAKTHROUGH. HUD allocated "open space" funds to cover half the cost of designing and building a new active, outdoor recreational facility. The playground serves both BREAKTHROUGH and the surrounding community (Fig. 16).

The accommodation of visitors was found to be an important element in the BREAKTHROUGH demonstration at many sites. Recognizing the value of a visitors center, and viewing the favorable national publicity St. Louis received as one of the eight cities in the United States where BREAKTHROUGH prototypes were constructed, the developer proposed a large-scale effort. This could not be funded, but in October 1971, the Government Technical Representative (GTR) did authorize a temporary visitors center located in a LaClede Town storefront. The facility opened in time for an important United Nations team visit on November 20. With modish decorating, supergraphics, displays of site models and plan renderings, audio-visual stories of BREAKTHROUGH, and above all a congenial staff of local residents, the center entertained over 10,000 visitors, many from foreign countries. It received enthusiastic community support and proved an invaluable aid to public information regarding the project. The developer operated the center until August 1972, when the function was transferred to the new community center facility.

The project review reports by the plan commission to the board of aldermen, also proved to be important to public information. These illustrated documents were used to explain the local program, its goals, and progress. One project review noted that the developer "was actively involved within the community to cause continued interest and involvement in the development of the project." This casual citation doesn't adequately express the fact that the commitment and experience of Millstone and LaClede Town Company did so much for good community relations in St. Louis.

Millstone's affirmative action program created extensive equal employment and contracting opportunities. The existing "St. Louis Plan" for training and hiring, which had been endorsed by local trade unions, associations, employers, and contractors—including Millstone—strengthened the commitment to this approach. Affirmative action succeeded on BREAKTHROUGH. The St. Louis Council on Human Rights, charged with enforcing the city's Equal Opportunity code, reported full compliance by the developer.

This success was commended by the Director of Operation BREAKTHROUGH: "St. Louis' site leads

all others in the employment of minorities on their staff, workmen on the construction site and minority entrepreneurship contractors. Millstone actively pursued Operation BREAKTHROUGH Equal Opportunity goals and is now participating in the fair housing aspect of their tenant selection."

Operation and Maintenance

Millstone initially conducted site operation and maintenance tasks as was routine for BREAKTHROUGH developers. To apply effectively the principle of preventive maintenance, Millstone involved service personnel in the review of drawings and specifications prior to the actual start of construction. The same personnel also observed the construction work to help them more efficiently conduct later maintenance and repair. This is a key technique and was particularly valid for a development featuring new housing concepts.

Effective May 1, 1972, LaClede Associates took over all operation and maintenance activity, in addition to the leasing, under direct contract with OBW. These activities were assigned to LaClede Town Company, the operating branch of LaClede Associates. After using a temporary office in an HBC unit on the west parcel, LaClede Town Company opened its permanent rental office on the ground floor of the Rouse-Wates tower (Fig. 18).

Fig. 17—LaClede Town Company maintenance

The operation and maintenance philosophy of LaClede Town Company is commended to anyone interested in residential community management. Developed over years of experience at LaClede Town—recognized as one of the most successful new in-town communities—a detailed approach is explained in the BREAKTHROUGH management manual prepared by LaClede Town Company. This manual divides management into social, physical, and fiscal tasks. The treatment of subjects such as rent-up, seeding the community, move-in, initial contact, building the community through communication, activities, maintenance, and security is refreshing.

Millstone maintained responsibility for the site safety and security program since construction began. It provided a chain link security fence around the perimeter of both parcels during most of the construction period. Uniformed, armed, licensed security watchmen—one for each tract during nonworking hours—were hired from LaClede Town Company. Most security watchmen were community residents and members of minority groups. Duty watchmen prepared daily reports. Budget cuts by OBW terminated construction security guard services on June 20, 1972. The developer kept the security fence intact, if possible, in areas where HSPs continued with basic construction work. A part-time guard service on the Descon portion of the west parcel began again in November 1972 at OBW request; losses due to theft and vandalism had been substantial.

Following the completion of the units, Millstone, and later Boeing, administered a standard BREAKTHROUGH warranty. This warranty guaranteed the structural integrity of the units, including all defects except those items of normal maintenance. Typical items repaired included leaks and water damage in both the Descon and Rouse-Wates and the air-conditioners in the HBC units.

Fig. 18—LaClede Town Company offices

Marketing

Millstone's "Marketing and Feasibility Analysis" was particularly valid because of its strong market trend base. Existing demand exceeded the proposed supply, so the marketing task was to generate the best concept for tenant selection. BREAKTHROUGH did not develop in a vacuum; it benefited from the experiences and data of the LaClede Town community. The objective was a socioeconomically mixed tenancy, accommodating all races, age groups, and income levels—based on the LaClede Town approach. Although the housing was mostly for in-city residents of the greatest need, it included nonsubsidized units for people choosing to live in-city. BREAKTHROUGH was marketed to establish a rental group of varied status, consistent with the larger LaClede Town

Fig. 19—Completed Descon high rise

Fig. 20—First BREAKTHROUGH occupancy was in HBC units

	EFF	1 BR	2 BR	3 BR	4 BR	Totals
Rent Supplement	11		13	14	12	50
236 Program	10		61	29	32	132
236 Exception	34	76	120	12		242
Market Rate	8	6	15	11		40
Totals	63	82	209	66	44	464

Fig. 21—St. Louis marketing mix

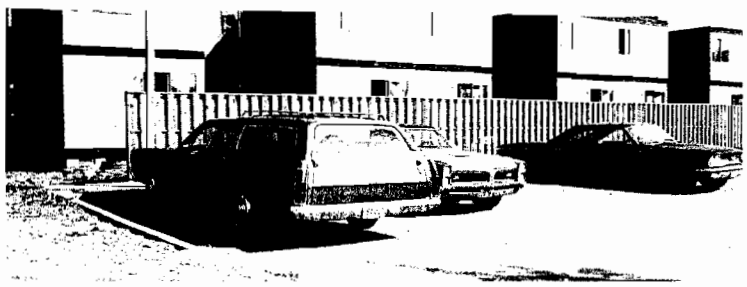


Fig. 22—Conventional units built to MSC design

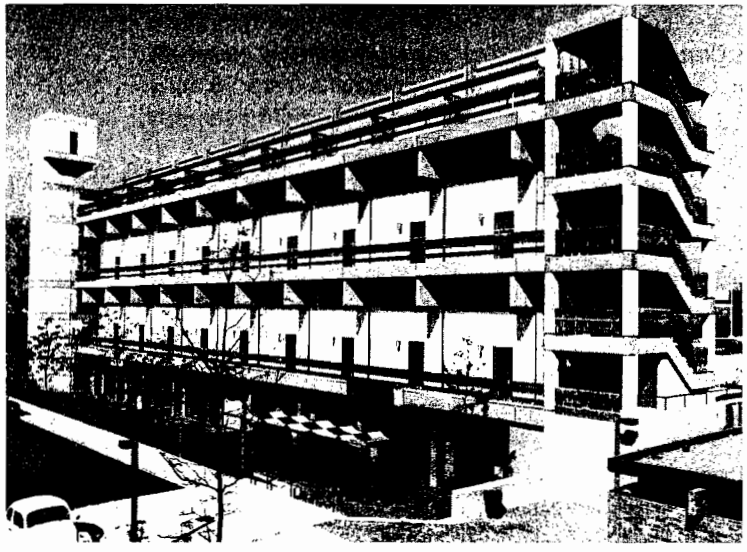


Fig. 23—Completed Rouse-Wates mid rise

Weather and Comfort

Located near the geographical center of the United States, the St. Louis site has a somewhat modified continental climate. Warm moist air from the Gulf of Mexico and cold air masses from Canada produce a variety of weather conditions. Temperatures remain below freezing 20 to 25 days, and above 90° 35 to 40 days per year. In order to provide a comfortable environment, the BREAKTHROUGH units have air conditioning.

community.

The OBW contract with the LaClede Town Company for operation and maintenance and leasing, in May 1972, anticipated the subsequent sale of the BREAKTHROUGH site, now known as LaClede/West and LaClede/East, to LaClede Town Redevelopment Corporation—a nominee for LaClede Associates—on June 1, 1972. Millstone, operators of the existing LaClede Town community, then also sold the housing between the two BREAKTHROUGH parcels to LaClede Town Redevelopment Corporation, putting the entire community under one owner/operator. This sale of BREAKTHROUGH made the project an integral addition to the community and created a continuity of management.

LaClede Town Company rented the units, as groups of them became available for occupancy, under four different programs: market rate, FHA Section 236, FHA Section 236 exception, and rent supplement. Each of the four programs was allotted a certain percentage of units within a group. For example, about 10 percent of the units was leased at market rates and about 10 percent was assigned to HUD's rent supplement program. Using this program, a joint council of management, LaClede Town/Park residents and businessmen, and local neighborhood associations recommended tenants for the subsidized units. Management made final determinations of tenant qualifications based on HUD guidelines. Marketing on a percentage basis within each group achieved the planned socioeconomic mix. The units are extremely popular with the tenants and a high rate of occupancy, at all income levels, seems assured for some time to come.

Fig. 24—BREAKTHROUGH children at play

GTR for site development — R. Jones, W. Wilcox
GTR for planner — M. Chateauneuf, S. Hodges
STR — L. Payne
ACO — C. Wolfe
Director of OBR — F. Porterfield

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM September 1970:	Start site preparation	11-70
	Start housing construction	12-70
	Finish housing construction	11-71
	End demonstration/marketing	11-71
Interim CPM March 1971:	Start site preparation	11-70
	Start housing construction	4-71
	Finish housing construction	11-72
	End demonstration/marketing	2-73
Actual Performance:	Start site preparation	11-70
	Start housing construction	4-71
	Finish housing construction	1-74
	*End demonstration/marketing	2-74

*MSC units occupied this date

HSP COSTS
(dollars in thousands)

Producer	Cost
Descon	$ 3,865.0
Home Building	1,358.9
Material Systems	40.8
Wallace Construction	242.7
Rouse-Wates	5,995.4
Total	$11,502.8

HOUSING SYSTEM PRODUCER SCHEDULES

DESCON SYSTEMS, LTD.
14 Multi-Family Low Rise
24 Multi-Family Medium Rise
90 Multi-Family High Rise

Phase II Contract:	Start foundations	9-71
	Start erection	4-72
	Complete erection	10-72
	Finish units	11-72
Actual Performance:	Start foundations	9-71
	Start erection	5-72
	Complete erection	12-72
	Finish units	10-73

MATERIAL SYSTEMS CORPORATION
20 Multi-Family Low Rise

Phase II Contract:	Start foundations	9-71
	Start erection	8-72
	Complete erection	9-72
	Finish units	10-72
Actual Performance:	Start foundations	9-71
	Start erection (Wallace Constr.)	6-73
	Complete erection (")	N/A
	Finish units (")	1-74

HOME BUILDING CORPORATION
75 Single Family Attached

Phase II Contract:	Start foundations	6-71
	Start erection	9-71
	Complete erection	2-72
	Finish units	4-72
Actual Performance:	Start foundations	6-71
	Start erection	9-71
	Complete erection	1-72
	Finish units	5-72

ROUSE-WATES, INC.
34 Multi-Family Low Rise
123 Multi-Family Medium Rise
84 Multi-Family High Rise

Phase II Contract:	Start foundations	4-71
	Start erection	11-71
	Complete erection	10-72
	Finish units	11-72
Actual Performance:	Start foundations	4-71
	Start erection	11-71
	Complete erection	6-73
	Finish units	12-73

SITE IMPROVEMENT COSTS
(dollars in thousands)

Item	Cost
Grading	$135.7
Sewers	250.1
Water	126.9
Electrical	371.4
Paving	315.9
Pools	330.4
Landscaping	153.9
Fences, play structures	124.2
Community center	286.5
Other	134.0
Total	$2,229.0

Fig. 25—St. Louis site costs and schedules

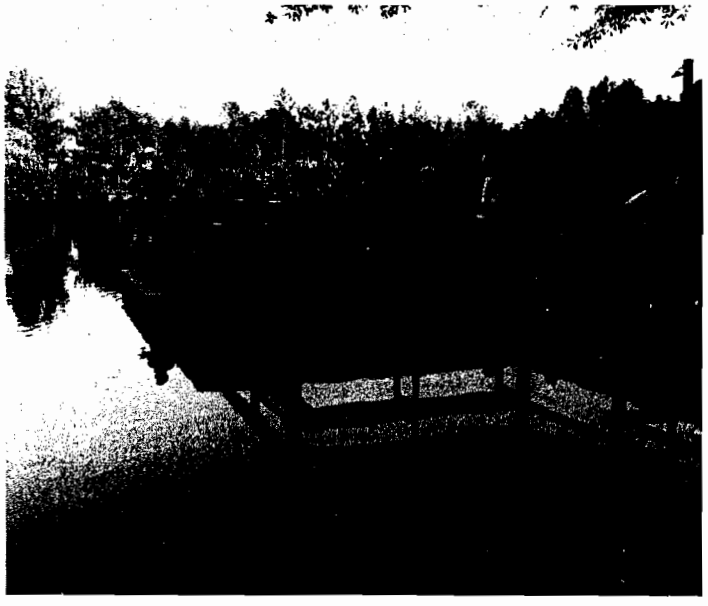
1-31-75

Macon, Ga

Macon

Site Location: Chambers Road & Crystal Lake Circle
Prototype Site Developer: Macon BREAKTHROUGH Housing Venture (MBHV)
Prototype Site Planner: Reynolds, Smith and Hills
Housing System Producers: Alcoa, Boise Cascade, Building Systems International, Christiana, Hercoform, Material Systems
Total Housing Units: 287

Basically, the site is a tree-covered, sloping horseshoe oriented to Crystal Lake. The plan is sensitive to vegetation, terrain, and water. The loop road and clustered housing intrude as little as possible upon the delicate ecological balance.



The six-acre lake, left in its former state, is the central attraction of the site. Although man-made, it fits naturally into the rustic setting. Protection of the lake and its ecology was a foremost consideration in the development of the project.

Introduction

Crystal Lake at Macon, Georgia, is often referred to as the most attractive of the Operation BREAKTHROUGH prototype sites. The site plan took into account all the natural beauty and advantages of the 49.6-acre suburban property. Site development was accomplished with care to preserve and protect the environment. This was the responsibility of MBHV, a joint undertaking of Fickling and Walker, Inc., and the National Corporation for Housing Partnerships. HUD contracted with MBHV to manage activities on-site, arrange for financing, contract for land improvements and housing erection, supervise construction, and accomplish disposition of the site.

A well-planned community relations effort earned broad public support for BREAKTHROUGH. Initial neighborhood response was hostile, but, through meetings with MBHV and timely media coverage, the program gained the support of the community.

Crystal Lake is a cooperative containing a total of 287 units at a density of 5.8 units per acre. Members own one voting share in the community and living rights to a home. In exchange, they make monthly payments toward mortgage and operating costs of the cooperative association, Kenilworth Manor.

After a slow marketing start when very little variety was available, sales moved well in 1973. By October, 257 units were leased, and the co-op was declared viable soon thereafter. Like other aspects of BREAKTHROUGH, market response serves as a valuable demonstration of the feasibility of industrialized housing.

Cover:

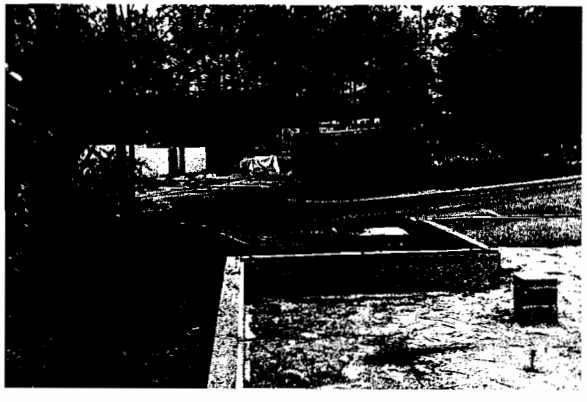
The high-rise tower at Crystal Lake provides a striking and attractive visual contrast. It is definitely urban in character but blends well with its semi-rural surroundings due to resourceful planning, design, and construction efforts.

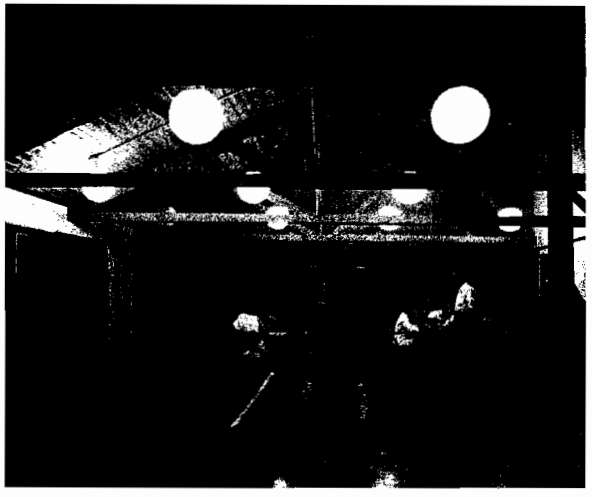
Six acres of dense woods, where the springs rise that feed Crystal Lake, are virtually untouched—wild and teeming with birds and small animals.

By late spring, 1972, some townhouses were ready. During the next year, the rest of the units were completed, accepted by the developer, and turned over to the marketing agency.

Eight play areas, extensive trailways, a fishing pier, and recreational vehicle storage are features that contribute to the Crystal Lake success.

Site preparation began in November 1970, and housing foundations were started on June 21, 1971. The first units were erected two months later. Other producers began work between September and March 1972, with erection completed in February 1973.





A lakeside clubhouse and swimming pool are among the community facilities available to the 750 residents. A broad mixture of incomes and races enhances the balanced community life.

The essence of Crystal Lake is the site itself—its natural beauty, the location of the housing units, the subtle improvements in facilities, the community way of life.

Background

Macon first learned of Operation BREAKTHROUGH in August 1969. In early September, the mayor, the city council, and representatives from the Middle Georgia Area Planning Commission (MGAPC) met with HUD representatives to get more information. At this meeting, the local people learned that the deadline for applications was September 19, already close at hand. Because of several unresolved questions, the most troublesome being the nature of the requirement to waive construction codes, it was decided that a contingent representing the city and MGAPC would go to Washington, D.C., for a conference with BREAKTHROUGH officials.

Upon the group's return from a successful meeting, Mayor Ronnie Thompson declared that "the location of the southeastern prototype site in Macon would be a tremendous achievement." On September 16, 1969, the Macon City Council authorized program participation and delegated to MGAPC the responsibility to prepare the application.

On September 19, the mayor and representatives from MGAPC and Macon-Bibb County Planning and Zoning Commission hand-carried the application to Washington, D.C. Three Macon sites were proposed among a total of five from the State of Georgia.

In late October, HUD officials toured the sites included in the Macon application. The mayor, the several planning organizations, and the chamber of commerce continued to promote local participation in the program. On December 2, the mayor approved an agreement between HUD and the City of Macon removing local code restrictions that might hinder the BREAKTHROUGH program, and on December 17, 1969, Secretary Romney announced the selection of the Crystal Lake site. Local officials were enthusiastic, with Mayor Thompson commenting, "It will be an instrument to achieve better housing for all our people, but equally important, it proved that the local governments can work together and effectively compete with any community across this land."

Fig. 1—Crystal Lake before development, looking N.E.

The 49.6-acre property selected was a private estate and game preserve owned by a partner in a local real estate company. The only structures on the site were a pier and a rustic lodge. Six-acre Crystal Lake, created in the forties by an earth-filled dam across a branch of Tobesofkee Creek, was the main feature.

Densely pine-clad slopes run down to the lake on three sides. Along the northwestern edge, an open ridge rises beyond the lake. The site is located approximately 4.5 miles southwest of downtown Macon in a district known as Bloomfield. Generally speaking, the population is middle class, white, and employed in blue-collar jobs. The site lies just inside the recently extended city limits, but the surrounding area is suburban and near-rural in character. A scattering of 100 or so middle class residences covers several blocks adjacent to the northwest border of the site. At the time of site selection, there was no nearby commercial development. Since then, a major interchange between U.S. 80 and I-475 has been completed a half-mile from the site, and the usual growth of motels, restaurants, and gas stations is occurring. Macon's population is estimated to be 135,000, with 230,000 people in the metropolitan area of Bibb and Houston Counties.

Most local authorities helped from the start. On September 17, 1969, the planning and zoning commission passed a resolution of cooperation, which became part of the proposal. It stated "that in the event the City of Macon is selected as a prototype housing site this Commission when called upon to do

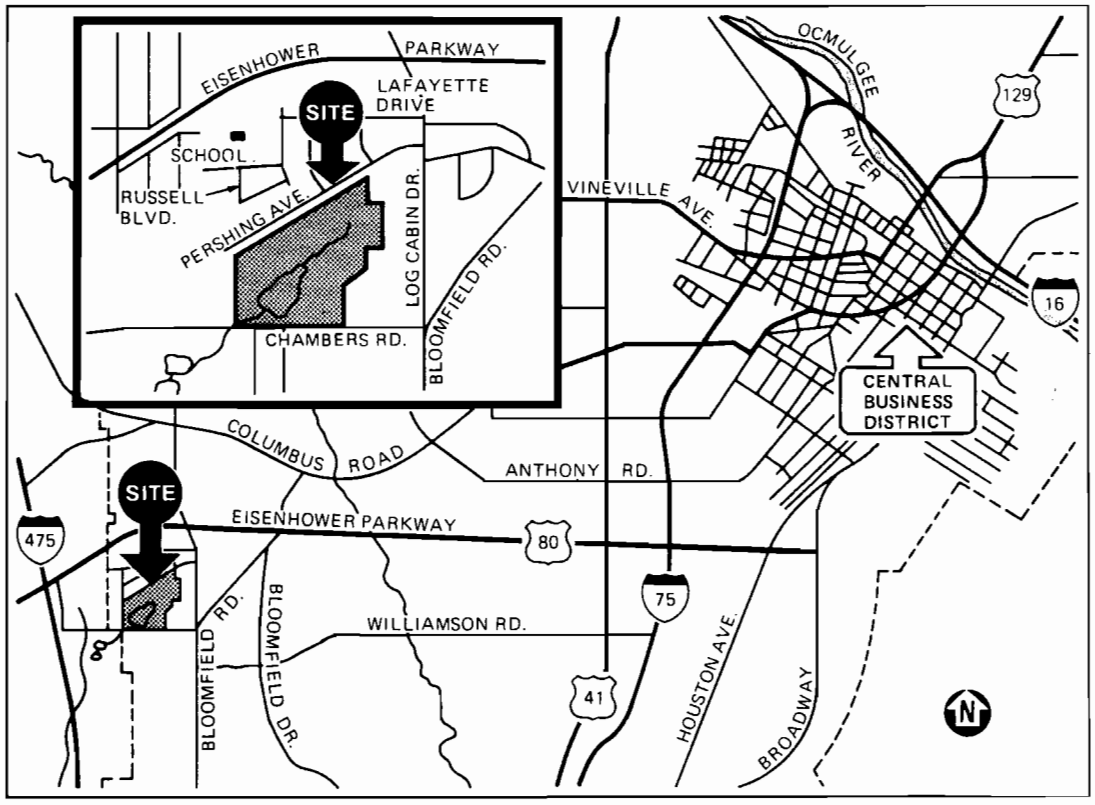


Fig. 2—Location of BREAKTHROUGH at Macon

so does hereby agree to waive any and all of its regulations in conflict with the program requirements of Operation Breakthrough as they apply to the sites approved by it on this date and . . . in order of priority: first priority: Chambers Road . . ." The commission approved the site plan in October that year. Having previously issued a blanket waiver of all zoning requirements, the commission noted that no further action was necessary, and there would be no need to apply for a certification of zoning compliance or a special zoning permit. Meanwhile, a zoning extension and a waiver of height limitations had been approved. The Bibb County Engineer agreed to the emptying of the storm sewer into the county drainage system. The Macon Board of Water Commissioners agreed that city water would be made available to the property at cost to the owner, and facilities would be maintained by the board. The city engineer agreed that, after meeting city specifications and upon recording of the planning and zoning commission approved layout, the City of Macon would maintain streets and sanitary and storm sewers.

On November 24, 1969, the planning and zoning commission passed a complete "Resolution for Cooperation in Connection with Prototype Housing in Operation Breakthrough."

Pre-Development Activity

HUD initiated competition for Prototype Site Planners (PSPs) in September 1969. One of the respondents was Reynolds, Smith and Hills (RSH), architects, engineers, and planners from Jacksonville, Florida. This firm had performed extensively at Cape Kennedy for the National Aeronautics and Space Administration. HUD selected RSH as PSP for the Macon site.

Housing System Producers (HSPs) had not been assigned when RSH carried out Task I of the site planning contract (H-1203), consisting of investigation of local characteristics and preparation of land use and conceptual site plans. From the start, the scheme was to develop the site by taking advantage of the beautiful setting without harming the natural features. Approximately 300 living units were initially scheduled to be built, including a wide variety of types and exterior styles representing various HSPs.

In May 1970, tentative assignment of six producers—Alcoa, Boise Cascade, Hercules, Home Building Corporation, FCE-Dillon, and a consortium formed by Henry C. Beck—was announced. Phase I design contracts were signed with these producers by July 1970, although several changes in assignments were subsequently to occur. Meanwhile, the planner continued with the next task of preparing a preliminary site plan.

HUD's program headquarters in Washington, D.C., (OBW) encouraged the inclusion of a high-rise building at Macon. Both FCE-Dillon and the Beck consortium had MFMR/HR system concepts available for demonstration. A high rise would increase the density and number of units and thereby improve the site's financial feasibility; on the other hand, there was a question as to the suitability of such a structure in a comparatively rural setting. To study the visual impact of the structure, RSH flew balloons above the site at the height planned for the building. (This idea came from simulations made at Disney World before development of that project in Florida.) The conclusion was that the building could be unobtrusive to adjacent properties but distinctive as a feature of the BREAKTHROUGH site design. Persons holding reservations about the compatibility of the proposed high rise with the surrounding community were offered

the opportunity to convince themselves, from the vantage point of a mobile crane (Fig. 3), that the privacy of neighbors would not be violated. Both tests helped to affirm the feasibility of the high rise system. Beck (later Building Systems International) was assigned to produce this structure.

During the second half of 1970, several changes were made in producer assignments. The tentative plan for six producers and about 300 units was carried into the Phase I design period. When the Prototype Site Developer joined the program, it immediately called a conference of all producers in Atlanta. In a progress review, the developer evaluated adaptability of the systems to site conditions and recommended adding two more housing producers and increasing the total units to 323. This housing system progress review and evaluation was repeated several times. In August 1970 the allocation of 323 units included Material Systems Corporation and TRW as the seventh and eighth producers. Soon after, TRW was deleted.

Transportation costs dictated reconsideration of one producer's assignment. Home Building Corporation (HBC) estimated that shipments from its Sedalia, Missouri, plant to Macon, almost 900 miles, would cost approximately $10,000 more than the total value of its 20 units in the Macon market. The merits of demonstrating the system would not support these overcosts. HBC was deleted from the site demonstration.

The October 1970 version of the site plan incorporated these changes, showing six producers and a reduction to 293 units. Next month, the National Bureau of Standards reviewed progress of the Phase I housing designs, which were well advanced, as was the plan layout of the separate site parcels assigned to each producer. At this time, one last change was made in HSP assignments, with Christiana Western

Fig. 3—High rise balloon test

	ALCOA				BOISE CASCADE				BUILDING SYSTEMS				CHRISTIANA				HERCOFORM				MATERIAL SYSTEMS			
	1 BR	2 BR	3 BR	4 BR	1 BR	2 BR	3 BR	4 BR	1 BR	2 BR	3 BR			2 BR	3 BR	4 BR	1 BR	2 BR	3 BR	4 BR		2 BR	3 BR	4 BR
SFD (6)																							3	3
SFA (159)		10	20	10			23	8						4	10	12		8	24	6		4	11	9
MFLR (42)	4	8			7	11											4	4	4					
MFMR (24)										16	8													
MFHR (56)									31	25														
Totals (287)	52 UNITS				49 UNITS				80 UNITS				26 UNITS				50 UNITS				30 UNITS			

Fig. 4—Housing unit mix

Structures replacing FCE-Dillon.

FCE-Dillon had been designing 35 townhouses and garden apartments for Macon, a departure from the system of pre-cast concrete high-rise apartments that Dillon designed for other BREAKTHROUGH sites. The producer declined an OBW request to add 16 units because of its own forecasts of potential cost overruns and schedule problems. The developer suggested that FCE-Dillon withdraw from Macon. This advice, acceptable to both OBW and Dillon, was acted on.

After all these changes and refinements, the housing assignment called for six producers to build 287 units.

Site Plan

The site plan took into account the following design objectives of the conceptual plan:

- Creation of an optimum living environment with a variety of housing types
- A cluster approach to development responding to the site topography and vegetation
- A traffic circulation system providing convenient access to housing clusters while maintaining minimum conflict between pedestrians and vehicles
- An extensive open space system offering a variety of recreational activities
- Maximum orientation of housing units to the open space, lake, and views
- A system of pedestrianways within the open space system providing safe and attractive routes to encourage pedestrian circulation within the site

The lake, spring marsh, trees, and slopes were respected. Clustered housing saved a large amount of open space and made practical the inclusion of six

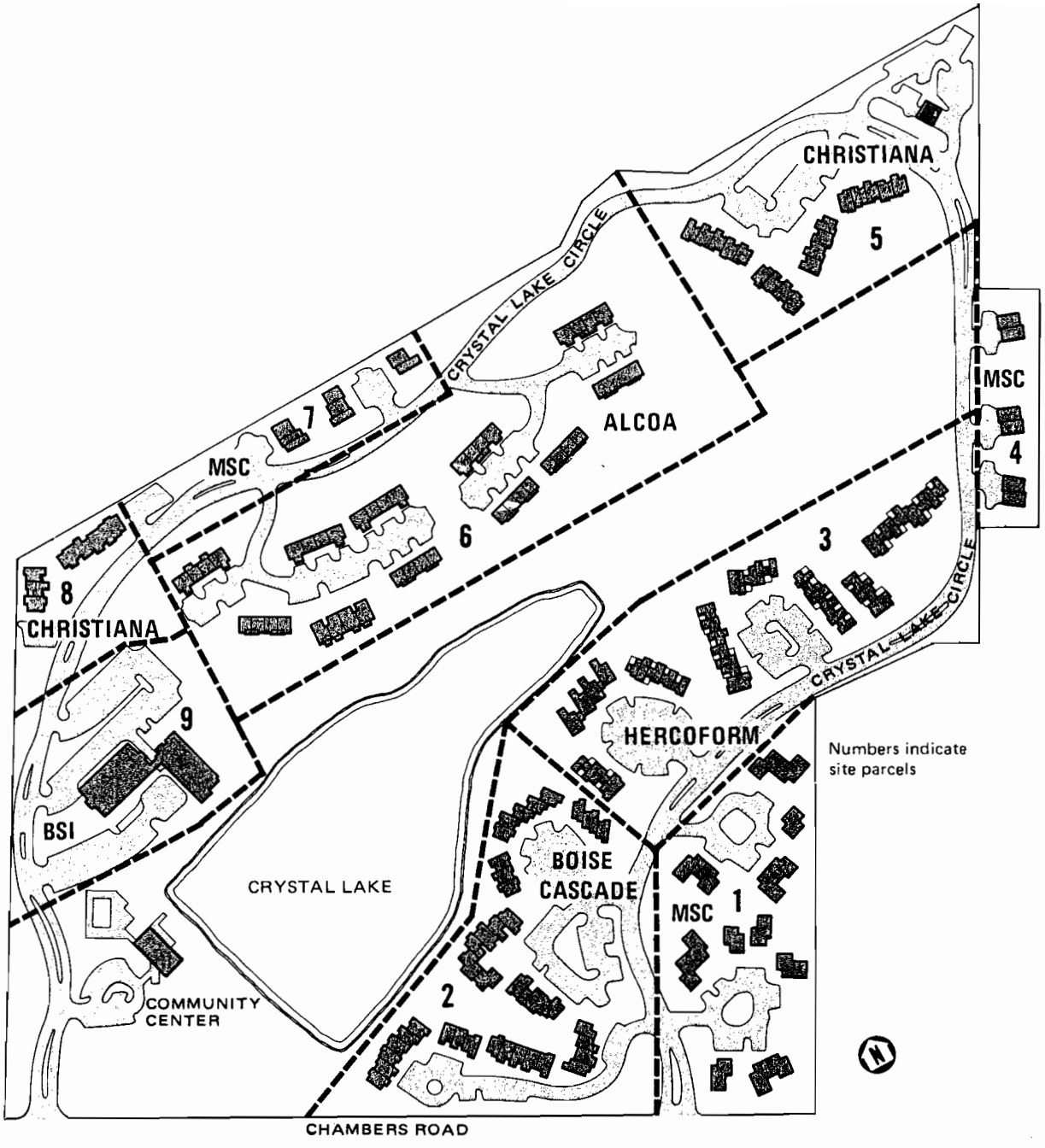


Fig. 5—Site plan as built

different housing systems while avoiding visual conflicts. These systems ranged from the typical 1-, 2-, and 3-story dwellings (SFDs, townhouses, and garden apartments, respectively) to the 12-story tower and its adjoining 6-story medium rise. Siting of the living units was well oriented to the environment.

A horseshoe-shaped peripheral road allowed good access to the clusters with minimum intrusion upon the natural setting and living style. Originally, the site plan showed an intermediate access road along the northwest boundary. This was not developed in the final site plan, but the option was left open in case future traffic demands warranted later construction. Fences at site boundaries were also thoroughly studied. A barbed wire fence along the east side was kept intact. Decorative stone walls, complete with name boards, were erected at the entrances off Chambers Road. Because of the adjacent residential area, the northwest boundary presented a more difficult design problem. Only after site construction was well under way did the planner and developer decide on a board fence, which, when built, served more as a screen than as a security device.

The plan incorporated such features of modern planned unit developments as underground utilities. Walkways link a series of distinctive, improved play areas called "tot lots." RSH showed great concern for the lake, analyzing the dam in detail to ensure that site preparation would not affect its structural integrity. Guidelines laid down for the developer required careful site work and clearing to avoid leaving dead roots or other weaknesses near the dam. The planner designed a storm sewer system to hold and pump away the initial surface runoff—that with heavy hydrocarbon content—from streets and parking lots. This not only protected the lake from pollution but also reduced erosion on slopes and at the housing areas. Overall, the site plan earned for RSH the 1973 Award of Excellence from the Florida State Chapter of the American Society of Landscape Architects.

Housing Systems

Alcoa Construction Systems, Inc., (ACSI) used factory-built wood service modules that included kitchens, bathrooms, laundry facilities, stairways, air conditioning, lighting, doors, finishes, fire and acoustical treatments, and appliances. Around these "wet cores," ACSI erected the balance of the dwelling with factory-produced aluminum- or wood-framed panels. Exterior details were finished on the site.

The Boise Cascade Housing Development system employed volumetric modules with light-gauge steel framing and wood sheathing. Modules were assembled separately in the Arabi, Georgia, factory and trucked to the site. Particular attention was given to the design of interior "usage" zones for better consumer acceptance.

Building Systems International, Inc., adapted for BREAKTHROUGH the established French Balency system. Pre-cast, prefabricated, load-bearing, concrete panels and slabs were used for floors and interior and exterior walls. Of the 80 units, 56 were assigned to the high-rise tower.

Christiana Western Structures was an established West Coast builder with several hundred houses to its credit in the State of California. It originally planned a BREAKTHROUGH system based on the use of shop-fabricated, wood-framed panels with a special resin finish coat, reinforced with fiberglass, for interior and exterior wall covering in lieu of paint. However, several design changes were made later, and Christiana built these units by a method different from that proposed. Many pre-fabricated components were used, but the innovative surface coatings were not applied.

Hercoform Marketing, Inc., a subsidiary of Hercules, employed mass-produced wood-framed volumetric modules, factory-built in Bloomsburg, Pennsylvania, and trucked to the site. The modules contained all electrical wiring, plumbing, appliances, painting, and carpeting.

In its Escondido, California, factory, Material Systems Corporation made structural shapes based on fiber-reinforced resin. These components were shipped to secondary plants for assembly into panels and then box modules.

Prototype Site Developer

OBW solicited proposals for management and demonstration of the prototype sites in Phase II, advertising the request for proposal in the *Federal Register*, April 18, 1970. Respondents were asked to propose on specific sites before May 4.

At the time, Fickling and Walker, a prominent Macon firm, and the National Corporation for Housing Partnerships (NCHP) were discussing possible mutual involvement. The subject of Operation BREAKTHROUGH came up, and the two agreed to submit a proposal. On July 28, HUD announced that Fickling and Walker had been awarded a contract as the Prototype Site Developer (PSD).

Fickling and Walker is active in real estate, mortgage loans, insurance, sales, residential rentals, commercial leases, and land development throughout Georgia and Florida. NCHP, of Washington, D.C., is the central organization and only general partner in the National Housing Partnership (NHP). NHP was authorized under the 1968 Housing Act to foster private investment in low income housing. Shareholders in NCHP participate as limited partners in NHP, which provides a vehicle for sound business investments by the private sector on a profit-seeking basis. NCHP joined seven builders and developers in competition for PSD contracts and submitted successful proposals at Kalamazoo, Sacramento, and Macon.

The Fickling and Walker/NCHP joint venture formed Macon BREAKTHROUGH Housing Venture (MBHV) to implement the PSD tasks. It was MBHV's responsibility to develop the project by supervising

construction of site improvements and housing systems, arranging for construction and mortgage financing, marketing, and ultimately disposing of the property. MBHV was operated as a separate company, with peak manpower of approximately 30. The project manager was assigned from Fickling and Walker, but most of the staff was hired specifically for BREAKTHROUGH. Initially, operations were conducted out of the Georgia Power Building in downtown Macon. Offices were moved on-site late in 1970, located in the existing lodge; in mid-January, 1971, they were moved into a trailer complex near the west entrance to the site.

MBHV implemented the management systems outlined in the Fickling and Walker/NCHP proposal and specified by OBW. A control room was maintained at the site, where critical path method (CPM) schedules were used effectively to control activities of the six housing producers and numerous subcontractors. Operation BREAKTHROUGH, with many decision makers distributed from Washington, D.C., to California, depended heavily on current visibility of operations. The concentrated control room data also proved useful in providing public information and gaining community support.

MBHV considered these sophisticated management systems vital to the program. When OBW introduced a different scheduling technique, MBHV reported by the new method to OBW, but continued to use the established activity-oriented CPM for actual control of the job.

Most of the control systems were scaled down after the construction stage was well under way. When OBW directed staff reductions, some reports were eliminated and operations were consolidated into two office trailers in the maintenance area.

To prepare and implement a marketing plan, the developer subcontracted with the Foundation for Cooperative Housing (FCH), a nonprofit organization involved in sponsorship of cooperative homes on a national scale. The FCH role was later expanded to include maintenance. FCH became, in effect, a stand-in for the planned cooperative until the co-op itself was activated. One important result was that a staff was hired and trained in advance for potential follow-on employment.

When the original two-year PSD contract H-1386 expired on July 24, 1972, HUD negotiated a six-month extension with MBHV. NCHP became an inactive partner. On February 2, 1973, Boeing Aerospace Company, selected as HUD's Master Site Developer for all BREAKTHROUGH sites, took over the Macon developer responsibility. Boeing retained key MBHV personnel for project continuity.

Land Acquisition

The Crystal Lake site was privately owned by Thad Murphy of Murphy, Taylor and Ellis, a local real estate company. The owner had agreed to make the land available for BREAKTHROUGH development and had quoted a reasonable price to the mayor and the planning staff. These commitments enhanced the original Macon proposal.

After selecting the Crystal Lake site, HUD arranged an option to buy 49.6 acres. MBHV picked up the option from HUD and purchased the property, through funds advanced by NCHP, for $300,906. (HUD reimbursed NCHP directly from Research and Technology funds.) The property was then deeded to Kenilworth Manor, Inc., which had been incorporated by FCH at the developer's request to hold title.

Financing

Early in the development stage, OBW asked each developer to obtain private financing for prototype site construction. MBHV thereupon began internal planning studies of possible financing schemes. NCHP proposed using Federal Housing Administration (FHA) Section 234 mortgage-insurance financing, covering condominium construction, while Fickling and Walker was inclined toward a conventional Section 236 project involving construction of multifamily housing for lower income families. On September 9, 1970, MBHV recommended to OBW that the site be financed under Section 233, experimental housing, pursuant to Section 236. OBW eventually accepted this method and strongly encouraged MBHV to broaden the marketing base beyond the usual 236 program range.

Fickling and Walker made an analysis of Title 10 financing for land development in conjunction with Section 236 construction loans. However, this was not recommended, because it was assumed at the time that the Federal National Mortgage Association would finance the entire package.

MBHV filed a firm commitment for financing with the FHA regional office on October 21, 1970. Kenilworth Manor, Inc., was eligible under FHA Section 236, which guarantees construction loans up to 90 percent of appraised value for limited dividend rental housing (cooperative) projects.

Macon Federal Savings and Loan Association was tentatively identified as the lead bank in a lending pool formed by Macon area firms to finance BREAKTHROUGH. In a letter dated November 5, Macon Federal confirmed the intent to commit more than $6 million from six associations at a rate of 8-1/4 percent plus 1 percent for the fee and services. Three months later, at a meeting held in Washington, D.C., OBW asked Macon Federal to re-bid at a lower interest rate. Macon Federal declined to do so.

Late in March 1970, OBW released a memorandum outlining the format for financing the prototype sites and procedures for sale of prototype mortgages to Government National Mortgage Association (GNMA). GNMA Program 19 was funded specifically to purchase mortgages on the BREAKTHROUGH sites. At

the time, HUD also investigated a national package for construction funding on all the sites and arranged with the Federal Home Loan Bank Board for member savings and loan associations to participate. MBHV continued to search for a local lender.

Fickling and Walker's FHA Multi-family Department learned of the availability of a better interest rate than that offered by Macon Federal and, therefore, MBHV released the latter from its offer in June 1971. Both the Mercantile National Bank of St. Louis and the National Bank of North America, in Macon, were willing to provide funds at a rate of 7 percent plus 1 percent commitment fee and 3/8 of 1 percent mortgage services. MBHV, concerned with expediting monthly draws, chose the local lender. FHA guaranteed to the mortgagor, Kenilworth Manor, Inc., a construction loan for $5,600,000. Of this amount, $4,744,750 covered site development, buildings, and HSPs; the balance was for financing charges. Initial closing took place in Atlanta on June 21, 1971, and all papers, plans, and specifications were delivered to FHA on June 24.

The construction loan was for two years and was extended by mutual agreement until final closing on October 30, 1973. The permanent loan will be amortized, over 40 years, with final maturity on June 1, 2014.

Community Relations

The Macon site lies in a comparatively rural area that is gradually becoming suburban. Single family homes have been built nearby, some in small subdivisions but most on individual parcels of land. A community of about 100 homes adjoins the site's northwest boundary. Most of the nearby residents are white, in a lower-middle income range, and were characterized as politically conservative in press coverage of neighborhood opposition to BREAKTHROUGH. Initially, opponents voiced concern that Operation BREAKTHROUGH would decrease adjacent property values. Ironically, before BREAKTHROUGH, parts of the site were used as an illegal trash dump.

Community uneasiness over BREAKTHROUGH is generally attributed to a lack of information about the purpose of the program. The pervading misconception was that BREAKTHROUGH would be a low income housing project. A certain fear of "forced" racial mixing lay behind this misconception, one that took expression in heated statements by residents and several elected officials at public hearings. Charges of federal intervention in local government, improper "forced quotas," and socialism appeared in print in the early stages of the program.

In the spring of 1970, controversy arose when the mayor withdrew his support and publicly renounced BREAKTHROUGH. A number of local agencies and organizations, including much of the media, continued their support. The Macon Chamber of Commerce, which, with the mayor, had supported BREAKTHROUGH from the start, re-examined the program but reaffirmed its approval despite the mayor's objections.

Fortunately, no racial issues of any consequence were openly manifested. The debate subsided, although the mayor appointed a citizens' group called Bloomfield Citizens' Committee to investigate BREAKTHROUGH and determine its suitability for Macon. By then, MBHV had established its public relations program, and cooperated fully with the committee. As the neighborhood and the committee learned the facts about BREAKTHROUGH, opposition diminished markedly. MBHV encouraged this new atmosphere, and the citizens' committee actually helped introduce BREAKTHROUGH to the community. The mayor took a "no comment" position through the balance of the program.

A major promotional effort was planned for the demonstration period, but—as at other sites—HUD did not have funds available. In the early months, MBHV gave presentations to dozens of Macon, Atlanta, and Middle Georgia service clubs, professional societies, conventions, social groups, and governmental agencies; these events tapered off later. Site visits were not encouraged until the clubhouse was finished, then the developer set up a visitors center on the second floor. Attractions included a movie and slide show and display panels. Occasionally, professional people, local club members, and guests from foreign countries toured the site. After attempts to obtain funding from other sources (such as private foundations) proved unsuccessful, MBHV gradually ended the visitors program. Throughout development, media coverage remained consistently favorable, and called for local officials to support the BREAKTHROUGH program.

Site Preparation

During the second half of 1970, MBHV played a decisive part in the effort to complete the site plan. Several major HSP changes resulted from the developer's recommendations; the final line-up, consisting of six producers, was established in November. Meanwhile, the proposed total number of living units varied from 300 to 323 to 293, and finally settled at 287.

With the groundbreaking ceremony on November 6, 1970, actual work on the site began. The loop road was cleared and grubbed to open the site for access. Preparation was undertaken with great care to avoid damaging the natural assets—foliage, slopes, and lake. All of these posed difficulties.

The planner identified individual trees, and marked those to be protected. Most of them were kept intact by thorough planning, disciplined erection procedures, and adjustments made in the course of construction. In one case, MBHV recommended that the BSI buildings on the waterfront, as planned in early 1971, be moved. The relocation shifted the high

Fig. 6—Crystal Lake preservation

Construction Conditions

Moderate to steep hills, covered with mature southern pines and hardwoods, slope toward a 6-acre lake near the center of the site. This spring-fed lake is created by an earthen dam approximately 500 feet long. Soils are highly permeable sand except for two areas of wet alluvial land, totalling about 6 acres, at the head and foot of the lake. Maximum land elevation is approximately 450 feet, and the water surface elevation is 379 feet.

rise back about 20 feet from the lake, thus preserving a good stand of trees and a natural spring area.

Safeguards for the lake were imperative. Silting could be expected during construction and, in the long term, pollution by the residents was likely. Hydrocarbons, deposited on pavements by automobiles, were a special concern. The developer, upon reviewing RSH's storm sewer design, recommended some changes before construction began. In late spring the site improvements subcontractor started work on the system, which pumps runoff into the Macon city storm sewers.

Silting was the subject of a water quality study by the Georgia Institute of Technology, which noted that "the major effect of construction . . . is certainly the initiation of siltation, which was virtually absent before construction began." Some silting inevitably did occur, but permanent harm was avoided through regular monitoring of the lake and the developer's close control of construction activities. An improved spillway arrangement reduced stagnation in the lake, and better circulation was created by siphoning the outflow from a specific depth beneath the surface. In 1973, Crystal Lake regained its beauty (Fig. 6). The brown, muddy appearance disappeared, the water again became green and clear, and aquatic life flourished.

An essential part of the lake's ecology is the thickly wooded natural area at the headwaters where the springs rise. These six acres were left untouched except for the development of a lakeside trail. Wild creatures—including squirrels, rabbits, reptiles, waterfowl, and many types of birds—are protected. Mercer University made a study of the flora and fauna in this alluvial area during construction, and, as a result, changes in ecological subsystems were identified and corrective actions were taken as necessary.

Crystal Lake is the social as well as physical focus of the site. The planner put the community center in an excellent lakeside location adjacent to the dam, which posed some unusual problems. RSH designed a two-story structure on pilings over the outlet stream that runs from the dam into a small natural area near Chambers Road. A local subcontractor to MBHV began work on the building in mid-July, 1971. Shortages of skilled laborers, late material deliveries, and inclement weather delayed completion until March 1972. Besides the clubhouse (initially used for visitors and marketing), the community center includes a large outdoor swimming pool.

Another important community feature built by subcontract to MBHV is the maintenance facility at the north end of the loop road. The brick-and-wood building was the first structure completed on any BREAKTHROUGH site. It provides work areas and storage for the co-op's grounds and buildings maintenance operation, along with some room for residents to make minor repairs to their cars. The surrounding fenced compound also encloses a parking space for recreational vehicles.

Housing Erection

Hercoform started its foundations on June 21, 1971, approximately one week ahead of schedule. This was the first housing construction work on the site. The company finished and equipped its box modules in a Bloomsburg, Pennsylvania, factory and shipped them 800 miles to Macon by truck or rail. Large mobile cranes aided the emplacement; space for these and for transporter access was an important requirement. A special frame, with a crane attached to each end, was used to turn the tower modules upright. This method worked well, but the alignment of floor levels between modules presented difficulties, and handling damages caused a significant amount of rework. The Hercoform concept did prove adaptable to design variations on sidehill locations.

Deliveries continued throughout the summer, and by late in the year all 50 units were erected. Finishing

operations varied according to the exterior style. The contemporary units had redwood-stained plywood sheathing, put on in the factory, while the painted aluminum sheathing and trim (susceptible to marring in shipment) on the traditional units were applied at the site.

Aside from waiting for warm weather to test the air conditioning, Hercoform was essentially complete in April 1972. The Site Technical Representative did not approve all 50 units for the developer's acceptance until June 1.

The developer was responsible for having the parcels ready for housing erection. Although compaction was part of this task, pilings and foundations were not. Building Systems International (BSI) engaged a subcontractor to drive pilings in accordance with the approved medium rise and high rise designs of September 1971. The bearing was specified, but not the depth of penetration. Piles were driven in early September, using a crawler-mounted LinkBelt 440 hammer with a capacity of 18,200 foot-pounds. It was subsequently discovered when excavating for the high rise lower levels that the piles had not penetrated to the necessary depth, typically extending only 4 feet below surface grade and 15 to 18 feet short of the base elevation. By the end of September, it was decided that redesign was necessary. The new plan used spread footings, which eliminated underground parking because of the additional area required by the redesigned foundations.

Excavating for the BSI utility tunnels began September 10, 1971. The first concrete was poured in footings on the north side of the medium rise the following week. During October, efforts concentrated on the high rise, which was given priority to meet the schedule for starting erection.

BSI subcontracted the pre-casting of the Balency system to Gifford-Hill, Inc., in Conley, Georgia, near Atlanta. The factory made the first pour of floor slabs on December 8, and reached full production within the week. Floor slabs were cast on flat casting beds and wall panels on tilt tables, then moved by dollies to storage areas. At all times, from casting to erection, wall panels were kept upright.

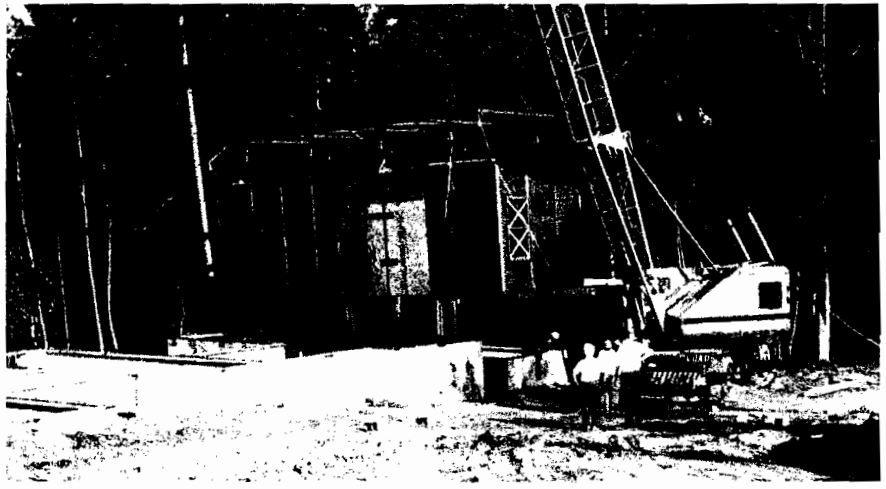


Fig. 7—First erection: Hercoform, August 19, 1971

The BSI structures involved approximately 3,000 pre-cast elements, each weighing 8,000 pounds. Trucks carried an average of five elements per trip from Atlanta to Macon, 40,000 pounds being the load limit. The first truckload arrived at the site on January 10, 1972; three floor slabs and six panels were set the next day. At this time, work was 45 days behind schedule.

Up to the third floor, a 50-ton crane hoisted panels into place. While the crane held the load aloft, erection crews leveled the panel by means of adjustment nuts on two protruding bolts and affixed two inclined braces. With the panel thus stabilized, reinforcing steel was set, horizontal PVC (plastic) pipe placed, and the panel joints grouted. Plumbing lines were external rather than cast into the pre-cast elements on the prototype units (although the BSI concept allowed for this production refinement).

Erection had reached the third floor when the developer requested a halt because none of the work to that point had been approved by MBHV or HUD. It appeared that production control at Gifford-Hill was inadequate: interfaces between pre-cast elements were not meeting as designed. Panel joints varied from 0 to 1-3/4 inches in width, fitting poorly, and only about 80 percent of the conduits matched connections in the poured-in-place concrete. The integrity of the wet joints was in question because of misalignment of the reinforcing steel.

The firm of T.Y. Lin & Associates, consulting engineers, was hired to survey the job. It was difficult to get clear X-rays of the joints due to the mass of material and the limited angles presented, but the work already done was provisionally approved after some field corrections. Better procedures were ordered for the balance of the structure, and production quality was brought under control.

By March 1972, the erection process was moving well, with 20 to 30 panels being set each day and 40 to 50 joints approved for pouring. Above the third

Fig. 8—BSI tower one day before topping out

Fig. 9—Last Boise module placed, March 23, 1972

floor, a 90-ton Moto tower was required to hoist the panels into place. With one floor per week the established rate, work reached the sixth floor before the end of the month.

Until March, the contractor regularly worked six days a week, exclusive of rain-outs—at times 10 hours a day. Safety was a constant concern to the developer. Weekly safety meetings with all subcontractor personnel became standard practice.

The high-rise tower was topped out at the "penthouse" equipment room level above the 11th floor on April 21, 1972. Some remaining stairs, balconies, and parapets were set; then the crane was moved, and erection of the medium rise started April 25. Twenty panels were set on the medium rise the first day. The second floor was started May 3, the third floor May 9, the fourth floor on May 17, the fifth floor May 22, and the sixth floor June 1. Erection was completed June 7, 1972.

Recognizing this good application of pre-cast concrete to residential buildings, the 1973 Prestressed Concrete Awards Program commended the BSI structures for excellence in design.

Boise Cascade began foundation work late in September 1971. Its new factory at Arabi, Georgia, about 70 miles south of Macon, was building the box modules and had completed 47 by November. A test shipment was made by rail, but regular production modules were trucked to the site. The steel frames of the Boise modules provided excellent cross-bracing: wracking was controlled, and drywalls did not crack during handling.

Emplacement on the concrete block foundations was made by mobile crane, using a frame attached to the lifting points. Where trees and slopes limited maneuvering space, a sling was also used; however, the safety hazard was greater with the sling, and the well-conceived frame arrangement was preferred.

Although open work space was needed for the crane and truck access, the Boise Cascade system was well adapted to the site. Plan and elevation variations were quite practical. Lower modules were mated to the foundation by welded steel plates. Upper and lower modules were fastened by large bolts through matching holes in the modules. There were no alignment problems.

The schedule called for erection of nine modules per day. Utilities and appliances were factory-installed, but much of the interior work was done on-site, taking advantage of the short shipping distance from the plant. Modules were shipped with walls and floors unfinished, and some parts were shipped as needed instead of with corresponding modules.

In late spring of 1972, Boise Cascade became the second producer to have units ready for the Macon market. All 49 townhouses and low-rise apartments were completed by September 29, 1972.

Material Systems Corporation (MSC) units were distributed among three parcels on the Macon site. Foundation work began in the fall of 1971. MSC encountered many difficulties in the fabrication of an entirely new product, and commitments at six

Fig. 10—Erected MSC townhouses ready for finish work

BREAKTHROUGH sites severely strained the firm's resources. MSC could not meet schedules, and proposed postponing delivery of modules until late spring. MBHV objected because it appeared that such timing would seriously delay completion of the site. OBW, through MBHV, directed the producer to start deliveries in January, 1972.

MSC thereupon changed the production sequence at its Indianapolis plant. Basic elements—skins, stiffeners/spacers, and connectors—were molded at MSC's Escondido, California, factory and sent to Indianapolis for subassembly into panels; these were further assembled into box modules. The Indianapolis plant was to supply BREAKTHROUGH sites at Macon, St. Louis, Kalamazoo, and Indianapolis. Instead of building all the units for a particular site at one time, all similar types of units (SFA, SFD, or MFLR) would now be produced together. Although this was a good plan, MSC's troubles were not over. Rigorous testing by the National Bureau of Standards (NBS) led to some design and process changes. Production difficulties, including labor training and quality control, caused more delays.

The first modules were delivered by truck to the site in June 1972, and, by the end of the month, 18 modules had been set, making up a total of six dwelling units. The modules continued arriving singly and in small quantities during July and August. One module received on July 5 was split open from top to bottom and badly broken up inside.

Several hard rainstorms that summer disclosed numerous leaks in buildings erected on Parcel 1. Six units were found to be leaking through the ceiling or around the floor level. Water ponded up to 2½ inches on the flat roofs, where scuppers were too high, impeding effective runoff. Both the developer and HUD made engineering surveys of the situation. Plastic sheeting was placed on the roofs as a protective cover, and windows and doors were boarded up pending a plan for repair. Material Systems halted site work and remained inactive through all of August and most of September.

Part of the problem was due to the process changes made to meet NBS life-safety requirements.

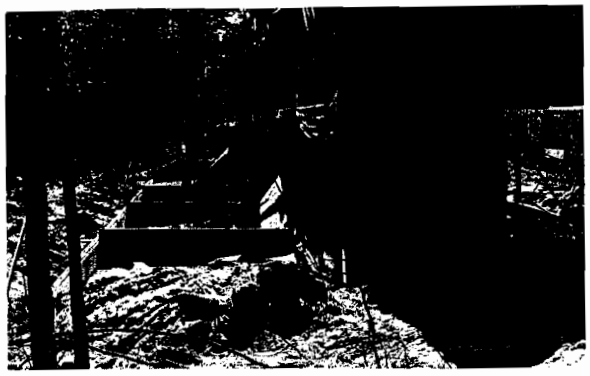


Fig. 11—Service cores triple-decked for only Alcoa MFLR

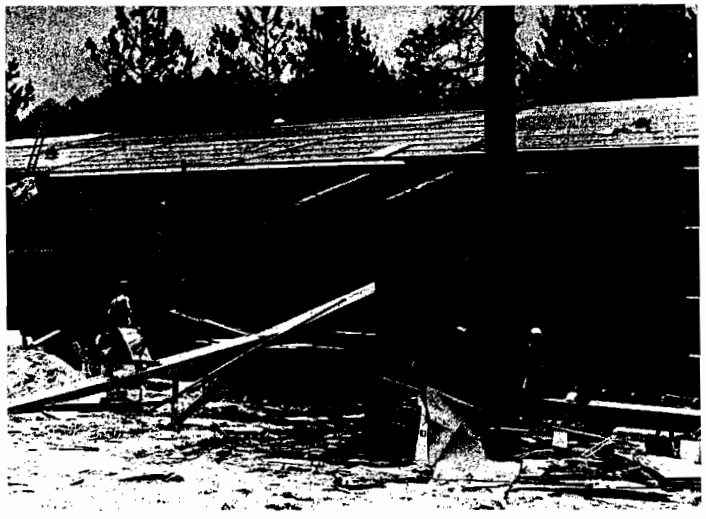


Fig. 12—Application of Alcoa siding and roof, summer '72

Fig. 13—Christiana using prefab panels on SFA, Parcel 8

Fig. 16—Swimming pool at community center

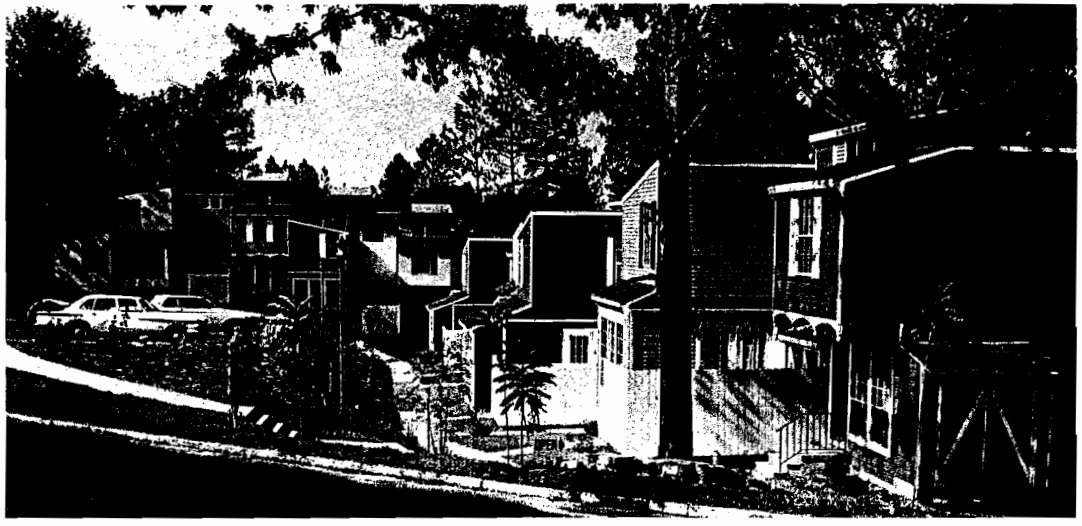


Fig. 17—Hercoform units first to be marketed

Weather and Comfort

The heavily wooded Crystal Lake site is somewhat sheltered from the prevailing light winds. The site is exposed to more winter sun than any other BREAKTHROUGH development, with an average winter temperature of 57°. Summer temperatures average 75° and frequently exceed 90°, making air conditioning mandatory. The lush vegetation of Crystal Lake is attributable to the combination of temperature, sunshine, and 44 inches of annual rainfall. Snowfall is rare, averaging less than a half inch per year.

Marketing

HUD, NCHP, and Fickling and Walker held many discussions and studied several alternatives before a marketing plan was established. Some considerations related to the site itself, others to the Macon area, and still others to the overall BREAKTHROUGH program and its national goals. Each prototype site had its own individual characteristics, but all nine were expected to contribute to regional and national objectives as well.

Macon is situated about 90 miles southeast of Atlanta. Suburban development infrequently extends beyond the city limits, and there are no large population centers nearby except for Warner Robins Air Force Base. The economy is stable and growing steadily though not rapidly. At the outset of the BREAKTHROUGH program, the Macon housing market was soft. The HUD regional office knew this but believed that any slump in demand was temporary and would not adversely affect the development and demonstration of the Macon site. HUD also appreciated that the absorption of about 300 units into the local economy was not a critical matter and that the program had many aspects to prove or disprove, marketing being one.

The selection of MBHV brought with it the extensive local marketing experience of Fickling and Walker and the broad philosophical outlook of NCHP, a combination of practicality and theory that shaped the marketing plan.

Cooperative developments, although not new, have yet to become a major factor on the national housing scene. In the Southeast, they were rarely found until recently. Operation BREAKTHROUGH has two cooperatives: Macon, Georgia, and Kalamazoo, Michigan. The basic plan involves selling shares to the residents, who thus own shares of the project as a whole rather than the individual units in which they live. Regular payments, similar to rent, cover mortgage costs and fees, utilities, and other operating and maintenance expenses incurred by the co-op. The organi-

Fig. 18—High rise identifies site from a distance

Fig. 19—Hercoform "contemporary" style

Fig. 20—Alcoa garden apartments

zation is democratic, with open meetings, elected officers, a hired staff, and voting rights on policy matters.

Macon's co-op, Kenilworth Manor, Inc., is under FHA Section 236, which provides interest subsidies for some lower income families who qualify. Crystal Lake was intended to be a balanced community, one that would thrive long after the demonstration of innovative housing was formally concluded. There would be no "low income housing project," no "instant ghetto," HUD and Fickling and Walker assured Macon. An essential part of the plan was to lease many of the units, unsubsidized, on the open market. It was hoped that perhaps 30 percent of the units could be leased this way at market rates. An effort would be made to maintain a racial mixture as well as a range of income levels, thus ensuring a balanced community.

Prices were determined by FHA appraisals and sales strategy. On the basis of local market experience, Fickling and Walker recommended specific appliances and other amenities that it believed should be included. Air conditioning was standard, and carpeting in most units. Other recommendations included range with hood, refrigerator, dishwasher, and garbage disposal as a minimum. HUD approved the inclusion of ranges and refrigerators in all except the BSI units, where they were not approved by the producer. HUD initially decided not to furnish dishwashers or garbage disposals in the Hercoform or Boise Cascade units; however, early sales response showed these features in demand, so they were added

to the balance of the homes under construction.

FCH, acting through a subsidiary, FCH Services, Inc., completed the marketing plan in March 1972 and opened the Crystal Lake sales office April 1. A model unit was furnished, and several open houses were held, starting Easter Sunday. By the end of April, 25 units were "reserved" by serious customers, 18 of them at market rate.

Marketing had been planned to start when three systems were available, but because of construction delays, only Hercoform houses were ready. These units, although displaying imaginative concepts, were not particularly successful with the homebuyers. Complaints often mentioned the floor plan and a lack of closet space on the first floor. Some people regarded the loft, an intriguing feature, as a safety hazard. There were no basements, and the townhouses offered 300 to 400 fewer square feet of dwelling space than other housing systems. Gradually, improvements were made that reflected the lessons of the marketplace. Garbage disposals and portable dishwashers were added to all townhouse units. Compressors for the air-conditioners were moved outside the townhouses, which reduced the inside noise level, simplified maintenance, and increased usable storage space. Two-thirds of the Hercoform units remained vacant after the first year. The traditional-style units demonstrated a stronger sales appeal to the local market than did the contemporary-style.

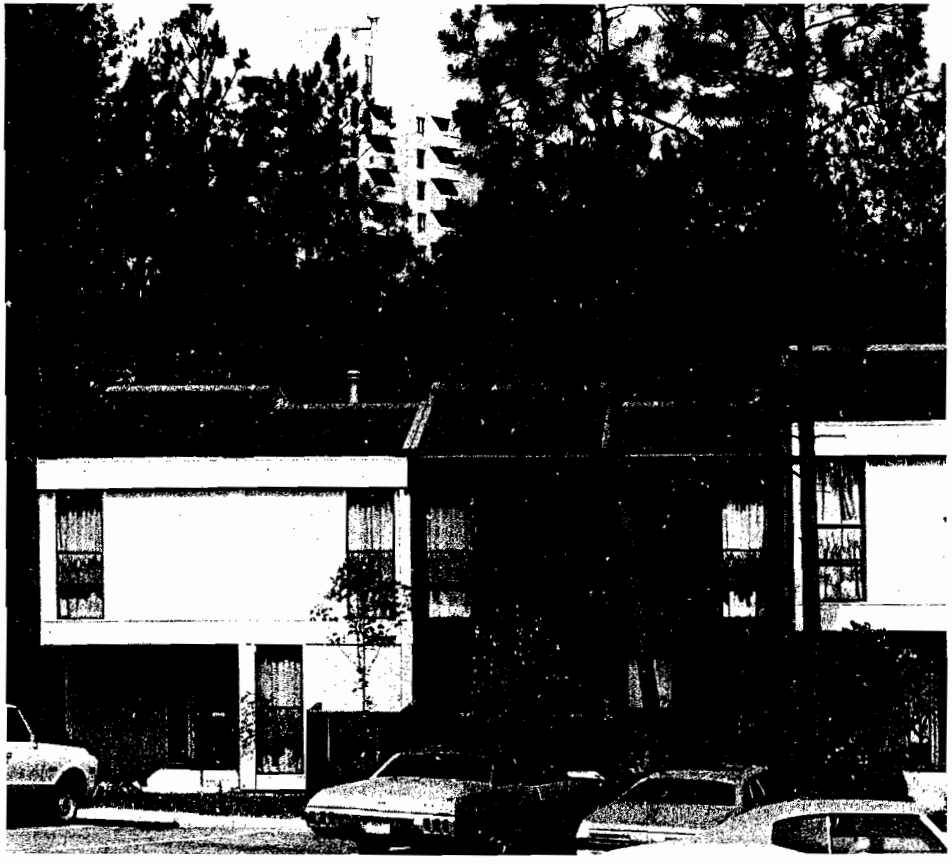


Fig. 21—Boise units across lake from high rise

By June 1, 1972, the first Crystal Lake residents moved in. Some Hercoform and Boise Cascade units were occupied during that month. Marketing improved as more producers finished. The Boise Cascade units, well-oriented to the lake and woods, were popular. The first ACSI unit was available to show in August. To enhance sales, MBHV completed installation of the half-baths, stubbed out by the producer downstairs in the townhouses.

FCH used six model homes, three of them furnished, in the BREAKTHROUGH sales campaign. The advertising policy was revised several times for reasons of economy and to reflect changing marketing strategy. Use of an advertising agency was discontinued in July 1972.

Overall, FCH was successful, with over 50 percent of its sales at market rate. That appeared to confirm the possibility of a balanced population, blending income levels, races, and vocations. By June 1, 1973, 222 units out of 287 were leased, even though the popular MSC parcels were not yet fully available. Early in 1974, all but 13 units were occupied. Hercoform, with 11 vacancies, persisted as the most difficult system to market. The housing systems generally have been accepted as readily as conventional homes in the equivalent price bracket ($16,000–23,000).

The cooperative was found to be viable and in January 1974 assumed control of the development. On the 18th of the month, a meeting was held for the purpose of electing the first resident board of directors. The community responded enthusiastically, with

13 persons announcing their candidacy for the five positions. In a well-attended meeting, the first board was seated. This board—with members from a wide range of backgrounds, interests, and capabilities—was integrated from the standpoint of both race and sex, and included a retired postal employee who previously served as chairman of the Crystal Lake Recreation Committee, a local architect, a young engineer who had served on the finance committee, a retired New York City public relations man, and a local accountant. It was evident that the co-op was off to a good start.

Utility costs proved a financial handicap to the new cooperative. It therefore installed electric meters at each unit (except in the BSI buildings), and the residents assumed their own separate electric bills. The co-op still pays for gas and water.

GTR for site development — R. Jones, W. Wilcox

GTR for planner — M. Chateauneuf, S. Hodges

STR — A. Reed

ACO — D. Murray

Director of OBR — J. Mills

HSP COSTS
(dollars in thousands)

Producer	Cost
Alcoa	$ 911.0
Boise Cascade	1,047.9
Building Systems International	2,647.9
Christiana	473.3
Hercoform	1,061.2
Material Systems	684.9
Total	$6,826.2

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM July 1970:	Start site preparation	9-70
	Start housing construction	12-70
	Finish housing construction	10-71
	End demonstration/marketing	7-72
Interim CPM July 1971:	Start site preparation	11-70
	Start housing construction	6-71
	Finish housing construction	7-72
	End demonstration/marketing	12-72
Actual Performance:	Start site preparation	11-70
	Start housing construction	6-71
	Finish housing construction	8-73
	*End demonstration/marketing	1-74

*Declare co-op viable

Fig. 22—Macon site costs and schedules

HOUSING SYSTEM PROD

ALCOA CONSTRUCTION SYSTEMS, INC.

Phase II Contract:

Actual Performance:

BOISE CASCADE HOUSING DEVELOPMEN

Phase II Contract:

Actual Performance:

BUILDING SYSTEMS INTERNATIONAL

Phase II Contract: (Extrapolated)

Actual Performance:

Also, Computer Sciences Corporation, HUD's quality assurance contractor, found evidence of poor production control. Remanufacture of a substantial number of components was not a practical solution, so MSC took the original roofs off the Parcel 1 buildings and replaced them with new wood-framed roofs.

More modules arrived for erection. These townhouses, produced at the Sacramento, California, plant rather than at Indianapolis, evidenced a significant improvement in quality.

The townhouse modules were moved by train to Bolingbroke Siding on the Southern Railway, a few miles northwest of Macon. After being hauled to the site by truck, they were emplaced with a 70-ton crane, beginning September 21. Material Systems set more modules on Parcel 1 early in October, and applied built-up roofs to Parcel 4 units that month. By December 1972 only 2 units of the 30 remained to be erected, with the last modules set on February 5, 1973.

All units had serious moisture problems, the walls and ceilings sometimes becoming saturated with water. The plastic material seemed to be slightly porous, perhaps because of process changes. MSC replaced the leaking roofs, and devised a field modification for the walls, which OBW and the developer approved. It involved drilling "weep holes," then covering the exteriors with plywood and Tex-cote. These repairs and other punch-list corrections were complete and accepted by August 1973.

ACSI began excavating for footings on November 22, 1971. Site improvement costs had been somewhat

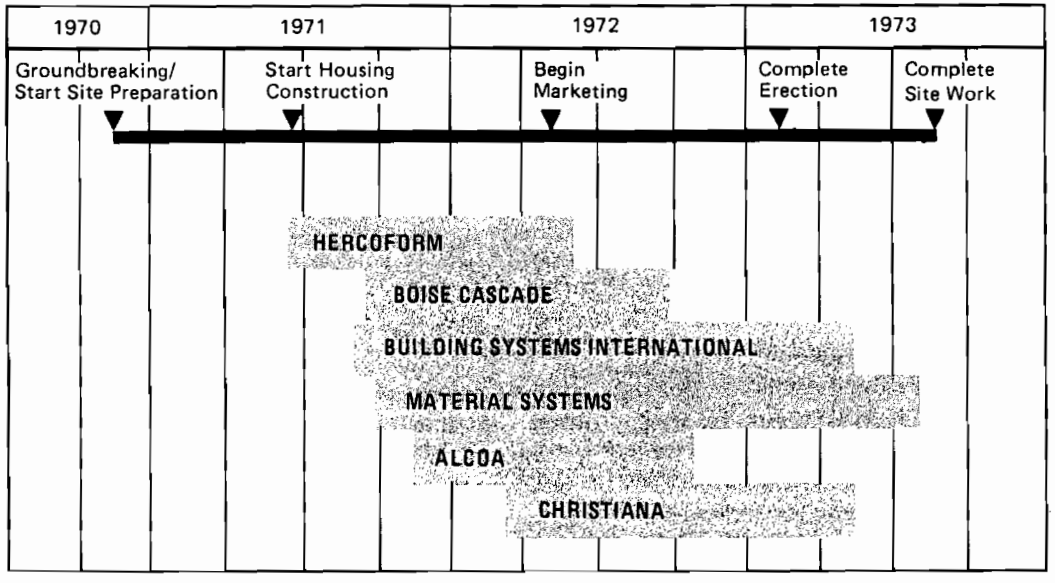


Fig. 14—Progress of housing construction

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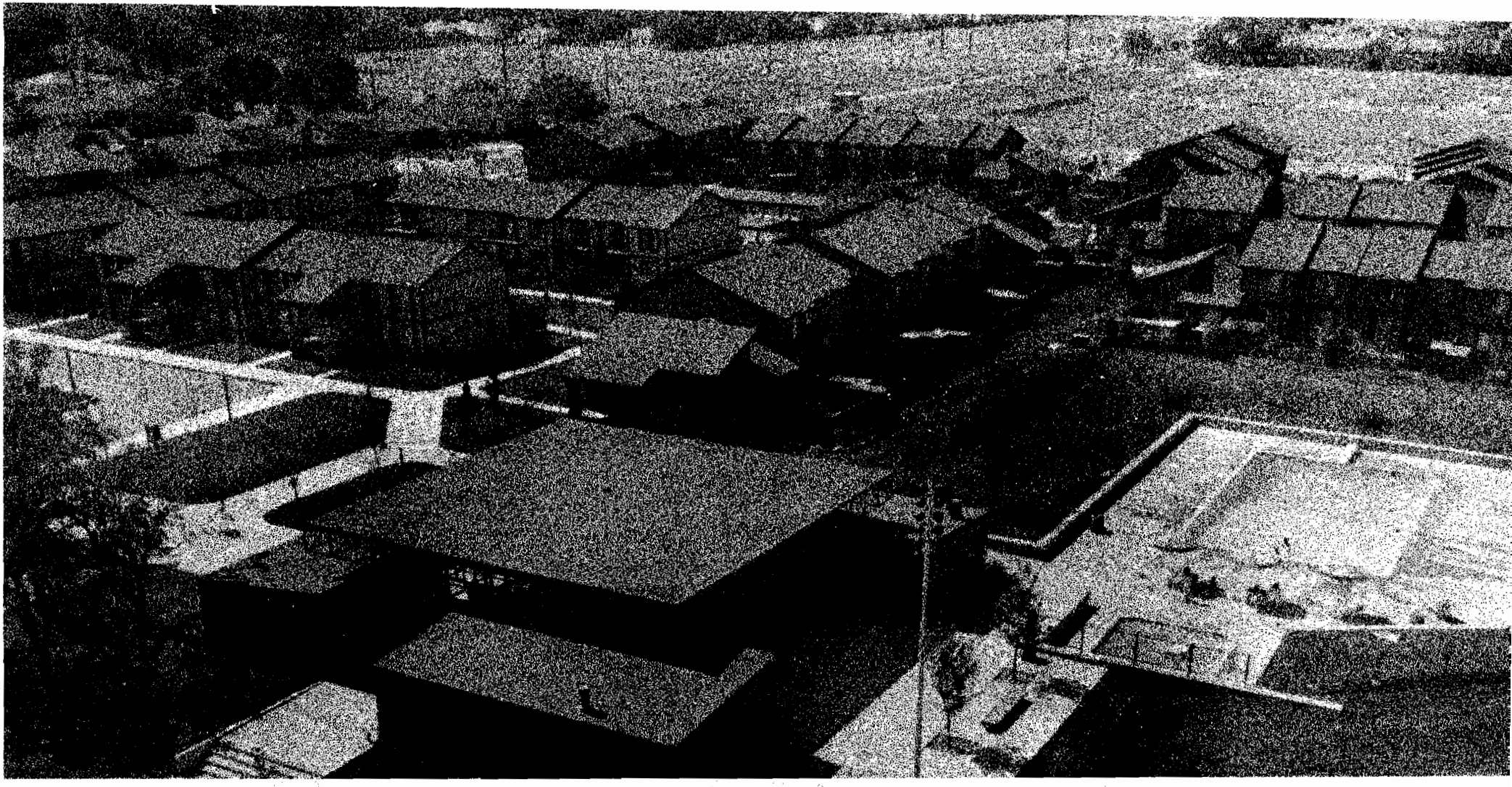


Sacramento, Calif

Sacramento

Site Location: Broadway & 55th St.

Prototype Site Developer: Sacramento BREAKTHROUGH Housing Venture (SBHV)

Prototype Site Planner: Wurster, Bernardi and Emmons

Housing System Producers: Alcoa, Boise Cascade, Christiana, Community Technology Corporation, FCE-Dillon, Material Systems, Pantek

Total Housing Units: 407

As the long-time home of the California State Fair, the site had special advantages. It was readily accessible—about 4 miles from downtown and the capitol by major thoroughfares—and utilities and services were well developed.

Introduction

Greenfair, the Sacramento BREAKTHROUGH site, is a 30.4-acre portion of the old State Fairgrounds, vacant since 1967. From its inception, local support for the project was high. The neighborhood had long been seeking a suitable development for the abandoned fairgrounds property, and effective public relations throughout the early stages of site development, combined with a successful visitors program, cultivated this support.

Objectives of the site plan included creation of an environment that would be both pleasant and compatible with the surrounding area. The flatness of the terrain and the general lack of vegetation posed many challenges to the planner. Careful siting of buildings and extensive landscaping were seen as answers to these shortcomings.

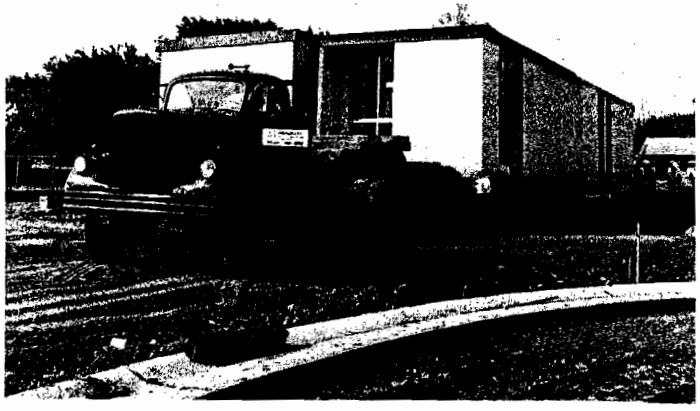
After erection, the Retirement Housing Foundation, a nonprofit organization that provides housing for the elderly, purchased 192 units, including the 112-unit high rise. Campbell-Greenfair, a local partnership, later bought 16 apartments, and Greenfair, Ltd., a limited partnership, bought 147 units. The remaining 52 dwellings were sold directly to individuals by the developer's sales agent.

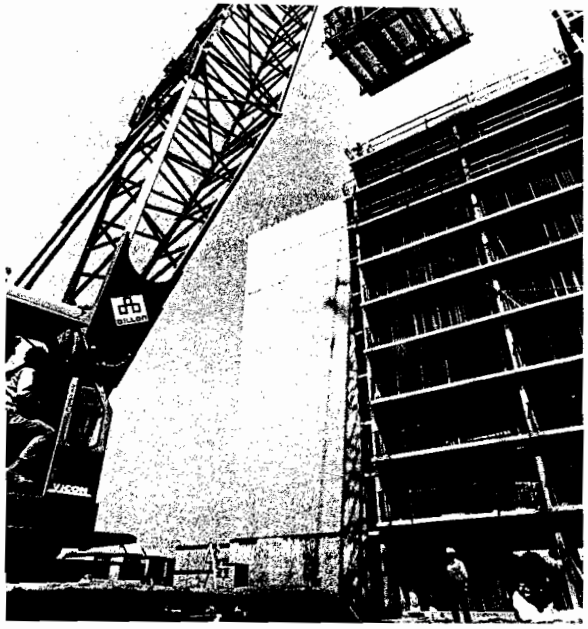
Sacramento BREAKTHROUGH Housing Venture, a joint venture of Campbell Construction Company and the National Corporation for Housing Partnerships, began on-site construction shortly after groundbreaking on October 22, 1970. Several delays were encountered during the first year; at one point all work on the site came to a standstill because of heavy rains.

Cover:

Well over half of Greenfair's dwellings are townhouses or low-rise apartments, and the gross density is 13.4 units per acre. The multipurpose community center architecturally reflects the theme of industrialized building.

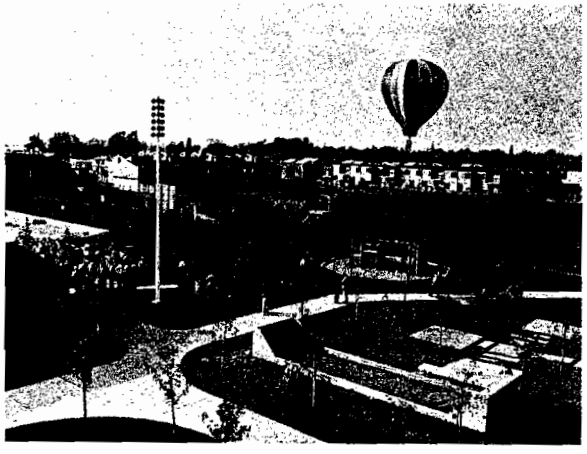
Housing erection began with the emplacement of a Material Systems module on October 14, 1971, and ended one year later. The last units were finished and ready for sale in April 1973.





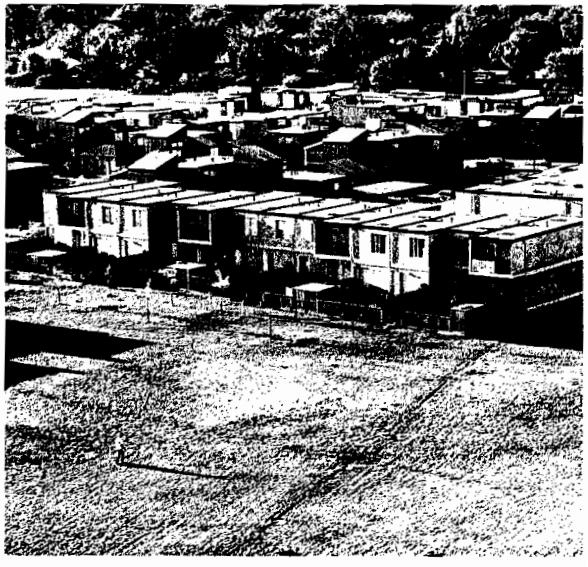
Construction of the nine-story high rise dramatically demonstrated the rapid erection possible with industrialized housing. This system's success has led the owner to build a similar high rise just east of the BREAKTHROUGH site.

The development takes the form of a block, with some characteristics of an enclave. Clustered housing, served by perimeter roads, bounds the large central open space. Vertical relief to an otherwise flat site is given by the high rise, called the tallest building in Sacramento outside of downtown.



Marketing plans treated the site location as a key factor and set objectives for economic and racial mixes. Homes were offered to individuals in the moderate income bracket, who were attracted by promotions like the "Housing Fair" held in October 1972. Bloc purchases accounted for most of the sales, however.

Among the 1,200 Greenfair residents, many elderly people mingle harmoniously with young married couples and professionals from the nearby medical center. Site features such as the pathways that link housing and recreation areas while avoiding vehicle routes are popular with them.



Greenfair's northwest quadrant concentrates modular units in a linear arrangement. The general appearance, level of maintenance, and tenant turnover must be carefully monitored to keep this area up to overall site standards.

Background

When the economy of California was based on gold and agriculture, Sacramento was at the hub of the State's activities. Thus, the farming town located in the flat river bottom area between the American and Sacramento Rivers became the State capital. Before the mid-20th century expansion of State government, the citizens' main interest was agriculture, and the annual State fair was an institution. Gradually, however, the old fairgrounds on Broadway (built in 1906-09) became cramped and outmoded, and in 1962 the California State Fair Commission purchased a new site north of the river, approximately six miles away. This purchase was made by obtaining a mortgage on the old Broadway site from the California State Public Employees Retirement Fund. When the new fair opened in 1968, the old property became available for sale and redevelopment. It had obvious developmental assets, including 136 acres of flat terrain located inside the city limits and excellent access to two freeways. During the initial HUD solicitation for BREAKTHROUGH sites, the City of Sacramento proposed using the former fairgrounds. This ultimately proved to be the only proposal accepted by HUD among a total of 12 sites nominated by various groups in California.

The prototype site itself is located in the southeast corner of the former fairgrounds. It is bounded by Broadway, a major arterial, on the south, residential development on the north and east, and the abandoned remainder of the old fairgrounds on the west. There are two nearby exits from the El Dorado and U.S. Highway 50 freeways. A 10- to 15-minute drive to central Sacramento and the State capitol even at the peak of traffic makes the site convenient to the major employment areas in the region. On three sides, the site is surrounded by modest single family homes constructed in the 1930s and 1940s and currently inhabited by racially mixed, moderate income residents.

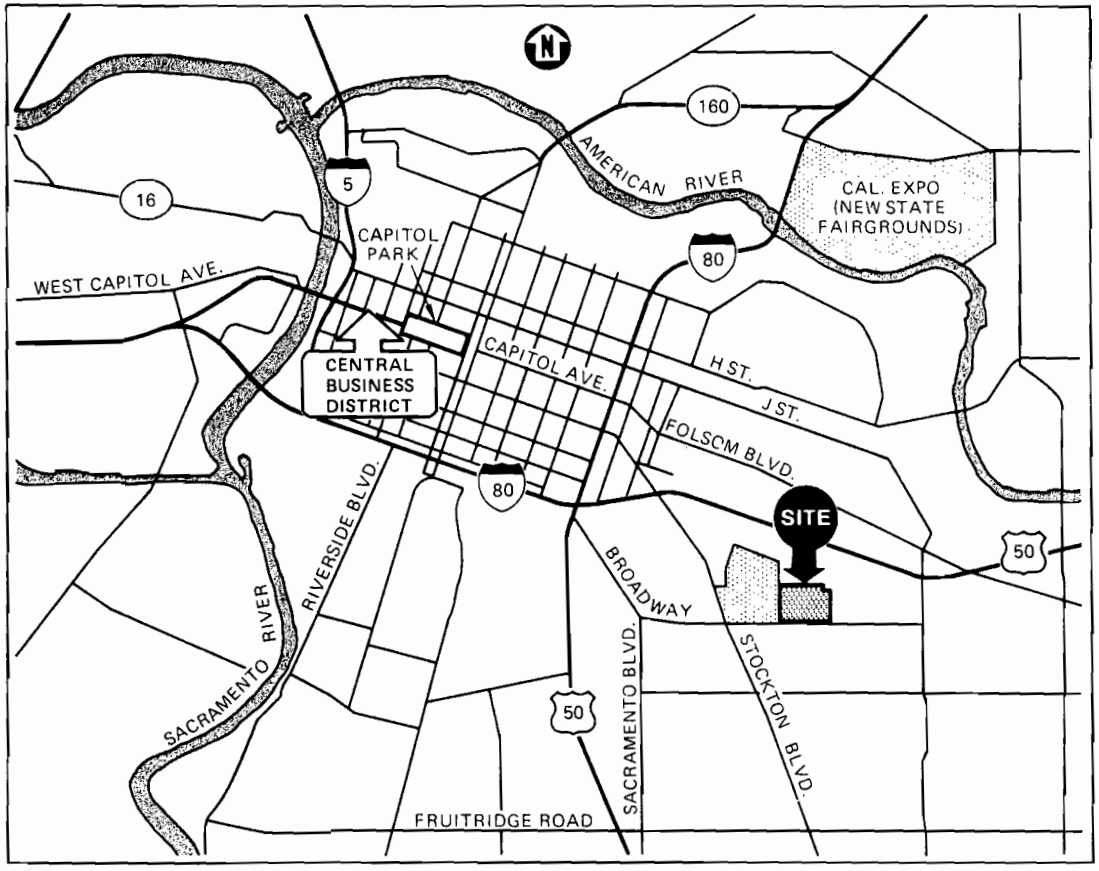


Fig. 1—Site location in Sacramento metropolitan area

A large and expanding medical complex and a proposed educational center are nearby. Shopping facilities are located in the Stockton Boulevard and Broadway commercial strips and in three shopping centers within a 10-minute driving radius.

There were some problems associated with the site. Oak Park, the district west of Stockton Boulevard, was one of the first neighborhoods developed outside old Sacramento, but it has since been absorbed by the city and is now, in part, a blighted area, having some features of an urban ghetto. Even though the eastern edge of Oak Park is approximately a mile to the west, its influence extends to include BREAKTHROUGH. This influence also affects the local schools. At the time that the fairgrounds site was being considered for BREAKTHROUGH development, conditions at Oak Park's Sacramento High School (which BREAKTHROUGH teen-agers would attend) were extremely unsettled.

In September 1969, prior to submittal of the BREAKTHROUGH proposal, Governor Reagan signed the California Factory-Built Housing Law, establishing a Statewide building code for industrialized housing. The statute, first of its kind in the nation, permitted manufacturers of factory-built housing who were "ready and willing but unable to engage in volume production because of the lack of uniformity of code requirements, to produce on a volume basis." Under this law, State inspection and

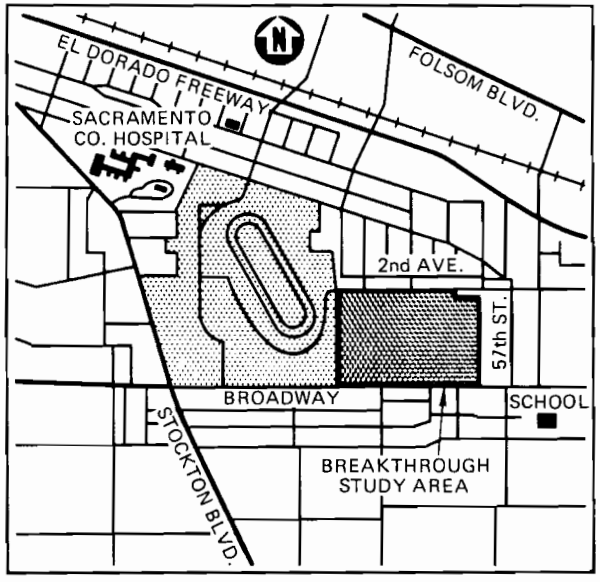


Fig. 2—Former California State Fairgrounds

approval of such factory-built housing replaces the hundreds of different local code requirements which otherwise might be imposed. Thus, the law preempts local building codes, but it does not affect zoning regulations.

In December 1969, the Sacramento City Council passed an ordinance of cooperation with BREAKTHROUGH. This ordinance established a special zoning classification of "X-1" for experimental housing and gave the city director of planning authority to grant variances and easements without the necessity of public hearings.

Pre-Development Activity

HUD selected Wurster, Bernardi and Emmons, Inc., in conjunction with Lawrence Halprin and Associates as the Prototype Site Planner (PSP) for the proposed Sacramento site. Contract H-1206 was awarded in January 1970. The planner began by making an inventory of the site; launching a community relations program; and initiating contacts with the local government agencies, starting with the California State Department of Housing and Community Development.

A 60-acre parcel of land located between the east boundary of the fairgrounds and the grandstand was designated as the BREAKTHROUGH study area. In early discussions with the State, the planner considered remodeling some of the existing buildings and creating a park. HUD's original guidelines for the demonstration site envisioned a total of 300 units divided into 75 high rise units, 150 single family dwellings, and 75 garden apartments. The planner arranged the units in an "enclave" facing inward in a generally self-contained development. This idea evolved from the very first drawings and was the pattern for the ultimate site plan. Besides the housing units, it was tentatively planned that a small commercial area would serve both the BREAKTHROUGH project and the adjacent neighborhood.

During the conceptual planning stage, numerous meetings were held with various interested groups representing the Urban Housing Task Force, Community Services Planning Council, and Oak Park area residents. The two Sacramento daily newspapers became involved in these meetings and featured detailed articles favorable to the program.

In March 1970, the planner's Task I report recommended that the site be linear in design, with the housing units aligned in rows bordering a central open area and served by a horseshoe-shaped road system. It further recommended that the central open area be surrounded by two-story townhouses and apartments and that a community center complex be located at the south end.

On March 25, the planner's marketing consultant completed an analysis of the local housing market which brought out the following points:

- The Sacramento area possessed limited potential for housing the elderly
- High-rise buildings were considered undesirable because of the visual impact
- A market existed for housing for the families in the $6,000 to $12,000 annual income bracket
- Attaining a racial mix of 75 percent white, 25 percent non-white appeared likely in this location
- A commercial area should be provided as part of the site

In reviewing the market study, the Sacramento Housing Authority expressed concern because subsidized housing for very low income families (those earning between $3,000 and $4,000 annually) was not recommended. The authority could foresee potential racial trouble when minorities learned that BREAKTHROUGH would not alleviate their particular needs. The consultant stated, however, that the project could not be a panacea, and if it were to have a fair chance of success, certain guidelines should be followed. These were: (a) limiting the number of units built for large families, (b) stabilizing occupancy to minimize the transient population, (c) upgrading the site and the adjacent area, and (d) stimulating participation of all racial groups through available subsidy programs. This discussion illuminated the need for a strong, informative Equal Opportunity program in connection with site development.

On April 27, the planner and HUD met to review the project as contemplated at that time. The site was planned to cover 60 acres, having 300 living units, and act as a catalyst for the complete development of the old fairgrounds. (As part of that overall development, an experimental park and an education complex would be built by others west of the BREAKTHROUGH site.) The plan showed a large lake in the center of the site, separating rental units on the east from sales units on the west.

The following month, this plan was presented to and approved by the Sacramento City Manager. The city agreed to support the concept and zone the area for experimental housing in accordance with the ordinance of cooperation.

HUD had chosen 22 Housing System Producers (HSPs) to build prototype units at the nine BREAKTHROUGH sites. Sacramento, with its marketing aims in the low and middle incomes, seemed most appropriate for townhouses or multi-family dwellings, and the identified producers of these types of units were considered first for assignment to this site. In May, HUD announced six HSPs for Sacramento. These were: Alcoa Construction Systems, Inc., Ball Brothers Research Corporation, Forest City Enterprises, Boise Cascade Corporation, Material Systems Corporation, and TRW Systems, Inc. (For BREAKTHROUGH purposes, Ball Brothers would build under the name of Pantek, Forest City as FCE-Dillon, and TRW as Community Technology Corporation.) A seventh producer, Christiana Western Structures, was added in June.

By June 13, the projected total number of housing units had increased to 388. As a result, the plan was changed substantially, and the size of the lake and green space within the BREAKTHROUGH site was reduced. At the June 29 design review, HUD questioned the density and the road network and asked the planner to find a more unified solution. This direction from Operation BREAKTHROUGH—Washington (OBW) eventually resulted in the configuration adopted on July 10, 1970, the same one that exists today.

The planner preserved the original linear layout, clustered housing, and central open space in the new compact site plan. Other factors such as the introduction of the developer into the program, a final fixing of the unit count at 407, and overall BREAKTHROUGH budget cuts began to influence the evolving design. The result was a smaller site, relocated to the east side of the fairgrounds, with an increased density. The lake, planned as a community focus for both site and neighborhood, was again reduced in size and finally deleted as too problematic.

In August, Wurster, Bernardi and Emmons com-

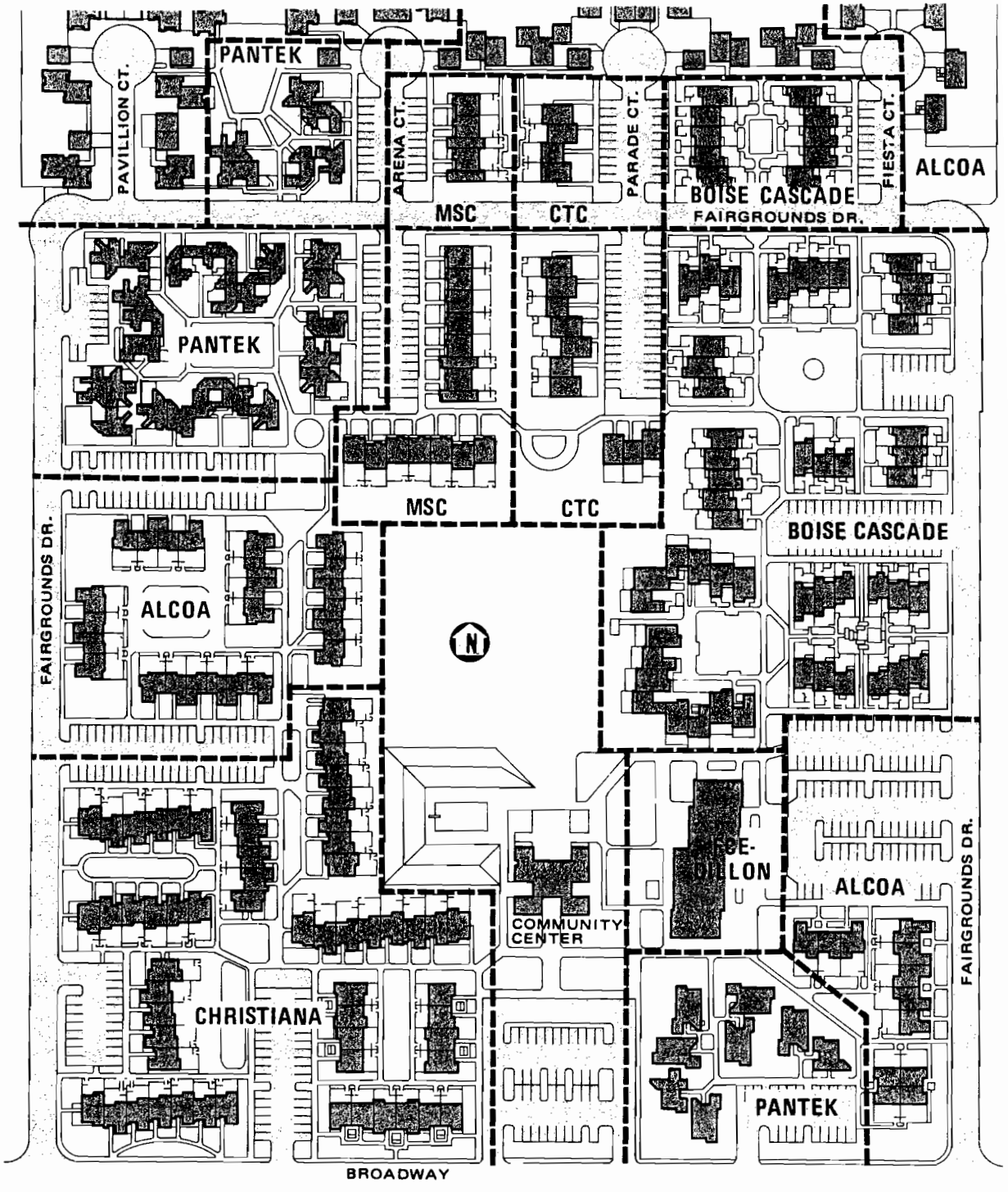


Fig. 3—Site plan as built

	ALCOA				BOISE CASCADE				CHRISTIANA				CTC				FCE-DILLON				MATERIAL SYSTEMS				PANTEK			
	1 BR	2 BR	3 BR	4 BR	1 BR	2 BR	3 BR	4 BR	1 BR	2 BR	3 BR	4 BR		2 BR	3 BR	4 BR	1 BR					2 BR	3 BR	4 BR		2 BR	3 BR	4 BR
SFD (20)			1	3											2	4							6	4				
SFA (179)			12	12		6	32	9		9	18	18		4	10							4	8	8		3	13	13
MFLR (96)	12	12			14	14			16	12																10	6	
MFHR (112)																	112											
Totals (407)	52 UNITS				75 UNITS				73 UNITS				20 UNITS				112 UNITS				30 UNITS				45 UNITS			

Fig. 4—Housing unit mix

pleted the basic plan, except for some details, and started to prepare working drawings. The planner and producers coordinated the arrangement of housing units within the areas assigned to the seven HSPs. Integration of these micro-site designs into the total plan was completed by October 15, and, when OBW gave its approval on December 14, the site configuration was established as final.

Site Plan

The prototype site used slightly more than 30 (30.38) of the 44 acres in the plot. The remainder was sold later to private builders for other developments.

Site location influenced the plan extensively. The surrounding neighborhood of old and modest homes suggested that the BREAKTHROUGH market would be found in low to middle income groups. Therefore, the planner elected to cluster the housing units, thus reducing site utility costs, increasing usable common open space, and enhancing the residents' sense of neighborhood identity.

The proximity of Broadway, a major arterial, led to the design of a traffic circulation system distributing vehicles from a perimeter road to a series of parking lots. These finger-shaped parking lots preserve an uncluttered appearance for the sake of the surrounding residents and minimize the conflict between pedestrians and vehicles.

A three-acre park for unstructured recreation occupies the center of the project. Adjacent to the open space, the contemporary community center, including outdoor swimming and wading pools, is the site focal point. Pedestrian walks connect this facility with an outdoor recreational area for the elderly, various "tot lots," and quiet, conveniently placed courtyards.

Housing Systems

The Alcoa Construction Systems, Inc., (ACSI) box-and-panel units featured a modular utility core system. Each unit has separate upstairs and downstairs "wet cores." The downstairs module included a kitchen, one or more bathrooms, and laundry facilities. The upstairs module contained the principal elements of the plumbing, heating-ventilating-air conditioning (HVAC), and electrical services as well as another bathroom. Also included were the lighting, doors, closets, stairways, finishes, and fire and acoustical treatments. Housing 601, an Alcoa subsidiary, produced the wet cores in a Kent, Washington, factory and shipped them to the site, where they were enclosed by conventional panel methods.

Boise Cascade Housing Development produced volumetric (box) modules in a Meridian, Idaho, factory and shipped them by train or truck to the site. The primary structural skeleton was wooden-framed. Gypsum wallboard enclosed both sides of the frame, providing protection against fire and reducing sound transmission. The outside wallboard was sheathed with plywood, grooved and stained. Interesting entrances and skylights mark the exteriors of these two-story units.

Christiana Western Structures was known before BREAKTHROUGH as a builder of hundreds of industrialized homes in the State of California. In contrast to conventional technology, Christiana's open wall panels, stairways, and roof trusses were factory-assembled. The design emphasized pre-cut and assembled components that could be transported easily and erected and finished on-site by craft labor. Both townhouses and garden apartments are two stories high.

The FCE-Dillon building is nine stories high and contains 112 units. The structural nucleus is a pre-cast concrete component subsystem consisting principally of walls and floors. Some of these pieces were partially pre-cast in a local factory and completed on the site. The "heart module," a factory-built service

and utility core component, encompassed the kitchen and bathroom. Its service chase contained all the central mechanical and electrical connections for each dwelling unit. All heart modules were produced in Akron, Ohio, and shipped by rail and truck to the site. The elevator shaft was cast in one-story-high concrete modules designed for sequential assembly and staged to coincide with the erection of the remainder of the building. The main feature of the FCE-Dillon housing system was its rapid assembly technology.

The Material Systems Corporation (MSC) one-story SFDs and two-story townhouses demonstrated the use of a man-made material: a blend of resins, reinforcing fibers, and additives, fire-retardant and odorless when cured, and formulated to meet specific dwelling requirements. The MSC concept embraced the full cycle from basic raw materials to completed dwelling units. Innovation was evident in the structural wall panels, roof panels, and wall panel joiners fabricated at the Escondido, California, plant and assembled into box modules in another factory near Sacramento. Floor panels used conventional wood construction.

Pantek Corporation's system depended on a load-bearing panel suitable for erection by unskilled labor using readily available equipment. The wall panel was a sandwich consisting of a sheet of plywood and a sheet of cement asbestos board with low-density polyurethane foam poured between them. The completed panels were framed with aluminum extrusions. A coating of epoxy and stone aggregate was applied to the exterior asbestos skin, and the interior plywood surface was covered by gypsum wallboard. Pantek panels were factory-produced at Muncie, Indiana, and assembled into one- and two-story housing units at the site. The floor was a concrete slab. Wood and steel framing was used for upper levels. Heating and air conditioning systems were centrally located in the master chase to facilitate removal and repair. By using the "plumbing tree" concept, Pantek provided plumbing as a complete subassembly.

TRW's subsidiary, Community Technology Corporation (CTC), developed a new industrialized building system called Fiber-Shell, shown only at Sacramento. The major component was a lightweight sandwich panel fabricated from gypsum and/or plywood, glass-reinforced polyester resin, and a cellulose honeycomb core of phenolic-impregnated kraft paper. Bearing-wall panels of 3-inch-thick core and floor/ceiling/roof panels of 6-inch core were assembled into box modules. The remaining walls were conventional wood stud construction except for bathrooms and kitchens, which were service modules, bought as complete units from an Alcoa subsidiary and installed at the CTC factory. The townhouse modules were joined as two-story units at the Sacramento plant and trucked to the site by the same conventional house-moving methods used for the single-story SFDs.

Prototype Site Developer

On April 20, 1970, HUD advertised for proposals for the Prototype Site Developer (PSD) role. Five Sacramento firms responded by May 5, and in July, HUD announced the selection of Campbell Construction Company in joint venture with the National Corporation for Housing Partnerships (NCHP) to be PSD of the Operation BREAKTHROUGH site in Sacramento.

The joint venture was formed under the name Sacramento BREAKTHROUGH Housing Venture (SBHV). On July 29, 1970, SBHV signed a two-year cost reimbursement contract, H-1400, renewable by HUD in one-year increments. It covered complete site development including construction management, site integration, and disposition.

The venture arrangement had Campbell responsible for the on-site management, while NCHP was responsible for coordination with HUD interfaces for site financing. Campbell Construction Company, founded in Sacramento in 1906, has been involved with the building of many residential, commercial, industrial, institutional, and military projects and had recently pursued an interest in factory- and systems-building. NCHP of Washington, D.C., consists of 268 corporations, each of which has invested $42,000. Although NCHP is composed of private firms, it was chartered by an act of Congress in 1968 to foster corporate investment in low income housing.

Campbell and NCHP set policy for SBHV, which was headed by a director of site operations. Campbell assigned two other permanent employees to the venture as chief engineer and chief inspector. With these exceptions, SBHV manned the project almost entirely with newly hired personnel. Developer manpower peaked at 31 for six months, receded to 7 in a four-month period during 1971, and remained at that level until the end of 1972, when all but 3 employees were terminated.

An on-site management control room, manned by one full-time scheduler and one part-time helper, was set up in two temporary construction trailers. Management of the construction program was time-phased by the Pert-O-Graph system, a basic PERT (Program Evaluation Review Technique) network method, on a site-sectionalized basis, the site being divided into areas (micro-sites) according to housing producer, type of structure, and geography. This enabled the developer to control work in detail on the micro-sites while maintaining the overall integration effort to meet the master schedule. The Pert-O-Graph system was used until June 1971, when OBW directed that a new scheduling format be used at all nine BREAKTHROUGH sites to simplify the collection of data.

Status reports, including a construction progress narrative, were submitted to OBW on a monthly

basis. The HUD Site Technical Representative (STR), the Sacramento site director, and the developer principal attended monthly program reviews in Washington, D.C., to discuss critical items and receive OBW management direction.

Early in the formative stages, SBHV recognized that a well-founded Equal Opportunity plan required minority representation not only in the work force but also in the contractors involved. For this reason, the construction work was divided into a series of bid packages designed to encourage bidding by local minority contractors. All of the construction contracting was accomplished through competitive bidding from an OBW-approved qualified bidders list. In each instance, at least three bids were received and reviewed for responsiveness by the developer, then further reviewed by OBW prior to contract award.

The original PSD contract, due to expire on July 29, 1972, was extended seven months. On March 1, 1973, Boeing Aerospace Company took over the remaining developer tasks under its HUD contract, H-1380.

Land Acquisition

In May 1970, the City of Sacramento and the PSP began preliminary negotiations for purchasing the site from the State of California Public Employees Retirement Fund. The State offered a 60-acre parcel on the east portion of the fairgrounds to the federal government at $10,000 per acre. Negotiations were conducted with utmost urgency to expedite site work, which was then scheduled for completion in one year. However, in August, HUD requested a 60-day extension of the State's offer. During this two-month period, the site location was shifted approximately 2,000 feet farther east, reducing the amount of land needed for construction to 30 acres. The State firmly rejected a new offer from HUD on the basis that no parcel of this property smaller than 42 acres would be sold.

HUD, therefore, took an option to purchase a minimum of 42 or a maximum of 60 acres. SBHV and the planner agreed that the site plan could be adapted to "42 plus" acres, so a letter of intent to buy 44 acres for $440,000 was given to the State on September 8. The purchase was consummated September 29, and title to the property passed to SBHV on October 16, 1970.

The 44-acre site included 30.38 acres for Operation BREAKTHROUGH. Two parcels of about 10 and 3 acres each remained on the east and west, respectively; these were held for later sale to housing developers. In March 1973, the Retirement Housing Foundation bought a 4-acre segment of the 10-acre parcel for construction of an FHA Section 236 MFHR for the elderly. (The structure built there that year used the Phase III version of the FCE-Dillon system; although larger, it closely resembles the high rise on the BREAKTHROUGH site.)

Financing

The PSD contract required the developer to obtain and coordinate financing for the prototype site. SBHV began discussions with several local banks, mortgage companies, and savings and loan associations. By August 1970, SBHV had identified the Sonoma Mortgage Company, a subsidiary of Wells Fargo Bank, as a suitable prospective lender. However, two factors prevented SBHV from obtaining a firm mortgage commitment. First, the housing producer and site development designs were not sufficiently advanced to permit an FHA analysis and mortgage insurance commitment, without which Sonoma would not make a loan. Second, OBW was negotiating with other lending agencies for construction financing on a national basis.

In October 1970, agreement between HUD and the National Savings and Loan League for total program financing was imminent; accordingly, OBW directed the developer to terminate negotiations with potential lenders. Because time was growing short, with construction due to start, the developer asked OBW for permission to borrow $600,000 from NCHP to buy the site property. Instead, HUD advanced Research and Technology funds for the purchase.

OBW negotiated firm financing with a group of seven California savings and loan associations. Sacramento Savings and Loan Association, being located nearest to the site, headed the group in these negotiations. On February 8, 1971, the initial closing for construction financing was completed and recorded. This loan, a first for the BREAKTHROUGH program, was insured by FHA under Section 233 pursuant to Section 207. SBHV consummated a blanket mortgage with Sacramento Savings and Loan including an interest rate of 8-3/8 percent, a 2-year construction period, and a 40-year term for amortization. The mortgage permitted take out loans on individual properties with the result that home buyers were allowed to arrange their own financing—FHA, VA, or a conventional loan. In total, the mortgage commitment covered $7,157,500 of the total projected site construction and management costs of $12,970,700.

In January 1972, Sacramento Savings and Loan purchased the interests of the other participating associations and in March made its initial construction loan mortgage payment.

Community Relations

Prior to selection of the developer, the site planner had retained a local consultant, John Baldwin, to perform community relations tasks. Although there was little evidence of active community opposition, street contacts indicated that considerable misinformation

was in circulation, much of it having to do with the exact nature of the BREAKTHROUGH program and its potential impact on the adjacent minority neighborhood of Oak Park.

In early September 1970, SBHV hired John Baldwin as assistant to the site director with specific responsibility for developing a final community participation plan and implementing an interim plan based on his prior work with the community. Among the events scheduled for October were:

- A meeting with faculty and student groups at Sacramento State College
- An open neighborhood meeting, including a slide show
- A presentation to the Sacramento City Council
- Ceremonial transfer of title from the State of California to SBHV
- Groundbreaking and luncheon

In September, SBHV also contracted with Dannenfelser, Runyon and Craig, Inc., to coordinate the public information program with the media. Not until preparations for groundbreaking began did the local press become enthusiastic about the activity at the "Old Fairgrounds," an enthusiasm that was fostered and given direction by Dannenfelser, Runyon and Craig. This agency proved effective at gaining community acceptance and keeping the public informed about progress at the BREAKTHROUGH site. Relations with the two daily newspapers, the *Sacramento Bee* and the *Sacramento Union*, remained favorable through timely presentations and forthrightness by the local HUD/FHA office and the developer.

The site developer established a $6,000 Community Action Program to provide summer employment for young people. Under the program, 27 local youths made a survey of neighborhood attitudes and market conditions. From the results an analysis was prepared which helped the developer understand community sentiments regarding BREAKTHROUGH.

In October 1970 SBHV opened an information center on the site, temporarily housed in a trailer pending availability of space in the community center. However, because of design delays, an interim facility became necessary. A small wooden structure was built for this purpose between January and May 1971. When the community center finally opened in April 1972, the interim building was sold and moved off the property.

A full-time receptionist and a part-time director staffed the information center, which was intensively used for the 50 or so people who visited the site each week. Good coverage was given to the national BREAKTHROUGH program as well as to details of the Sacramento development. Visitors were offered printed materials and viewed an integrated movie-slide show. This entire public relations effort—visitors, community meetings, and presentations to local church, school, and business groups—was reaching full stride when OBW deleted Task 3 from the PSD contract in February 1971, due to budget reductions. After that, the STR handled most of the visitors.

The developer gave much attention to labor relations, starting with informational meetings in September 1970. Negotiations with the labor council provided for selected minority union apprentices to be used at the BREAKTHROUGH site, an agreement that in essence circumvented normal union procedures. Each HSP was introduced to the building trade union officials, who then made arrangements for on-site labor. The union agreement established a basic crew of carpenters, plumbers, and electricians for on-site work. Generally, the producer signed separate labor contracts with other unions for the factory-produced items, while the traditional building trade unions did the on-site installation of factory-produced items including volumetric modules, panels, and utility cores.

An important objective of the program was Equal Opportunity for minorities and minority contractors. The developer obtained HUD and OBW approval of its June 28, 1971, Affirmative Action Plan, a document previously agreed to by representatives of the Sacramento minority community and the Associated General Contractors. Realization of the plan's major goal—to involve minorities in the on-site work force—can be measured by the fact that during construction the average minority participation was 30 percent.

SBHV held several meetings with the Minority and Specialty General Contractors Association to explain BREAKTHROUGH and encourage involvement. The significant results of those meetings were:

- Waiver of bonds for contracts less than $25,000
- Formation of joint ventures for contractors
- Dividing site contracts into smaller packages
- Help with understanding bidding procedures and documents

A training program for minorities was organized under the auspices of the Manpower Development and Training Act. Persons were trained to fill positions created in timekeeping, bookkeeping, and construction inspection. The program was successful in training five persons who later obtained jobs outside the BREAKTHROUGH program. Also, much work was done with the Oak Park Neighborhood Development Corporation in the formation of a sod and grass growing business designed to give job opportunities to neighborhood minorities.

To spur community involvement, the developer asked if the local historical society would suggest names for the streets and courts on the site. The society showed little interest, and SBHV elected to arrange a public contest instead. Three names for each street, court, and the project itself were chosen in the May 1971 judging. The city, the Post Office, and OBW then worked together to arrive at the final

Fig. 5—HUD Secretary George Romney breaks ground

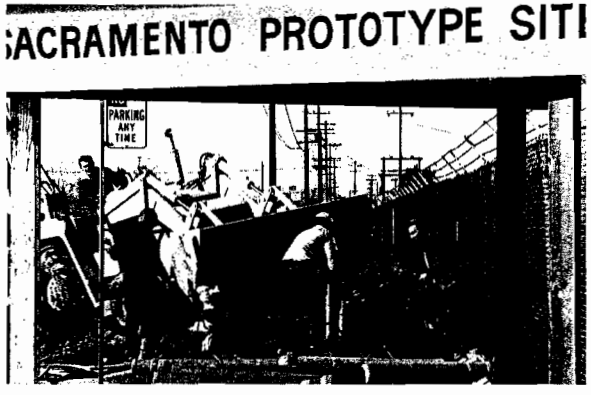


Fig. 6—Sewer installation along Broadway

Fig. 7—Joint utilities trench

winning names. As a result of these efforts, a much closer identification developed between the community and the BREAKTHROUGH project, newly named "Greenfair."

Site Preparation

From August until the groundbreaking, on-site activity was minimal except for soil testing and surveying. The groundbreaking ceremony—the first at any BREAKTHROUGH site—was held on October 22, 1970; HUD Secretary George Romney, Assistant Secretary Harold Finger, and many local dignitaries attended (Fig. 5). Demolition of the old fairgrounds structures began. Due to heavy rains starting in October (9 inches in November alone) and recurring for six months, this work was not completed until May 1971, long past the original contract completion date of December 15. The ground became excessively muddy whenever heavy machinery attempted to move. During February and March, four separate attempts were made to put grading equipment on the site but they bogged down and had to be towed away.

Meanwhile, Wurster, Bernardi and Emmons had asked OBW for permission to re-orient the nine-story high rise 90° in order to create a better relationship with the community building, improve its recreational area, and avoid unnecessary shade on adjacent units during the winter months. OBW approved the change, but the start of grading slid two months while the affected portion of the site was redesigned.

The first construction contract, for a sanitary sewer, was awarded in December, and despite bad weather both storm and sanitary sewers had been installed by the end of March 1971. To facilitate possible further development, the site's storm drains and utilities were sized to handle a 60-acre parcel. This, in turn, required the city to install a 60-inch main storm drain to the American River that would serve the

ultimate municipal separation of storm and sanitary sewers. HUD and SBHV helped the City of Sacramento prepare a grant application for federal matching funds for this line. Approval in May 1971 resulted in the city and federal governments sharing the cost. The city awarded the contract in June, with the schedule calling for completion by fall so that the site could be adequately drained during the next rainy season.

Upon receipt of site improvement drawings from the planner, SBHV began contracting for the various packages of work. By June, all construction contracts for site work except for landscaping and the community center had been awarded. OBW and the producers were continuing to negotiate changes to the HSP contract drawings, causing minor delays and some increases to the site cost. Due to those changes, a major regrading program was required prior to beginning the finishing site work contracts.

In mid-summer, the redesign and rebidding of fine grading, parking lots, secondary storm drainage, and flatwork packages delayed site work again, but improvements had progressed to the point where construction of housing systems was not affected. After OBW approval of the HSP contract drawings, most site work progressed smoothly. An exception was in the Boise Cascade area, where, due to a layout error, a foundation for a townhouse unit was located 10 feet from the planned position. Because most of the site elements were so closely related, the foundation had to be taken up and properly placed.

Fig. 8—Paving work preparatory to housing erection

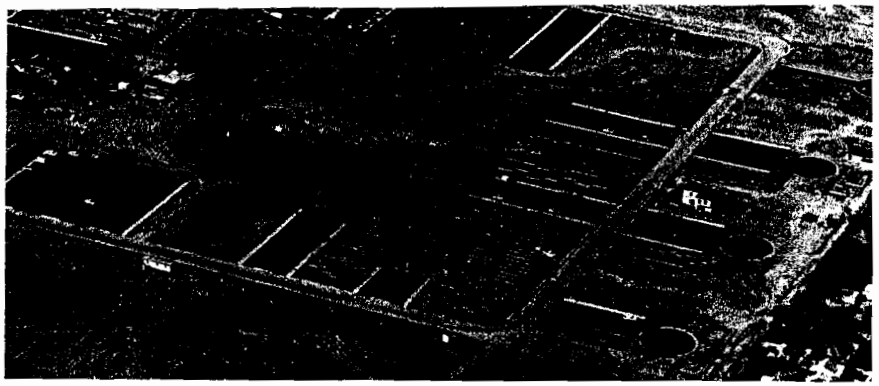


Fig. 9—Foundations under way in December 1971

An innovative feature of the site improvements was the joint utility trench containing telephone, water, electric, and gas lines. Cable television lines were laid in a separate trench which served the entire site.

In August 1971, the Teamsters Union struck the general Sacramento area. Picketing at the site lasted only a couple days, but the strike delayed both development and housing producer work due to nondelivery of materials. However, construction of the utilities trench continued without abatement.

As part of a study of construction-related crime, HUD and the California Crime Research Technology Laboratory, in joint venture, installed a portable laser beam fence at an open end of the site. This warning device was programmed so that birds, dogs, and cats would not set if off. A human intruder, however, would set off a time-delayed alarm after proceeding approximately 100 yards into the area. During the delay, a silent alarm would have alerted the security guard. Results of the test were outstanding, with a marked decline in vandalism at the site after the fence was installed.

Budget limitations forced a redesign of the community center complex, an effort that took three months. (Wurster, Bernardi and Emmons received a 1974 Citation of Merit from the American Plywood Association for the design.) The start of construction was delayed until August 1971. The contracting procedure was to divide the building into work packages covering the steel work, foundation, and carpentry, while SBHV managed and coordinated the various contractors. Minorities were strongly encouraged to bid, with the result that the pads and foundations were built by minority firms. Approximately 40 percent of the other site work, including storm sewers, was done by minority contractors.

By the beginning of the 1971-72 rainy season, the

Construction Conditions

The southern half of the site was open. The rest had been occupied by old fairgrounds structures, most of them razed, leaving shallow footings and floor slabs on grade, along with one large wooden building, several roads, and an unused railroad spur. Many abandoned utilities, including sewers, water, gas, and electric lines, remained underground, thereby impeding development. Sparse grass covered the site, which has a gentle downward slope from east to west of approximately 2 feet in 1,000.

Lightly cemented sandy silts and clays are located within a few inches of the surface and are encountered to depths of 18 feet with varying degrees of density.

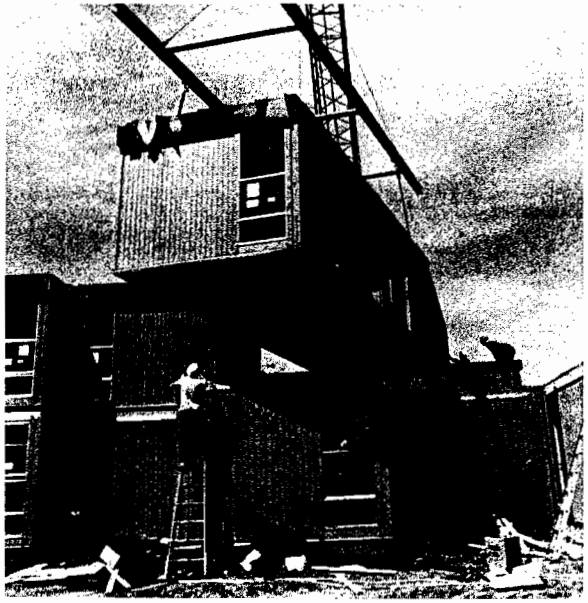


Fig. 10—Emplacement of Boise Cascade module

Fig. 11—On-site construction by Christiana

Fig. 12—Transporting CTC unit from factory

major site improvements, including paving, were essentially complete, while the HSP work was about 35 percent complete. Pantek and FCE-Dillon had not yet arrived. Work continued during the winter, but progress of site preparation was slow, as housing producer schedule slides paced installations of the fencing, sidewalks, and landscaping. These slides were caused mainly by redesigns, both of the micro-sites and of the housing units, but also involved such items as utility interface points. HSPs often made small shifts of the living units, horizontally or vertically, within the micro-sites. Such moves forced grading changes and attendant construction delays, all minor but time-consuming.

The developer still believed, as late as mid-winter, that the site would be completed before fall of 1972. Again, slides by Pantek and MSC delayed the completion of landscaping until the spring of 1973. The last work was done in April that year on the Pantek micro-site.

Housing Erection

By the end of May 1971, six months later than originally scheduled, all HSP Phase II contracts except Pantek's had been signed. The submittal to National Bureau of Standards (NBS) of 95 percent complete drawings and subsequent approval by HUD-NBS delayed the notice to proceed for all housing producers except Material Systems. In mid-July, MSC, the first housing producer to start work on-site, began laying foundations.

In August, all site activity was interrupted by the Teamsters strike, but not before Material Systems had completed foundations for all 10 SFDs and 5 of its 20 SFAs. The strike was settled after 36 days, and construction resumed on September 7.

MSC had leased an assembly facility at Fair Oaks near Sacramento, and, in mid-October, trucked the first SFD module to the site. It was lowered onto its foundation one week later. By early 1972, shipments were being made regularly. The first 10 units (all the SFDs) were completed in March. By June MSC had every module in place for all 30 units but, due to a problem with fiberglass matrix, the HUD-NBS review committee held up approval of occupancy. Specifically, the problem had to do with the siding material and its tendency to leak water. OBW conducted many tests on-site and at the Naval Testing Laboratory in Port Hueneme, California. Finally, all parties agreed that MSC would re-side the units with plywood and cover with another layer of "Tex-cote." The HUD Determination of Occupancy Committee granted approval in the spring of 1973, and all units were offered for sale on the open market at that time.

Boise Cascade received its notice to proceed during the construction stoppage caused by the Teamsters strike. After the strike, foundation forming and underground plumbing began almost immediately on the 47 SFAs. In November 1971, Boise Cascade completed all its foundations and, in December, received its plumbing permits and zoning variance approvals. Modules began arriving in February 1972, shipped on special cushioned railroad cars from Meridian, Idaho, to Salt Lake City via Union Pacific and then to Sacramento via Western Pacific. (Boise Cascade also shipped several modules by truck to compare the different forms of transportation.) By mid-August 1972, all 75 units were finished.

In March 1971, Christiana Western Structures (CWS) became the first HSP at Sacramento to sign a Phase II contract. Originally, site work was to start in April, but negotiations with HUD over design changes delayed construction. CWS got a partial notice to proceed (for foundations only) on August 3, during the Teamsters strike, but suggested waiting for approval of 100 percent drawings. (At the time, there was talk of replacing CWS at this site.) After the strike, building layouts and foundation construction were begun, CWS having agreed to go ahead. By December, foun-

dations were completed and framing, rough-in plumbing, and overall electrical wiring begun. Work progressed very rapidly and smoothly; in April erection was 77 percent complete overall, with sheetrocking, taping, and insulating being finished and plumbing fixtures and appliances installed. Christiana MFLRs were completed on August 15, 1972, and SFAs on September 22.

By the end of July 1971, CTC (TRW's subsidiary) had received its notice to proceed on construction of foundations, but submittal and approval of 95 percent complete drawings delayed the start of construction until September. CTC originally proposed to stack the townhouse modules together at the site in the conventional box module manner. The company had leased a factory nearby in southeast Sacramento, however, and the convenient factory location suggested an alternative method of stacking the boxes at the plant and trucking the assembled townhouses through the city streets. Trade-off studies showed that, for less than $1,000, utility wires along the route could be raised to clear the loaded trailers. This method compared favorably with the costs for renting a mobile crane and employing additional site labor. Therefore, when a foundation was ready, a complete two-story unit would be shipped from the plant by normal house-moving methods and emplaced with the use of jacks. CTC did assemble one unit on-site, instead of at the factory, using the same kind of panels that went into the box modules. This single unit demonstrates the feasibility of the system for distant or inaccessible sites (Fig. 24).

By early February 1972, CTC was doing finishing work on some units and had begun to build garages. Throughout the spring more units were set and finish-up work continued. Construction was completed by June 30, 1972.

ACSI received partial notice to proceed on August 9, 1971, covering foundation work only. The Teamsters strike interrupted these plans, and the next few weeks were spent preparing a prospective bidders list. Early in October, layout work began on the foundations, and pouring started October 21, two days after final notice to proceed was received. Foundations and floor slabs were completed by the end of the year.

Housing 601, an Alcoa subsidiary, manufactured the "wet cores" for the ACSI and CTC units and shipped the service modules from Kent, Washington (near Seattle), to Sacramento by truck. The wet cores were the most significant factory-built components in the Alcoa system, although wall panels, floor panels, and roof trusses also were preassembled locally. Erection started with 24 MFLRs the second week in January 1972. The four SFDs did not get under way until March and were the last units to be finished. ACSI completed construction on September 1, 1972.

FCE-Dillon received a notice to proceed with foundations in November 1971 and began pouring

Fig. 13—Setting first CTC unit on foundation

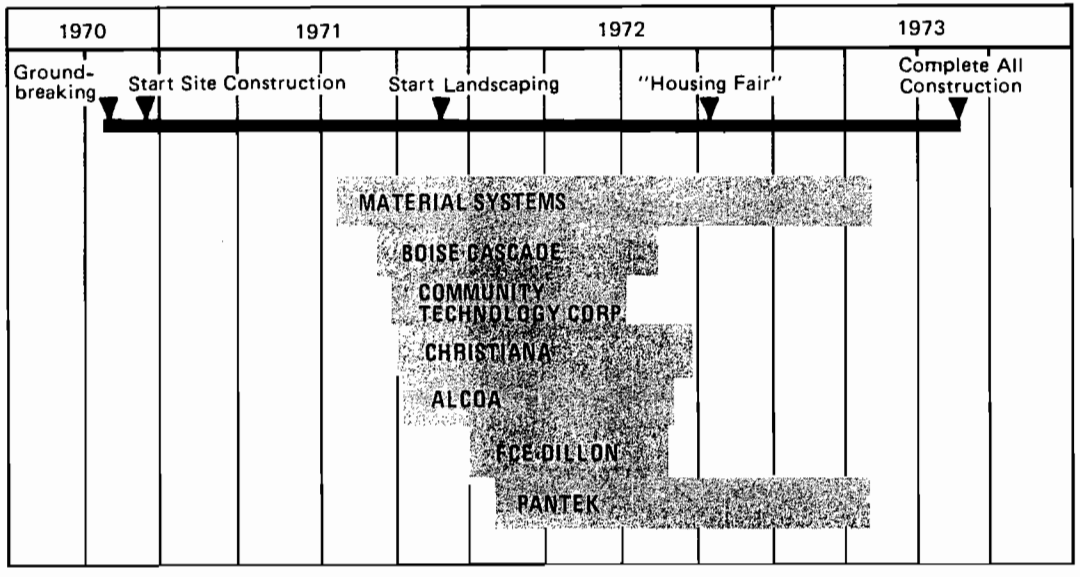


Fig. 14—Progress of housing construction

main footings for its high rise the next month. By the end of January, the producer had started to form the first-story walls, which were conventionally built of concrete. They were completed March 11. By then, underground sewer connections were made, and four elevator shaft modules, pre-cast in a local contractor's yard, were on hand. FCE-Dillon shipped the larger heart modules, fabricated at Akron, Ohio, to Sacramento by truck trailers loaded "piggyback" onto railroad flatcars.

Within days, Dillon had advanced to placing modules and floor panels and pouring floor slabs at the ninth floor level. Only 23 working days were used to erect the top eight floors of the nine-story structure. Summer saw interior and exterior finishing completed, and the developer accepted the building on August 22, 1972.

Because of an extended negotiation period with HUD, Pantek was the last housing producer to begin on-site construction. The Pantek contract was unique in that HUD and Pantek shared equally in the overruns above a specified amount. Pantek rejected the initial notice to proceed early in January 1972, but on-site construction began later that month, and in April the footings were poured. By July, work had progressed to the point where wall panels for six units were in place. Various minor completion problems (punch-list items) lingered until April 23, 1973, when the developer finally accepted the Pantek units.

SBHV provided the interface between housing producers and the State of California Department of Housing and Community Development. The State incorporated into its factory-built housing law a section designed to accommodate review of BREAKTHROUGH criteria. Subsequently, the review was made and the criteria accepted. Also, a State acceptance permit was granted. Early in the erection phase, the State was actively involved in the on-site inspections, but the developer subsequently arranged for the State to turn over its responsibilities to the City of Sacramento. Later, approvals of producer documents were obtained by the developer from the city. The city engineer reviewed BREAKTHROUGH's building permits and listed deviations from the building code. There was some pressure on the city council because of deviations, especially in street widths. But, in keeping with the ordinance of cooperation, the city gave the necessary approvals as requested.

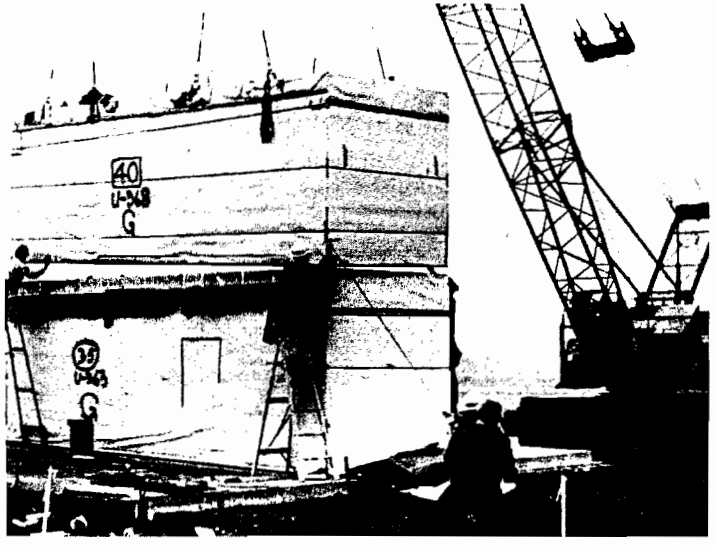


Fig. 15—Positioning second-story Aloca core

Operation and Maintenance

Upon completion of the living units, the various producers turned them over to SBHV for maintenance, including regular inspection, replacement of damaged items, and minor repair work. The HSPs guaranteed their units against defects in workmanship and material for one year after acceptance by, and turnover to, the developer. Following the expiration of HSP warranties, the developer provided warranties so that each new home buyer received standard coverage from one source or the other for a full year.

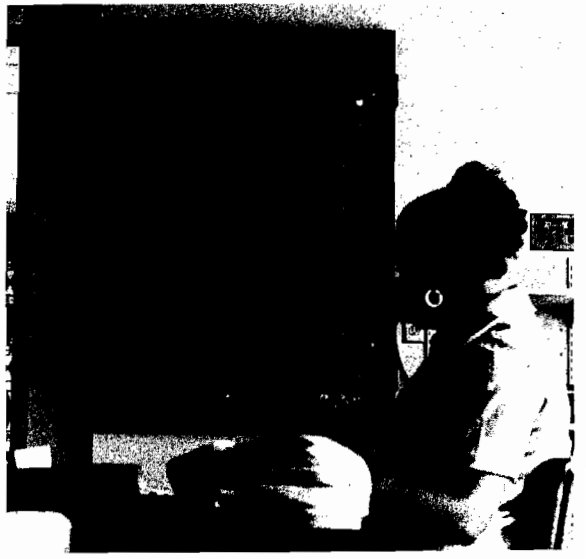


Fig. 16—Alarm system panel

Before the start of public marketing, OBW arranged for the developer to sell 192 units to the Retirement Housing Foundation (RHF). As part of the sales agreement, RHF was to manage and perform site maintenance for the Greenfair Homeowners Association, composed of all housing unit owners. Under this agreement, RHF collects dues, disburses funds, provides personnel, and maintains all common grounds. Maintenance includes grass cutting, weeding, fertilizing, and watering, along with upkeep of the pool and the community center.

(RHF also provides various activities for the elderly tenants of its own rental units. The high-rise building includes a special security feature, an alarm system that can summon aid from the duty nurse station (Fig. 16). It can be triggered from any room by a fountain-pen-sized device. A similar system has

been included in another FCE-Dillon high rise built later just across the street for the same private owner.)

Grounds maintenance, especially grass cutting, became a major job. Another problem appeared in the summer of 1973 when the combination of compacted soils and heavy watering, necessary to start new grass, caused flooding of the low central lawn area. Water wouldn't drain through the hardened subsoil, so many trees "drowned." Steps then were taken to select and plant trees that were indigenous to the area and, therefore, more likely to survive.

During the month of November 1973, heavy rains fell on the Sacramento area. Leaks of varying nature and intensity began appearing in many of the units. The MSC units were severely affected where flat roofs permitted water ponding and related leaks in about 10 of the units. Building interior damage from leaking water included wall, ceiling, and floor staining and warping, soaked carpets, damaged fixtures, and mildew. The Tex-cote siding material also leaked. Hollow-core doors, often improperly sealed, tended to delaminate and warp. Negotiations between the producer, the developer, and OBW finally resulted in major repairs to the Material Systems units but not before many residents moved out over the frustrations and delays encountered in getting their units refurbished.

The balconies of some Pantek units were inadvertently sloped toward the sliding glass doors; water leaked over the door thresholds, making it necessary to rework some of the balconies. In other units, joints between the outside panels developed leaks, necessitating recaulking. Ground water entered the underground heating/cooling ducts in some SFAs, restricting air circulation to the units and causing excessive interior humidity. Major rework, again involving much negotiation between Pantek, HUD, and the developer, was undertaken in an attempt to correct these conditions.

Christiana Western buildings suffered interior damage as a result of water ponding on the decks and then draining over the thresholds of the sliding glass doors. To alleviate this condition, the doors had to be reworked; also additional rain spouts were installed. Several of the Christiana tenants complained of poor quality appliances in their units too.

Some time after erection, CTC noticed severe failures in the plastic surface covering the exterior gypsum board. These failures can be broadly categorized as tension cracks at and contiguous to exterior gypsum board joints and failures which started as bulges in locations away from joints. Patches applied by CTC under HUD-approved procedures failed, and it was decided to re-side the units with hardboard siding. After hardboard was applied to a small number of SFDs, it could be seen that the screwing and nailing pattern allowed the siding to bulge. Additional negotiations between CTC, HUD, and the developer finally resulted in a decision to discontinue the hardboard application and use 5/8-inch exterior plywood instead. This rework was finally accomplished in the spring of 1974.

Boise Cascade hired Campbell Construction Company to perform its warranty work, and in general, responses occurred in a timely manner. Alcoa and Christiana were, for the most part, very slow to respond to requests for warranty service. These three housing systems have all had varying degrees of failure in their textured or panel sidings.

Marketing

Marketing the Sacramento site presented a complex challenge in attempting to marry the objectives of BREAKTHROUGH with those of the marketplace. Even though Greenfair had received consistently good press coverage during its construction, the image of "subsidized government housing" remained. This stigma of a low income project was compounded

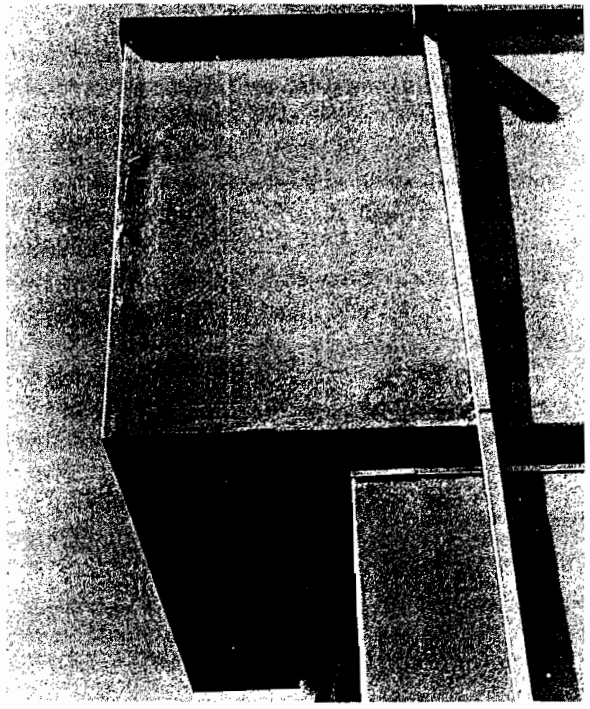


Fig. 17—Caulked corner patch failure

Weather and Comfort

Greenfair and its surroundings are on flat terrain, exposed to prevailing southwest winds that average 9 mph. Frequent breezes contribute to the relatively low level of air pollution. The average summer temperature is 76° but often climbs into the 90s, making air-conditioners a necessity for Greenfair homes. The sun shines regularly from May through October, the dry months. Most of the 16.3 inches of annual rainfall occurs between November and April. The average winter temperature is in the mid-40s, with minimums averaging around 37°.

Fig. 18—West side of FCE-Dillon high rise

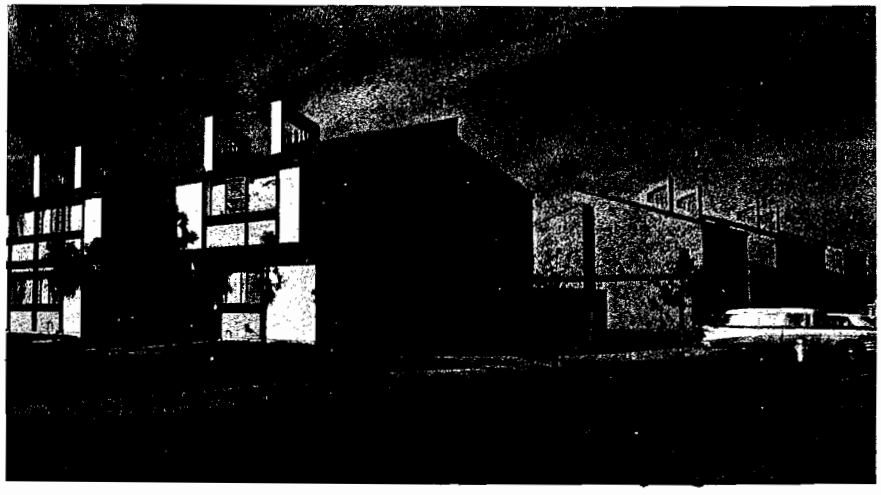


Fig. 19—Completed ACSI garden apartments

Fig. 20—Christiana micro-site with tot lot

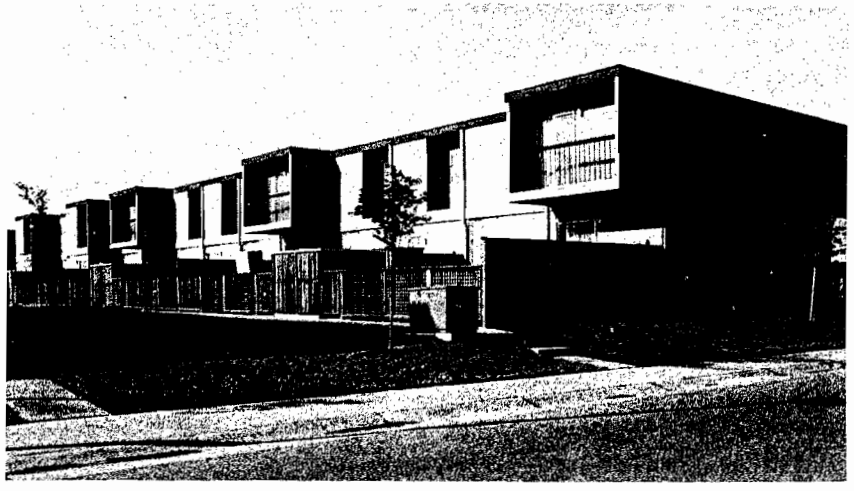


Fig. 21—Material Systems townhouses on Arena Court

by the failures of two large FHA Section 236 projects in the Sacramento area at about the time the site marketing program began.

Perhaps the single largest problem was the location of the BREAKTHROUGH site. In 1969, during national protests over United States involvement in the Vietnam war, the Oak Park area became embroiled in controversy, and riots followed. Sacramento High School (the school that Greenfair residents would attend) was the center of most of the dissent. Although relative calm was eventually restored, memories of the turmoil are still fresh, and many people are reluctant to live in an area so closely identified with Oak Park.

Greenfair marketing objectives were as follows:

- Provide a showcase for industrialized housing
- Create a community compatible with the surrounding neighborhood
- Attain a wide-ranging economic mix
- Match the racial mix for the Sacramento area (white, 83 percent; black, 7 percent; Spanish-speaking, 6 percent; other, 4 percent) and surpass Equal Opportunity guidelines

SBHV contemplated a contract for sales management with Del Monte Properties of Los Angeles, a subsidiary of the Del Monte Corporation, one of the investors in NCHP. OBW and Del Monte could not come to an agreement on terms, and negotiations were terminated in December 1971. The marketing agent then chosen for the site was Jones & Brand & Hullin (J&B&H), a well-established Sacramento real estate brokerage firm. J&B&H had been a consultant to SBHV since the 1969 submittal of the PSD proposal and, in January 1972, was contracted to act as sales agent for the BREAKTHROUGH site. A sales commission of 2-1/2 percent was agreed upon.

J&B&H immediately began a series of meetings with the local minority brokers, hoping to involve

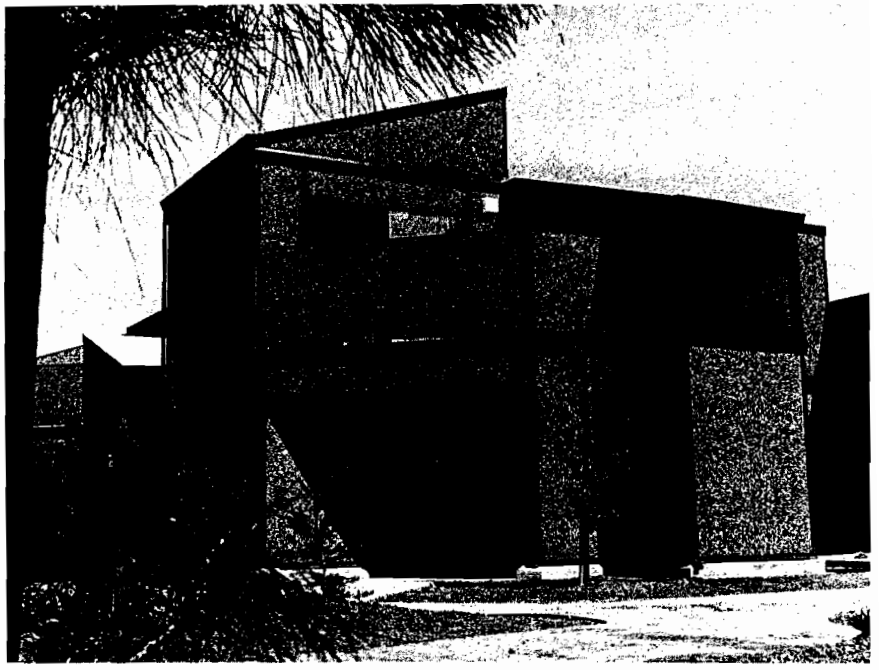


Fig. 22—Distinctive Pantek units

Fig. 23—Boise Cascade dwellings after occupancy

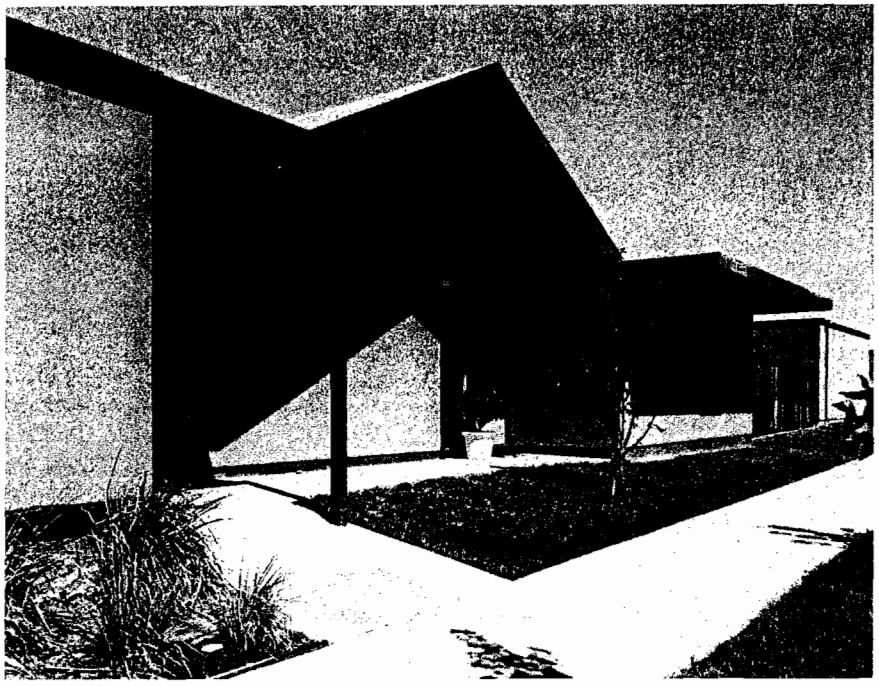


Fig. 24—One CTC unit assembled on-site from panels

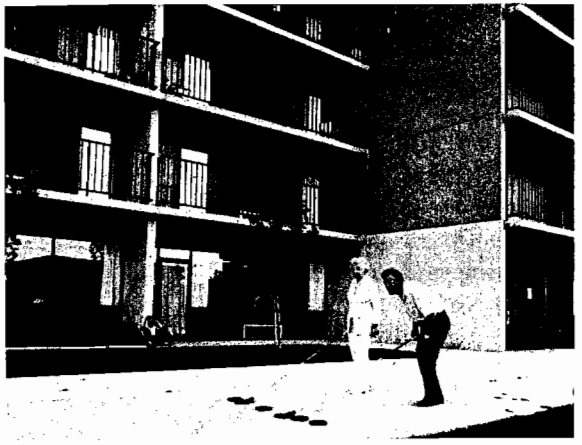


Fig. 25—Recreation for high-rise residents

them in the sales program. Through HUD funds made available to the PSD, J&B&H founded the Minority Brokers Association, which elected salaried officers and met monthly with representatives of J&B&H and the developer to discuss site progress. These meetings went on for six months but, because of slides in site and housing producer construction schedules, minority participation declined, and finally only special meetings were called. Prior to the grand opening, minority brokers were brought up to date on site status; however, they made no sales at Greenfair.

The developer arranged with Buhler Mortgage Company of Sacramento to make permanent financing loans available to Greenfair buyers. These included FHA- and VA-insured loans as well as conventional financing methods. The FHA-insured loans were under Section 233 pursuant to Sections 203(b) and 221(d)(2) for the single family homes and 236 and 221(d)(4) for the MFLR and MFHR units.

Before the individual units were put on sale to the public, OBW found a buyer for the FCE-Dillon high rise and the Boise Cascade, Christiana, and Alcoa garden apartments (192 units in all).

The purchaser was the Retirement Housing Foundation, a national nonprofit organization that provides housing for qualified elderly persons. On July 1, 1972, the first BREAKTHROUGH site residents occupied a Boise Cascade unit.

The actual sales program for Greenfair began in June that year, and consisted of selling the remaining 179 SFAs, 20 SFDs, and 16 garden apartments (215 total) in the general marketplace. The units to be sold individually—the 199 SFA and SFD units—were priced in the range of $17,000 to $25,000, while the 16 apartments were valued at about $196,000 total.

Dannenfelser, Runyon and Craig conducted the advertising campaign, with OBW's counsel and approval. Small classified ads appeared in the two daily newspapers on weekdays, and larger display ads on weekends. Frequently, advertisements were also placed in the *Sacramento Observer*, a minority newspaper.

During the initial weeks, a "soft sell" technique was used. A salesman greeted clients at the community center, gave them promotional materials, and then took them on a walking tour of the model homes. Since the models were in various locations, much time was used showing each client around the site. This reduced sales efficiency and effectiveness by presenting a confusing number of alternatives.

Early sales were slow due to the unfinished nature of the site and a "soft" real estate market in the Sacramento area. To boost sales, a promotional Housing Fair was held on the weekend of October 14-15, 1972. Entertainment was provided, including ascension of a hot-air balloon, Spanish dancers, a wild West shoot-out, and refreshments for the 6,000 visitors.

According to market predictions this particular mix, with its large number of townhouses, would have sold quickly in 1970 and 1971. Unfortunately, 1972 saw a general decline in the new housing market in the Sacramento area. Despite this handicap and the fact that sales commenced with the site unfinished, J&B&H had received earnest money on 50 units by January 1973. That same month, Campbell-Greenfair,

a joint venture of one general and four limited partners, entered into a sales agreement for the 16 Pantek garden apartments.

On March 1, Boeing took over site operations from SBHV and instituted a revised sales campaign. This effort included more model homes, a general site cleanup, and a revised advertising program. SBHV still owned the property and in April negotiated an agreement to sell the remainder of the site to one owner, Greenfair, Ltd., a limited partnership with headquarters in Oregon.

The sale, involving 147 units, was consummated in August. The new owner, a limited partnership, took over the sales program as well. Within three months, Greenfair, Ltd., disposed of the remaining units. A few were sold conventionally but most were on contracts for sale with two-year options to close or terminate.

In summary, J&B&H, acting for the developer, sold 52 units. Greenfair, Ltd., sold 18 units outright and 129 under contracts for sale. Retirement Housing Foundation rented all 192 of its units (including the high rise). Campbell-Greenfair owns and has rented the 16 Pantek garden apartments. This accounts for all 407 units at BREAKTHROUGH Sacramento.

GTR for site development — F. Hansen
GTR for planner — M. Chateauneuf, S. Hodges
STR — R. Hirsch
ACO — R. Nicholson
Director of OBR — J. Keast

HSP COSTS
(dollars in thousands)

Producer	Cost
Alcoa	$ 935.0
Boise Cascade	1,425.0
Christiana	1,074.2
CTC	801.7
FCE-Dillon	1,977.5
Material Systems	715.2
Pantek	1,485.0
Total	$8,413.6

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM August 1970:	Start site preparation	12-70
	Start housing construction	3-71
	Finish housing construction	10-71
	End demonstration/marketing	7-72
Interim CPM January 1972:	Start site preparation	10-70
	Start housing construction	7-71
	Finish housing construction	10-72
	End demonstration/marketing	1-73
Actual Performance:	Start site preparation	10-70
	Start housing construction	7-71
	Finish housing construction	4-73
	*End demonstration/marketing	11-73

* All units sold

Fig. 26—Sacramento site costs and schedules

HOUSING SYSTEM PRODUCER SCHEDULES

ALCOA CONSTRUCTION SYSTEMS, INC.

4 Single Family Detached
24 Single Family Attached
24 Multi-Family Low Rise

Phase II Contract:	Start foundations	8-71
	Start erection	9-71
	Complete erection	11-71
	Finish units	1-72
Actual Performance:	Start foundations	10-71
	Start erection	1-72
	Complete erection	6-72
	Finish units	9-72

BOISE CASCADE HOUSING DEVELOPMENT

47 Single Family Attached
28 Multi-Family Low Rise

Phase II Contract:	Start foundations	10-71
	Start erection	11-71
	Complete erection	3-72
	Finish units	4-72
Actual Performance:	Start foundations	9-71
	Start erection	2-72
	Complete erection	6-72
	Finish units	8-72

CHRISTIANA WESTERN STRUCTURES

45 Single Family Attached
28 Multi-Family Low Rise

Phase II Contract:	Start foundations	6-71
	Start erection	6-71
	Complete erection	8-71
	Finish units	9-71
Actual Performance:	Start foundations	10-71
	Start erection	11-71
	Complete erection	5-72
	Finish units	9-72

COMMUNITY TECHNOLOGY CORPORATION

6 Single Family Detached
14 Single Family Attached

Phase II Contract:	Start foundations	6-71
	Start erection	6-71
	Complete erection	9-71
	Finish units	9-71
Actual Performance:	Start foundations	9-71
	Start erection	10-71
	Complete erection	6-72
	Finish units	6-72

FCE-DILLON, INC.

112 Multi-Family High Rise

Phase II Contract:	Start foundations	7-71
	Start erection	1-72
	Complete erection	5-72
	Finish units	6-72
Actual Performance:	Start foundations	12-71
	Start erection	4-72
	Complete erection	5-72
	Finish units	8-72

MATERIAL SYSTEMS CORPORATION

10 Single Family Detached
20 Single Family Attached

Phase II Contract:	Start foundations	4-71
	Start erection	7-71
	Complete erection	12-71
	Finish units	3-72
Actual Performance:	Start foundations	7-71
	Start erection	10-71
	Complete erection	6-72
	Finish units	4-73

PANTEK CORPORATION

29 Single Family Attached
16 Multi-Family Low Rise

Phase II Contract:	Start foundations	12-71
	Start erection	7-72
	Complete erection	8-72
	Finish units	10-72
Actual Performance:	Start foundations	1-72
	Start erection	6-72
	Complete erection	10-72
	Finish units	4-73

SITE IMPROVEMENT COSTS

(dollars in thousands)

Item	Cost
Demolition	$ 44.9
Sanitary and storm sewers	104.9
Earthwork	185.3
Community facilities	196.9
Landscaping	579.6
Water system	80.7
Fences and carports	160.7
Electrical	135.1
Other	104.3
Total	$1,592.4

King County, Wash

King County

Site Location: N. E. 149th St. & 124th Ave. N. E.

Prototype Site Developer: The Boeing Company

Prototype Site Planner: Eckbo, Dean, Austin & Williams/George S. Nolte

Housing System Producers: Alcoa, Christiana, Levitt, Material Systems

Total Housing Units: 178

Introduction

Lendemain, the King County site, is notable for its natural beauty. Great care was taken to preserve as much of the scenery as possible, and the results justify the attention given to all details.

With logic and ingenuity, the site plan brought out the best aspects of the 35.9 acres. Four producers built single family units, townhouses, and apartments. A fifth producer withdrew from the site during development, forcing important changes in the work.

Operation BREAKTHROUGH was a major test of Washington State's new factory housing law. The law provides that units pass design reviews and factory inspection to gain State certificates of acceptance. It eliminates redundant local inspection and broadens the potential market for industrialized housing.

Detail site design proved to be more complex than expected. The developer set up a joint team with the planner to prepare working drawings. This activity, coupled with progress of the housing systems, paced the overall schedule.

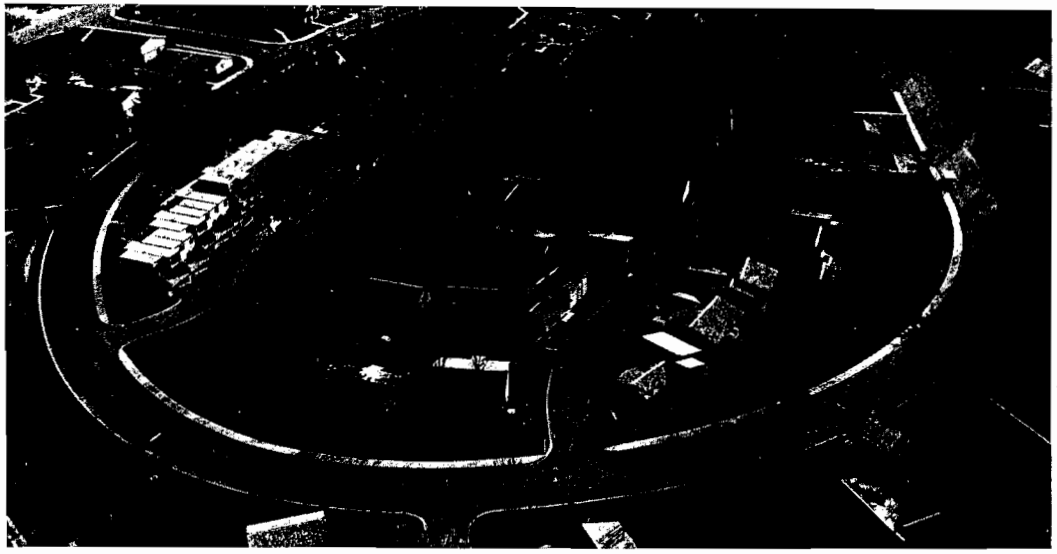
Cover:

The King County BREAKTHROUGH site demonstrates industrialized housing matched to the landscape: man's work in harmony with nature. By optimum placement and land use, the team of planner, developer, and producers achieved an unusual sense of openness and freedom, though the density (five units to an acre) is comparable to that of conventional suburban developments.

Site preparation began December 17, 1970, but was quickly complicated by serious drainage problems. Runoff from surrounding properties saturated areas near the center of the site, particularly during the wet winter season.

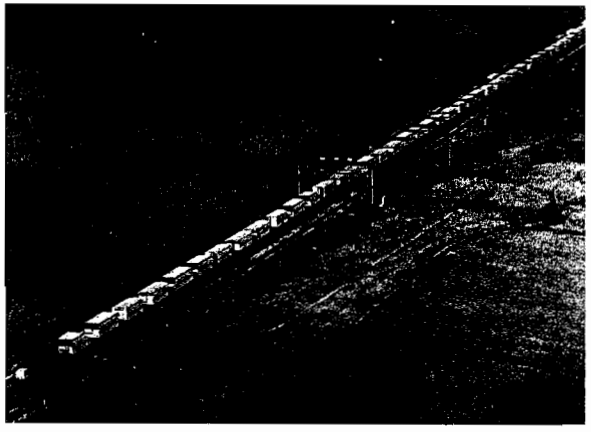
Although erection of housing systems began in August 1971, it was not until a year later that the last producer started on-site work. Actual emplacement went quickly, then finishing operations lagged. All units were finally completed by May 1973.

A strong community relations effort presented BREAKTHROUGH to the public. Opinion shifted in favor of the program, where earlier complaints nearly caused cancellation. Visitor tours, neighborhood meetings, open hearings, and media coverage all encouraged citizen involvement.



The planner designed a significant demonstration of advanced housing and land use featuring central open space, a loop road, and clustered dwellings. Approval for the site was gained under the county's planned unit development rules.

The first Lendemain homes went on the market in July 1972. Initial sales were slow, partly because of a limited variety of completed units. By the end of 1973, 75 percent of the units had been sold on the open market in a price range compatible with values in the surrounding neighborhood.



Shipment of the first housing units was a matter of historical and technical significance. The modules were moved 2,400 miles by train from the Levitt factory in Michigan, an event that attracted much attention.

Industrialized houses have large components and require heavy handling equipment. In the densely wooded areas of the King County site, this posed a challenge to development.

Lendemain offers facilities and site improvements that enhance community life for more than 500 residents. A pedestrian walkway system links housing clusters and recreation areas with the clubhouse and swimming pool.

Background

The Puget Sound area, the most populous region in Washington, appeared to offer a high potential for BREAKTHROUGH sites as well as a large market for housing. After learning about Operation BREAKTHROUGH, Governor Daniel J. Evans acted to involve the State of Washington in the program. The Governor's Office of Planning and Community Affairs organized a committee consisting of leaders from housing, labor, construction, local government, management, banking, and consumers. The established regional planning agency, Puget Sound Governmental Conference, assumed the staff work.

A proposal that recommended three possible locations (Fig. 1) for BREAKTHROUGH prototype housing was submitted on September 8, 1969. The sites proposed were:

A. Hazelwood—a hilly site in an unincorporated area north of Renton
B. Yesler-Atlantic—a city block of 71,000 square feet in the Central Area of Seattle. This was considered a supplement to one of the suburban sites to allow inclusion of high rise housing in the local demonstration
C. Mountlake Terrace—28 acres in a "bedroom" suburb in Snohomish County

Survey teams of engineers and appraisers from HUD and the Federal Housing Administration then inspected each site. The two suburban sites were not evaluated as highly as Yesler-Atlantic, so a search was made for other alternatives in the county area. In accordance with a suggestion in the governor's proprosal, availability of State-owned land was investigated, and the Woodinville site in the unincorporated Kingsgate area of the county gained attention. A survey confirmed its favorable qualities, particularly when considered along with other aspects of the proposal. The opportunity for a direct comparison of BREAKTHROUGH in urban and suburban conditions within the same metropolitan area was especially attractive.

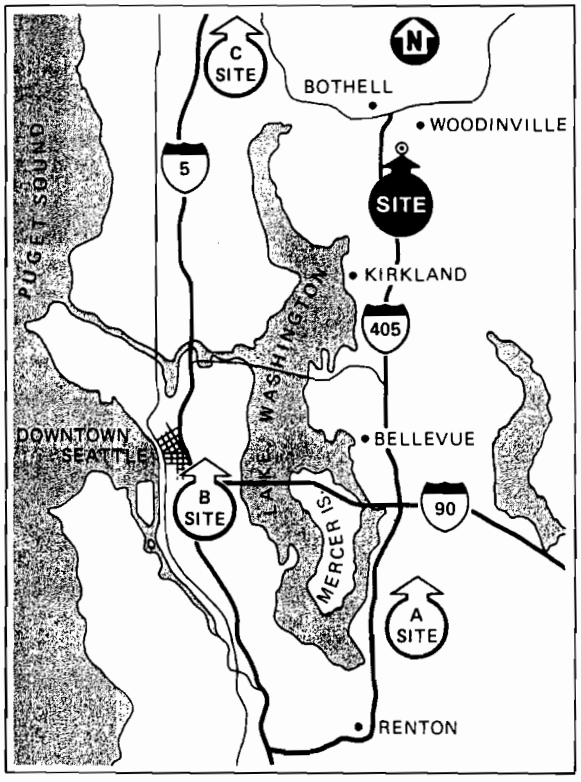


Fig. 1—Candidate sites in Seattle metropolitan area

HUD ultimately selected both the Woodinville and the Seattle city sites, designating the latter (temporarily) as a "subsite" of the King County location. Announcement of these choices was made on January 19, 1970.

Once a dense evergreen forest typical of the Pacific Northwest, the semi-rural King County site had been logged off early in the century. Second growth is a mixture of trees and heavy underbrush. About 1930, a strip was cleared along the eastern border next to 124th Avenue NE for a Seattle City Light power line. (For that reason, 124th Avenue NE is known locally as "Powerline Road.") Five acres in the northeast corner were leased to a farmer, who constructed a house and several outbuildings around 1940. In 1964, the State Department of Institutions leased five acres in the southeast corner for the Woodinville Group Home, a halfway house for boys.

The State of Washington Department of Natural Resources (DNR) owned the site. This agency holds title to considerable land, mostly undeveloped, with profits from leases and sales assigned by law to support public schools. Making the property available to BREAKTHROUGH thus had two advantages for the State: immediate school funds and future revenues from the return of the land to the tax rolls. Initial planning by HUD and DNR called for the purchase of 38.77 acres. Of this, the prototype site was to cover 31 acres, with the balance to be transferred from HUD to King County as park land.

In the governor's proposal were three letters from King County officials pledging county cooperation with Operation BREAKTHROUGH. County Executive John Spellman stated, "The present codes and ordinances in King County are considered to be sufficiently flexible to accommodate new systems, components or techniques of building houses . . ." He expressed the county's wish to "facilitate" BREAKTHROUGH and "consider making such changes in our codes and ordinances as may be needed to allow new types of housing construction which meet performance standards . . ." In the same vein, Austin VanDusen, Acting Director of the County Building Department, explained that, under the Uniform Building Code used in King County, the building official has "the prerogative of approving any material or method of construction not specifically prescribed in the code when he is satisfied that such

Fig. 2—View toward northeast before development

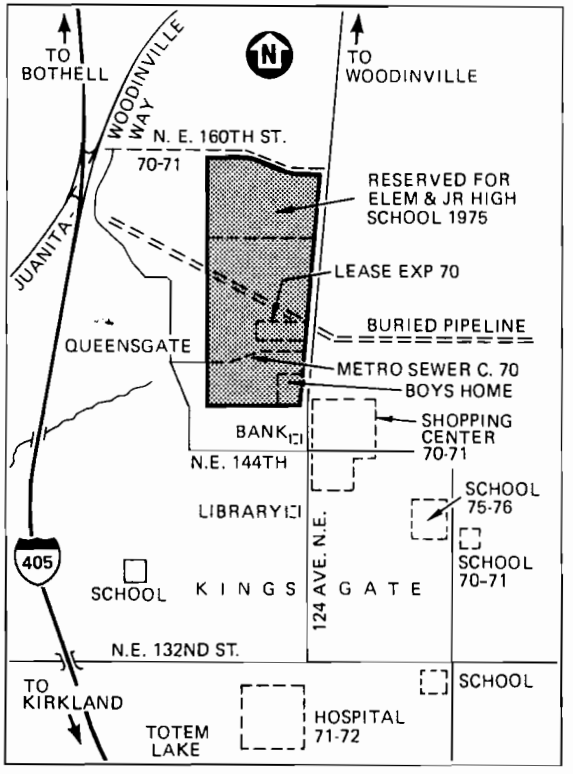


Fig. 3—Plans for State land and adjacent neighborhood

materials or methods of construction are at least the equivalent of those prescribed in the code . . ." He pointed out that approval would be based on "evidence submitted by the proponent" and said that his department would cooperate in "the evaluation of materials and methods of construction . . . under Section 106 and 107 of the Uniform Building Code."

Edward Sand, Director of the County Planning Department, declared his support for the BREAKTHROUGH "experiment." He noted that the Planned Unit Development section in the county's zoning ordinance "permits an almost unlimited variety of innovative land plans, building configurations and building locations" and said that proposals would be judged by performance criteria, using "all avenues of flexibility within existing county codes as well as variances from standards where appropriate."

Confirming its willingness to cooperate with BREAKTHROUGH, the King County Council passed Ordinance 264 on December 12, 1969. The ordinance was amended on January 16, 1970, by Ordinance 302, which declared that an emergency existed. This action forestalled a legal requirement for public hearings. After site selection, pressure from the voters influenced further changes and eventually did force a public hearing, late in 1970.

Pre-Development Activity

A competition for Prototype Site Planners (PSPs) for all 11 sites had been held by HUD late in 1969. Among the successful proposers was the joint venture of Eckbo, Dean, Austin & Williams, landscape architects from San Francisco, and George S. Nolte & Associates, engineers from San Jose, California (referred to hereinafter as Eckbo/Nolte). HUD awarded a letter contract to Eckbo/Nolte on January 27, 1970, covering a survey of existing county site conditions and recommendations for development. On March 25, contract H-1209 for the complete PSP work expanded the agreement.

Meanwhile, public resistance to site selection became apparent. A community meeting in Kingsgate on February 2 was attended by several hundred people, an audience so hostile that the BREAKTHROUGH presentation by HUD and the planner could not be finished. At that time, of course, with Eckbo/Nolte just starting work, plans for the site

were necessarily vague. No regional HUD staff was yet assigned to BREAKTHROUGH; hence, the program had no local spokesman. The opposition, on the other hand, was well organized. A petition bearing 300 names was sent to Washington, D.C., condemning the site selection. Many of the letters written to public officials sought only information, but strong pressure was also exerted on the county council. On March 16, the council passed Ordinance 381, amending Ordinance 302 by adding a review procedure.

Site surveys progressed, and planning of conceptual approaches to site development began. Also, Eckbo/Nolte and HUD's program staff in Washington, D. C. (OBW), studied possible housing system assignments, which were closely related to site planning objectives such as the housing unit composition or "bedroom mix." For this purpose, the site unit total was set at approximately 150. A composition of 84 single family detached units, 22 patio homes, 22 townhouses, and 22 garden apartments was recommended based on a study of the local market and other influences. Specific systems that could fill these needs would come from the winners of Housing System Producer (HSP) contracts.

The planner took inventory of zoning requirements, neighborhood circumstances, soils, topography, drainage, vegetation, and similar constraints natural and man-made. It was confirmed that county zoning allowed planned unit development. Orderly documentation was prepared, from which emerged a summary land use plan, showing the site's general assets and identifying those portions best suited for the purposes envisioned. Eckbo/Nolte completed the Task I Report on March 13, 1970.

The next step was to match a density target with the tentative assignment of HSPs. This operation involved many revisions and refinements as time went by. In April, the total unit count was raised, for planning purposes, to 175. A general concept of the development began to take shape, consisting of roughly 50

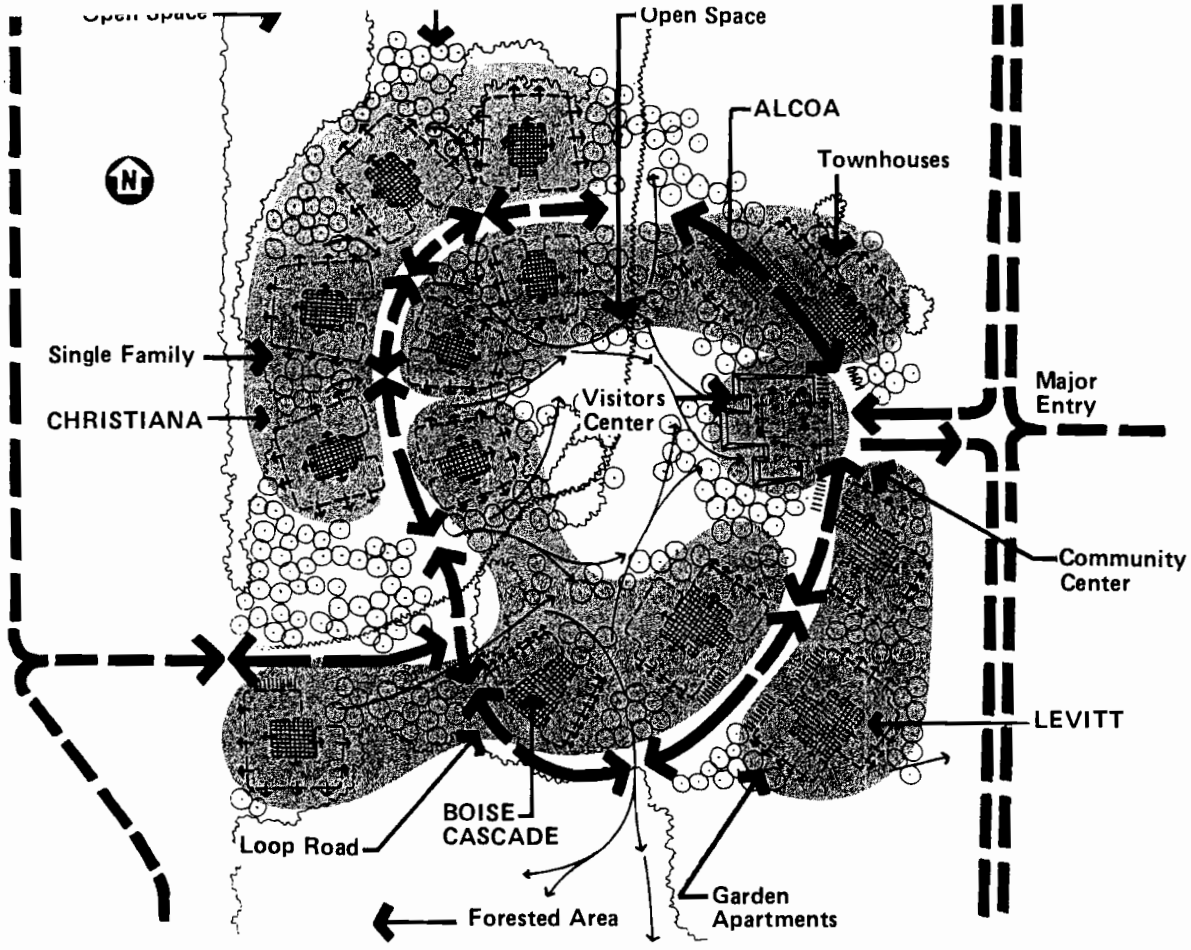


Fig. 4—Site plan concept

percent single family detached (SFD) homes and 50 percent townhouses and garden apartments. The distribution of the housing reflected existing zones and usage in the neighborhood.

HSP site assignments depended to some extent on the characteristics of the individual systems. The 22 national selections represented a wide variety of systems, ranging from contemporary subdivision styles to dramatic high rises; however, many of them were intended for suburban markets such as the King County site. During the spring of 1970, HUD negotiated Phase I contracts with the HSPs. These covered detail designs of the housing systems and included "working out with the site planners final plans for construction of their models at the prototype sites."

On May 4, HUD announced the tentative assignments of Boise Cascade, Christiana Western, and Levitt to King County and added Alcoa soon afterwards. Although the four producers had different system concepts, all offered SFD, single family attached (SFA), and multi-family low rise (MFLR) units, the types most appropriate to the site.

Site Plan

Concern for the natural beauty of the site dominated the design stage. Alternative layouts were prepared based on different access schemes. The one favored (Fig. 4) used a loop road with entry from 124th Avenue NE and from NE 148th Street in

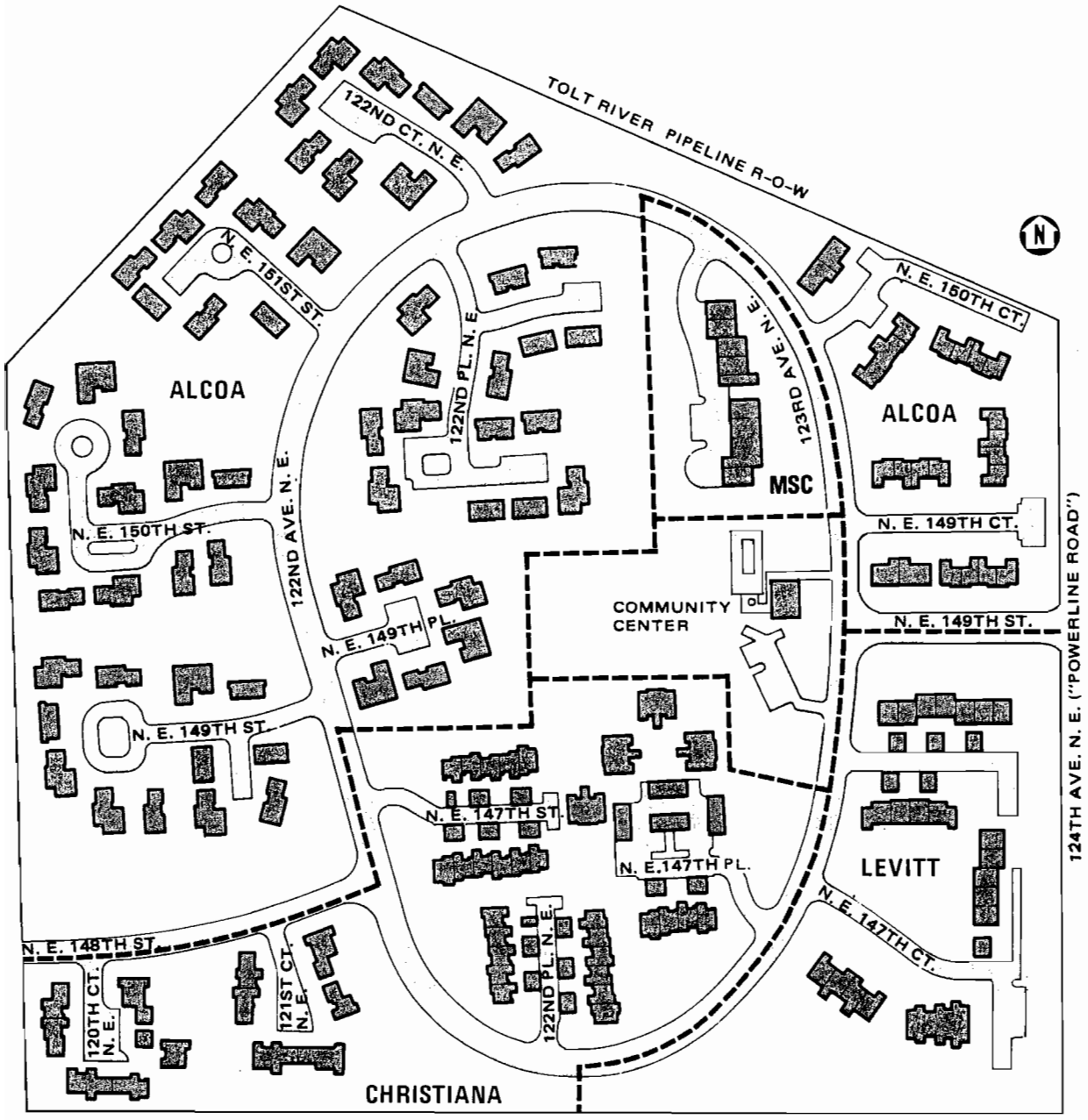


Fig. 5—Site plan as built

Queensgate. Housing was clustered in order to concentrate man-made developments and preserve open space. Subdivisions called "micro-sites" were distributed around the loop road and assigned to individual HSPs. Much of the site interior and several buffer areas on the perimeter remained as green belts.

The HSPs made design studies of the micro-sites, arranging their units in the type and number established by Eckbo/Nolte. The planner provided the geographical boundaries of the micro-sites, the tentative road access, and the layout concepts. Reviews of the preliminary designs resulted in joint modifications—minor changes involving such things as realigned cul-de-sac access roads—by Eckbo/Nolte and the HSPs.

The first firm plan called for 168 units, but the total increased to 178 in September 1970, when another producer, Material Systems Corporation, was added. Later, Boise Cascade's 60 units were deleted because HUD and the producer could not agree on a Phase II contract. In order to maintain the total of 178 units, the remaining four HSPs were realigned as follows:

Alcoa	86
Christiana	54
Levitt	28
Material Systems	10
Total	178 units

In its final form (Fig. 5), the plan showed a heavily wooded site served by a loop road with 178 housing units arranged in a dozen or so clusters of detached houses, townhouses, and apartments. Pedestrians had recreational facilities within a short walk. Open space linked the community to the planned large county park and school nearby.

Housing Systems

Alcoa Construction Systems, Inc. (ACSI), is a subsidiary of Alcoa, a major aluminum company. Alcoa has conducted research in the housing field for some years. Several test houses, built largely of aluminum, have been occupied by company executives near Pittsburgh. However, the Alcoa approach to volume production addressed more than just materials. ACSI analyzed the cost of housing and determined that costs are concentrated in high-value areas such as kitchens and bathrooms. The ACSI system, therefore, was conceived as factory-built "wet cores" about which the dwelling could be somewhat custom-designed and built. For Operation BREAKTHROUGH, local architects familiar with regional market preferences and native materials designed the housing units. The exterior appearance of the one- and two-story SFDs and townhouses at King County is compatible with quality suburban housing in the Pacific Northwest.

The Levitt house-building firm (now a part of ITT) established Levitt Technology Corporation to pursue industrialized housing business opportunities. A three-dimensional modular system was designed, one affording a distinctive appearance despite the use of "boxes." Clever features like hinged roofs, pull-out bay windows, and add-on porches overcame limitations imposed by shape and by shipping clearances. To build the wood-framed two-story townhouses and apartments, Levitt opened a new factory at Battle Creek, Michigan, in 1971. It employed a high degree of automation, with moving lines and similar volume production techniques.

Christiana Western Structures had previously built several hundred industrialized houses in California (home of the parent Christiana Oil Company), mostly for low income projects. The BREAKTHROUGH design was thoroughly engineered, employing standard material sizes and a minimum variety of hardware items to reduce inventory and improve interchangeability. Christiana developed a process for sprayed fiberglass wall surfaces, and established a pilot factory wherein wall panels were carried through a series of semi-automated work stations. This innovation was not proven in time to be used at the prototype sites, and the Christiana system had to be redesigned to emphasize conventional pre-cut, preassembled components. The King County units are SFDs, townhouses, and apartments with one or two floors.

Material Systems Corporation (MSC), a small, new independent company, was established for the express purpose of applying aerospace technology to the mass production of housing. The MSC concept involves the use of fiberglass-reinforced sheets, formed and joined into panels that are then assembled into volumetric modules. The modules are united on-site, making up two-story townhouses.

A fifth producer, Boise Cascade Housing Development, was assigned to King County until March 1971. Boise planned garden apartments, townhouses, and SFDs—all using steel-framed wooden box modules.

	ALCOA				CHRISTIANA			LEVITT				MATERIAL SYSTEMS			
	2 BR	3 BR	4 BR	5 BR	2 BR	3 BR	4 BR	1 BR	2 BR	3 BR	4 BR	2 BR	3 BR	4 BR
SFD (66)	1	26	29	6		4								
SFA (88)	4	15	5		4	16	14		2	12	6	2	4	4
MFLR (24)					16			4	4					
Total (178)	86 UNITS				54 UNITS			28 UNITS				10 UNITS		

Fig. 6—Housing unit mix

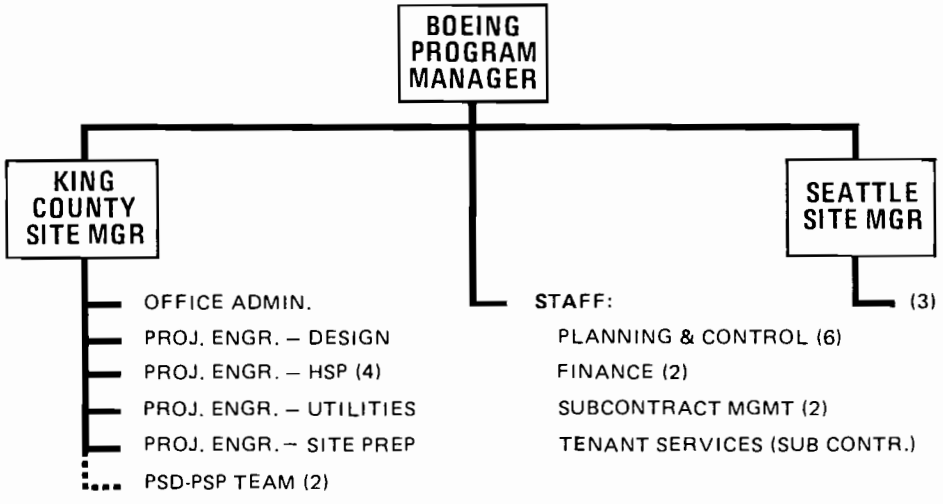


Fig. 7—Boeing BREAKTHROUGH organization

Prototype Site Developer

The Boeing Company is a large aerospace corporation, best known for commercial jet aircraft such as the 707 and 747. The company is also extensively involved in major space and defense programs. Interest in Operation BREAKTHROUGH resulted mainly from the company's capability in construction management developed during its major facilities expansion program of the 1950s and 1960s.

Boeing's emphasis on diversification into the civil sector coincided with HUD's announcement of Operation BREAKTHROUGH. A study team, investigating housing and related business fields, decided that BREAKTHROUGH was an excellent vehicle for demonstrating the company's skills.

A proposal was submitted May 3, 1970. In late June, HUD chose Boeing from a half dozen Northwestern firms to negotiate a contract as Prototype Site Developer (PSD) of the two Seattle area sites. Contract H-1380 was signed on June 30, 1970.

Boeing proceeded on the premise that aerospace management techniques were applicable to BREAKTHROUGH. It set up a project engineering type organization with a nucleus of key people from the proposal team. Responsibility for King County was assigned to a project manager, who was the focal point for all activities concerning the site directly. Project engineers were named for each of the housing systems, for the site planning, and for site preparation. These men had backgrounds in construction management and were sufficiently versatile to accommodate job shifts as site development progressed. The organizational approach, although unusual in the construction industry, was effective.

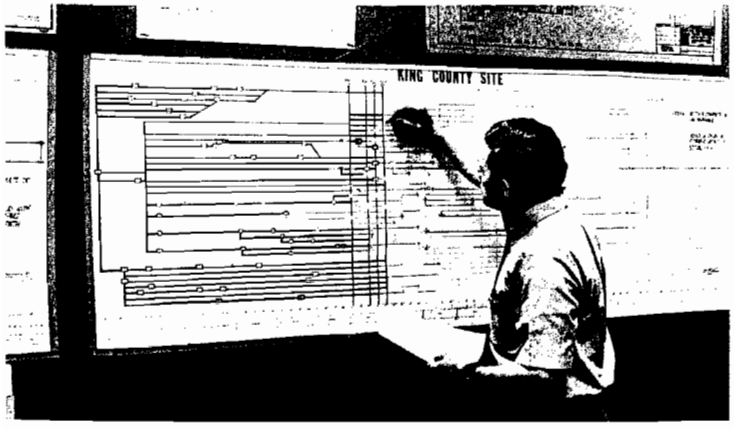


Fig. 8—CPM schedule posted in control room

The King County team also drew upon a staff that provided both sites with planning, finance, and subcontract support. Including a share of this staff, the county manpower peak shown in Figure 7 was about 16. Seattle Housing Development, the subcontractor for tenant services, was involved primarily at the city site but played a key role in implementing Equal Opportunities at both sites.

During the proposal period, a critical path method (CPM) schedule had been developed and was the main planning tool in early discussions. With the award of the PSD contract, planning was expanded to include a complete program plan, which became a baseline for site development. The program plan consisted of a summary document and detail plans for specific activities. Some of the early plans were quite sketchy but served to identify the scope of work and to channel management's attention toward needed decisions. Usually, the people responsible for implementation of the plans helped with their creation, which gave them a strong degree of reality and encouraged prompt preparation.

Planning, scheduling, control, coordination, and visibility were the essential elements of the "closed loop" management system. The CPM network was used for scheduling and displaying forecast flow times for the major activities, priorities, and milestones. Cost control involved assessment of financial feasibility, breakdown of the work by tasks and subtasks, preparation of a realistic budget plan, and assignment of accountability to key individuals. A small control room was available at the county site, but the actual data display and collection function was performed at Boeing's aerospace headquarters in the Kent Space Center near Seattle. This consolidated staff activities for both the King County and Seattle city sites where possible. The control room was a focus for schedule tracking and cost collection and was the source of essential facts needed to solve problems or make decisions. A "critical problem" procedure identified potential trouble and assured management attention.

Development of the county site required several million dollars of major construction. Obviously, subcontracts were important in size and number. Boeing negotiated, administered, and supervised them in accordance with established government procedures for the use of appropriated funds. These methods, already proven on many large construction jobs, worked well in their new application to residential housing.

Land Acquisition

After site selection, the State moved to sell the property to HUD. To expedite transfer of the land, the federal government processed a "friendly condemnation" so called because the owner did not dispute the action. The average of two independent appraisals made by local firms determined the value of the property. Meanwhile, Eckbo/Nolte negotiated some boundary changes with the neighboring boys home and the King County Park Department (Fig. 9). The State DNR offered 13 acres to the county as additions to the planned East Norway Hill community park and agreed to sell 35.962 acres to BREAKTHROUGH for $5,800 per acre plus $5,000 for lessee improvements.

HUD allocated money for the purchase from its

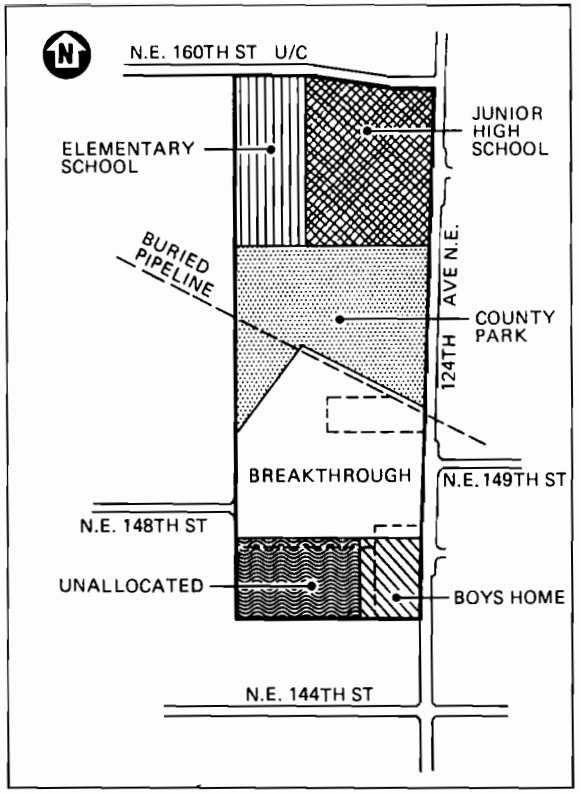


Fig. 9—Adjusted land use

Research and Technology (R&T)/BREAKTHROUGH funds. The developer, acting as HUD's agent for the site, formed a special purpose organization—the Boeing Housing Finance Corporation (BHFC)—to hold title during development. BHFC became the owner on December 15, 1970, when Boeing paid $207,767 to the State and $5,832 to the lessee. (The Operation BREAKTHROUGH regional office—OBR—later gave the lessee an additional $500 for relocation costs.)

In the fall of 1971, BHFC changed its name to Keenwood Corporation. This eliminated some confusion over the purpose of BHFC and gave a more appropriate image to the site development activities.

Financing

There are three main kinds of funds available to the prototype sites: (1) FHA-insured mortgage loans, (2) income from sales and rentals, and (3) HUD R&T funds. Generally speaking, the R&T funds are used for management and overcosts (including the PSD contract). The mortgage loans are used for site development and housing erection; the income will repay the loans.

While it was hoped that a single source could be used for mortgage funding of all nine sites, Boeing investigated local financing also. Tentative negotiations with several firms were discontinued when HUD arranged a national package with the Federal Home Loan Mortgage Bank. Pacific First Federal Savings & Loan was then designated "lead bank" for 20 local savings and loan associations for the Seattle and King County sites. Discussions continued between Pacific First, HUD, and Boeing throughout the first half of 1971. The U.S. economy was recovering from a decline, and interest rates were fluctuating. Final agreement on the interest rate was a significant point that delayed the closing of a King County mortgage. On August 3, the mortgage was signed at an appropriate ceremony in the HUD regional office.

BHFC, a limited dividend corporation, was indebted to Pacific First on a 40-year FHA-insured mortgage loan for $3,980,100, with interest of 7-7/8 percent until final FHA endorsement and 7 percent thereafter. Principal payments on this construction loan commenced June 1, 1973. As a convenience to the consumer and an aid to the marketing effort, BHFC also arranged "take out" financing with Seattle First National Bank for individual home buyers.

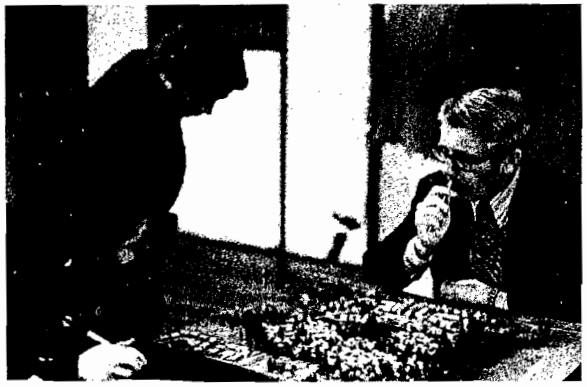


Fig. 10—Explaining BREAKTHROUGH to the public

Community Relations

HUD deferred community relations activities until a PSD could be named, so an information gap existed in the spring of 1970. The neighbors bombarded public officials with letters and inquiries, some in protest but many seeking only a clearer explanation of the program. The general belief was that BREAKTHROUGH would be another "low income housing project." Media coverage tended to emphasize the negative aspects because few facts were known about the plans for the site at that time. Certain vested interests openly opposed BREAKTHROUGH, and several members of the county council took a stand against it. Local events and national program uncertainties clouded the future of the county site on June 30, 1970, when HUD contracted with Boeing.

Boeing, as developer, moved quickly to ease the pressure on the county council. A plan was written, contacts with key people and groups were made, and information began to flow. Public participation was encouraged, especially in the Kingsgate area.

Throughout the late summer and fall, many meetings were held with community associations and service clubs. Because of its urgency, the effort continued despite a stop-work order placed July 30 on site development. (Deletion of several sites had to be weighed by HUD because of program funding cuts. Cancellation of the King County project actually was recommended within OBW but not carried out, and the moratorium was lifted after three weeks.)

It was apparent that elements of the home-building industry were fueling the controversy. Objective media coverage made their motives seem transparent and self-seeking, and hurt rather than helped their cause. Nevertheless, Boeing met often with individuals and groups representing builders, suppliers, real estate agents, and professionals in the building industry. During a series of briefings given by the developer, some attitudes changed from opposition to support, notably on the part of the real estate segment. Only the Seattle Master Builders, by a split vote, went on record as opposed to BREAKTHROUGH. Their opposition was primarily for appearance, and they did not withhold later cooperation.

The media covered the program fairly. Newspapers particularly maintained a high level of interest. Reporting was informed and competent, and the resulting articles helped spread the BREAKTHROUGH story. Boeing and the HUD regional public affairs officer worked closely together, making sure that the press had ready access to any possible story. Formal releases, although not used often, were routinely cleared, and Boeing essentially was authorized to speak for BREAKTHROUGH.

Good communication was established with the officials in the county government, including the executive branch, the council, and many of the administrative staff. After the early controversy, the council insisted upon specific approval of site plans and in November 1970 held a public hearing where Boeing and Eckbo/Nolte presented these plans. Citizen testimony was mixed, but it was clear that the opposition had host its broad base of support. The council voted 7-1 to approve the BREAKTHROUGH planned unit development. County Executive Spellman concurred with this decision.

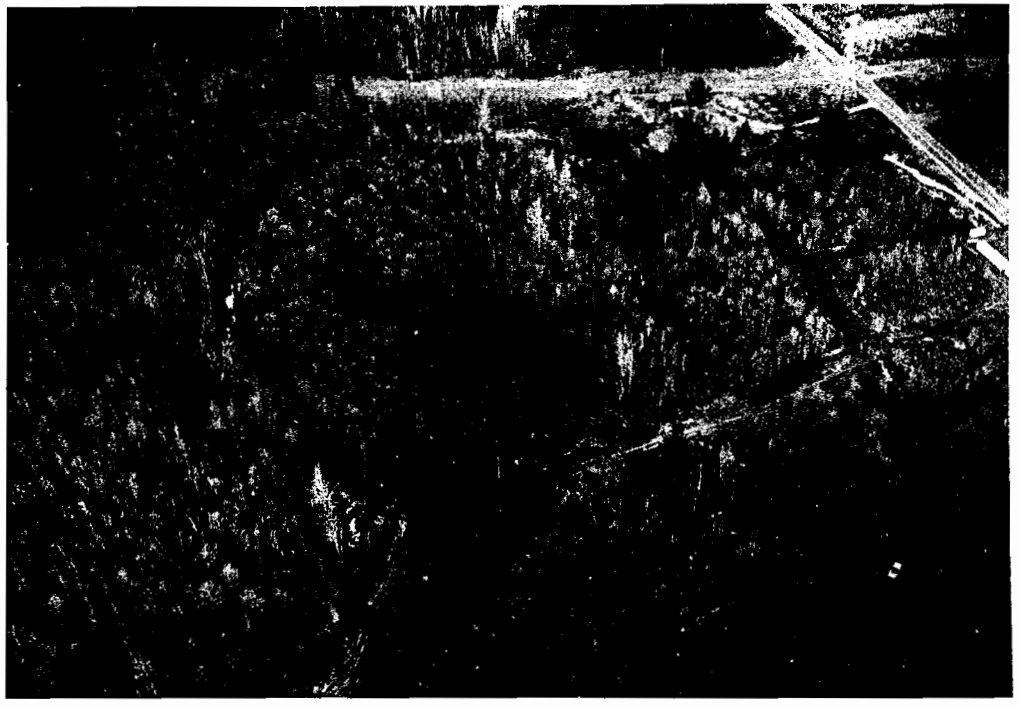


Fig. 11—Initial clearing for loop road, February 1971

Public concern over the proposed development had been allayed by full disclosure of program information and an honest attempt to respond to citizen input. The neighbors were assured that enjoyment of their property would not be threatened by the development. Elected officials were relieved of the pressure from the electorate and convinced by their technical advisers that the program was sound.

The hardcore opposition was reduced to a very small group of residents near the site. Attempts to settle the differences on an individual basis failed because of their conviction that BREAKTHROUGH was "government interference with free enterprise." Calling themselves Eastside Neighbors United Front (ENUF), this small group, numbering perhaps six people, hired a lawyer to challenge the council's decision, but their suit against the county was dismissed in Superior Court on December 7, 1970.

Groundbreaking ceremonies were held at both the King County and Seattle city sites on December 17, 1970. HUD Assistant Secretary Finger, Governor Evans, County Executive Spellman, and Seattle Mayor Uhlman spoke to several hundred people on

that occasion. Other significant events included the mortgage closing ceremony on August 3, 1971, a site tour by Assistant Secretary Finger late in 1971, and a visit via helicopter by Secretary Romney that same winter. Boeing presentations at several national conferences and conventions gave BREAKTHROUGH wide exposure. In May 1971, the developer presented a technical paper and a display about BREAKTHROUGH at the first Urban Technology Conference in New York City. A similar exhibit was shown in San Francisco the next year.

The visitors center was activated in a trailer on the county site in January 1971 and moved to the clubhouse upon completion of that facility in July 1972. A combined movie and slide show was installed there, together with appropriate displays. Visitors, especially foreign tour groups, were a constant concern because no adequate program for their accommodation had been funded. The Site Technical Representative and others of the OBR staff often aided Boeing with these guests.

Neighborhood growth reflected, to some degree, community acceptance of BREAKTHROUGH. The program contributed to a mood of optimism and action despite the severe local economic slump in 1970-71. The Kingsgate area developed rapidly. The county completed the NE 160th Street connection between the freeway and Powerline Road in time to serve site construction. A long-planned shopping plaza was built one block away, a bank opened nearby, and, within a mile or so, Evergreen Hospital and Totem Lake shopping center opened in 1972 and 1973, respectively.

Public relations were handled as an integral part of the development task, thereby avoiding a "press agent" image and ensuring good citizen participation. Many Boeing staff members were sensitive to community matters and often worked on presentations and special events along with their regular BREAKTHROUGH assignments.

Fig. 12—Creek drained under loop road near NE 148th St.

Fig. 13—Tree roots above grade on townhouse micro-site

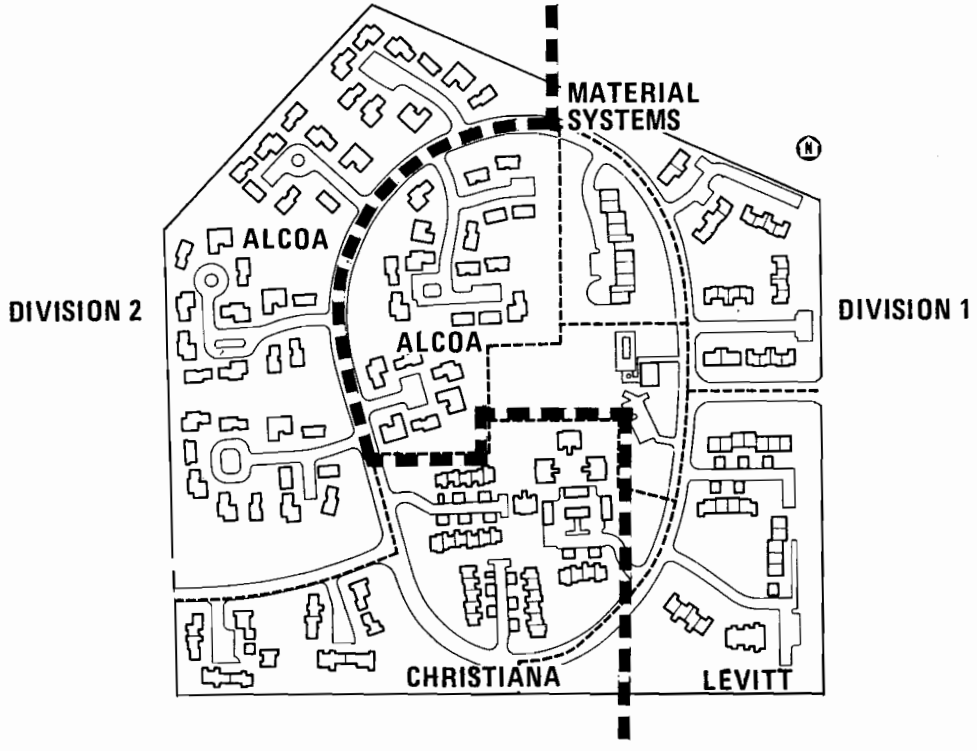


Fig. 14—HSP reassignments to two divisions

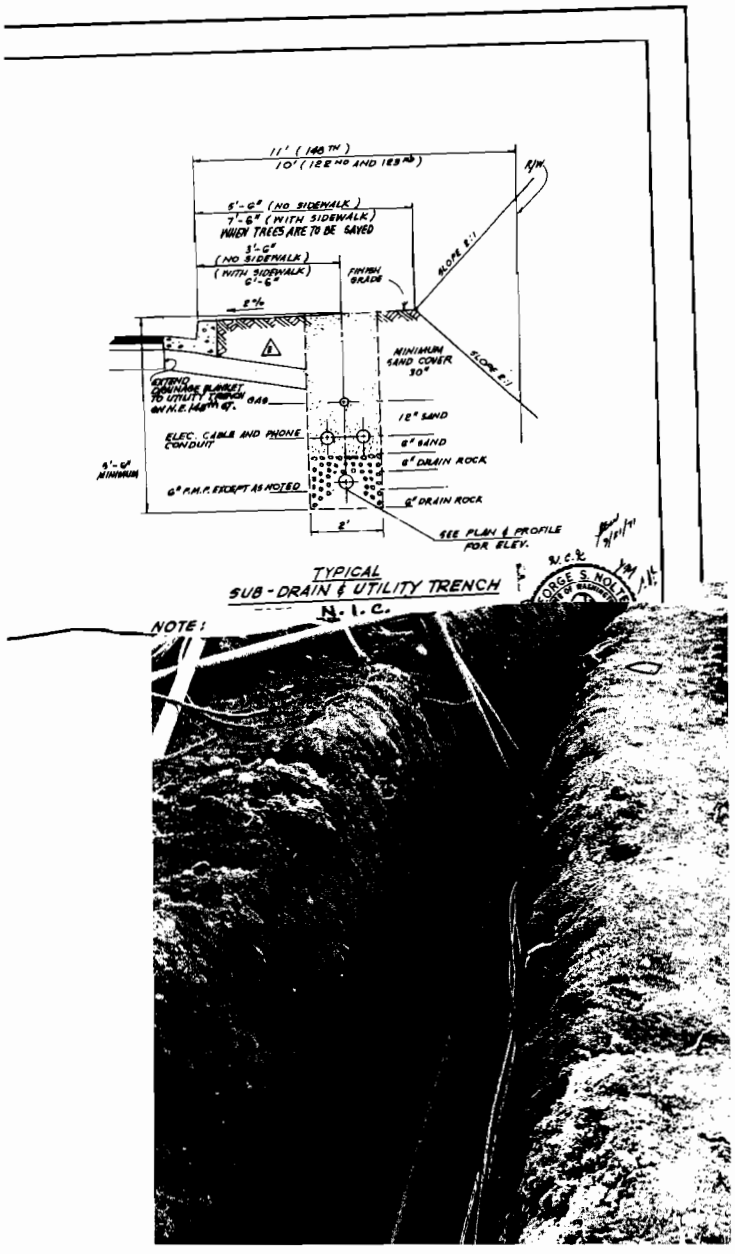


Fig. 15—Conduits in combined utility trench

Fig. 16—Clubhouse interior, upper floor

Site Preparation

Office trailers for use by the developer were set up alongside 124th Avenue NE early in December 1970. After groundbreaking ceremonies on December 17, clearing of the main entry and loop roads began.

Immediately, drainage problems in the form of ponds, deep mud, and heavy runoff from the adjacent area hampered the project. Surface water from over 200 acres flowed through the 36-acre site, causing King County to direct that HUD triple the carrying capacity of the downstream drainage structure.

Much work had to be done on the property as well. Generous use was made of select fill; the stream channel was defined and enlarged; and a short-cut diversion drain was built from 124th Avenue to approximately the center of the site. These actions imposed some delay on the overall site preparation schedule.

Surveyors also were busy early in 1971, adjusting micro-site boundaries in accordance with HSP comments on the Eckbo/Nolte plans and marking trees. By aerial survey, the planner had identified particular "specimen" trees to be preserved. Differences between existing ground levels and the planned grade complicated matters, and a design error caused the loss of good trees in the ACSI micro-site (Fig. 13).

In March 1971, Boise Cascade withdrew from BREAKTHROUGH King County, creating a serious development problem. Design, site preparation, and market planning, all well advanced, were affected. Boeing studied alternative means to replace the 60 units, including the assignment of new producers to

the site, and recommended realigning the four current HSPs. OBW agreed.

More time had been lost. There were now significant discrepancies between the schedules for individual micro-sites, so it was decided that the site would be split into two divisions. Division 1 included the micro-sites for which approved final designs were available (Levitt, Material Systems, Alcoa townhouses, and Alcoa SFDs within the loop road). Pending approval of a revised plat for Division 2 (Christiana and the balance of the Alcoa SFDs), work was suspended there.

Division 1 site preparation was accelerated to meet the schedules set by the HSPs. With the help of temporary utilities and access roads, enough work was done by July to allow the producers to start. Streets were not paved until after the units were erected, thereby eliminating damage to the pavement by heavy equipment.

By mid-1971, because production of working drawings had fallen well behind schedule, Boeing assigned some engineers to augment the Eckbo/Nolte effort. A joint design team was established on-site under Boeing direction and, over a period of several months, completed the needed detail designs.

Boeing devoted an important part of its effort at this time to coordination with local government agencies, especially the King County Building Department. Under the terms set by the county council, various departments reviewed design drawings for compliance with county standards. Some innovative features were sacrificed to retain others, one of the significant casualties being the narrow loop road. To allow parking on each side, the county asked for a 36-foot width, which seemed excessive in view of the site character. The added width later proved useful, but it was not an aesthetic triumph.

In the early planning stage, Eckbo/Nolte had encountered resistance to site innovations on the part of some county departments. This attitude prevailed during development despite the fact the the county's legal defense of the site reflected the official policy of cooperation.

Eckbo/Nolte planned a single utility trench that would combine, wherever possible, water, gas, electricity, and telephone service. Boeing carried out this scheme after extensive arrangements with Water District 104, Washington Natural Gas Company, Puget Power & Light Company, and Pacific Northwest Bell. Sanitary sewers were coordinated with the Northeast Lake Washington Sewer District.

Market research had confirmed that carports would be essential on single family units if adequate sales appeal was to be maintained. The site plan was sufficiently flexible to accommodate carports with slight crowding in the townhouse micro-sites. Boeing contracted for some of the carports and the HSPs for others.

Facilities provided for common use of the site residents included a community center, or clubhouse, and swimming pool. A plan to system-build the clubhouse proved impractical. The structure finally was designed locally and built by a Seattle craftsman under contract to the developer.

Throughout site preparation, Boeing and Seattle Housing Development continued to involve minority firms in the work, following an implementation procedure set forth in the Equal Opportunity plan. This practice, which went beyond the required affirmative action items, made good use of a working relationship with the Central Contractors Association in Seattle's black community. Other minority entrepreneurs were sought, and mixed joint ventures were promoted. Set-asides were not allowed, but minority participation in bidding was encouraged in other ways. The success of these efforts also helped in gaining acceptance of the Seattle site within the city's Central Area.

Construction Conditions

Second growth firs stand thick in well-drained soil on the south side; fir, cedar, and alder trees grow in the northwest and east. Most of the site is mantled with 2 to 4 feet of topsoil, under which there is dense sand. The ground slopes down from 320 feet to a southeast-trending seasonal creek at approximately 280-foot elevation. Swampy conditions prevail along the creek, with shallow deposits of soft organic sand and silt. This area is heavily overgrown with bushes and alders. The creek gradient becomes steeper and better defined below 280 feet. Several springs rise near the western course as well as in the bowl at the center of the site.

Housing Erection

Boeing (BHFC/Keenwood) subcontracted with the four HSPs to manufacture and erect the living units. HUD set the basic terms of these Phase II contracts, and conducted negotiations with the HSPs, supported by the PSD. Various PSDs were designated to negotiate with specific HSPs for all the sites on which those HSPs would work. Boeing led the negotiations with Christiana, Material Systems, Boise Cascade, and Alcoa. Bert L. Smokler & Company, the Kalamazoo developer, led the negotiations with Levitt.

In July 1970, when the developer's work began, the HSPs were scheduled to be on-site the following January and finish in June 1971. These schedules proved unrealistic, because optimum performance was assumed for factors that were not controllable. These included weather, individual housing procedures, and various financial and governmental agencies. More than a year passed before the first foundations were started, and the last house was not completed until May 1973.

Levitt, the first HSP to begin micro-site work, started on July 12, 1971. A subcontractor prepared the full-basement concrete foundations while the Levitt factory in Battle Creek was building the modules. The King County production run followed Levitt's BREAKTHROUGH activity in Kalamazoo, thereby profiting from experience gained with those 83 units; however, the variety of floor plans was substantially reduced.

In a carefully planned operation, Levitt shipped the modules to Seattle by rail. Design calculations had allowed for expected stresses, and the National Bureau of Standards (NBS) conducted structural tests to prove that the strength was adequate. Among the tests was a trial shipment of a module from Battle Creek via a roundabout route to NBS in Maryland. Originally, Levitt planned to ship by Burlington Northern to Woodinville and transfer the modules the remaining distance to the site by truck. However, the Burlington Northern route would have required raising the loads on the flatcars about 18 inches to clear some cut-banks; accordingly, Levitt chose another route via Union Pacific.

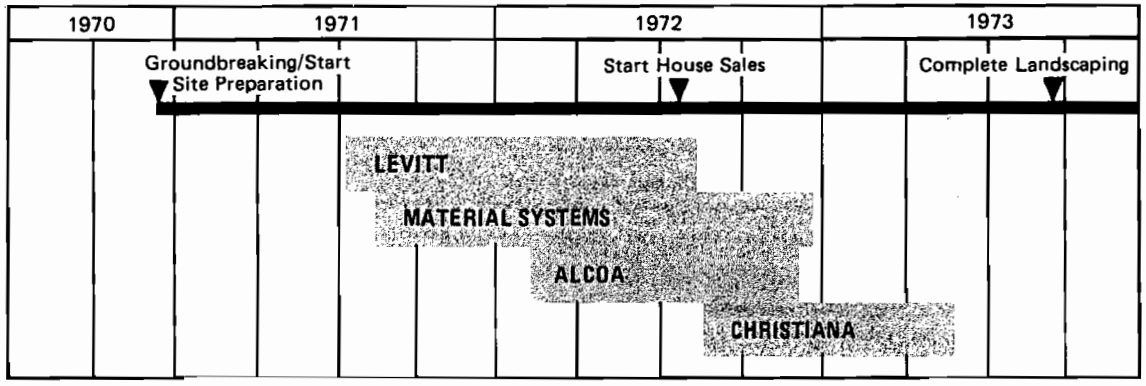


Fig. 17—Progress of housing construction

The first "unit train" (a train devoted to a single type of shipment and given a special shipping rate on that basis) was assembled at Battle Creek late in August. It was composed of 25 cars carrying 48 modules, which would make up 12 two-story townhouses classified as "Group II." Levitt temporarily modified the 85-foot-long flatcars, normally used for transporting "piggyback" highway trailers, to carry the modules. One car carried special hoisting frames for loading and unloading.

On August 26, the Penn Central Railroad moved the first train out of Battle Creek. It was interchanged with the Chicago & North Western near Chicago, and then with the Union Pacific at Omaha. After a fast trip, the train arrived in Seattle at 1:00 a.m. on September 2, 1971.

Some of the paperwork did not move as well, specifically that critical to State acceptance. Washington had been one of the first states to pass a factory-built housing law. The implementing State agency cooperated fully with BREAKTHROUGH, establishing inspection routines at the various HSP plants, usually through an approved third party firm, and reviewing design drawings. When discrepancies were identified, they were referred back to the HSP. In Levitt's case, the State asked that certain items be clarified, but no documentation had been provided by the time the first trainload was shipped. As matters stood, the State could not, under the law, certify the units for occupancy. Boeing and HUD had to intervene, promising the State that these questions would be resolved; accordingly, the State Factory Housing Board agreed to issue temporary certificates.

The train was stored at Union Station, and cars were switched as needed to Argo Yard in south Seattle. There, before unloading, Levitt, the railroad, and the State made inspections. They found no serious damage.

On Friday, September 10, the first foundations–for Group IIB, a townhouse structure of five units—were ready. A subcontractor's low-boy trailer moved the modules about 25 miles to the site. A 90-ton mobile crane was used to emplace them. The skilled nine-man Levitt crew, bolstered by the Kalamazoo experience, put up 10 or 12 boxes a day, roughly as fast as the three tractor-trailer rigs could bring them to the site. All 12 of the Group II units were emplaced by

September 14. The second unit train, consisting of eight townhouses (Group IV) and eight apartments (Group V), arrived late in October. All modules were in place by November 13.

Levitt did most of the finishing work in the factory. When shipped, units had all windows, doors, cabinets, and appliances—even chandeliers—in place. Floors were carpeted and interiors painted. Travel caused minimal damage, proving the practicality of the concept, if only from the transportation point of view. (Of course, the distance from factory to building site would have placed Levitt out of economic range in normal competition.) Some problems, partially corrected in the second shipment, resulted from water leaks and cracking of gypsum board interior panels. Later maintenance difficulties, particularly the leaking ducts in the ingenious Space-Pak heater systems, may also have been attributable to handling and shipping.

The on-site "zip-up" procedure was badly underestimated at 72 man-hours per living unit. Zip-up included connecting utilities, placing furring strips to cover the module joints, touching up items damaged in shipping, and correcting small discrepancies primarily affecting appearance. The scope of this work expanded until perhaps 400 man-hours were actually spent on each unit. The Levitt crew returned to Seattle, with high overtime charges, but did not complete all the units until August 1972.

Levitt satisfied most of the State's requirements, and agreement was reached on everything but single stack vents and plastic plumbing. NBS conducted instrumented tests for the State and King County, and permanent occupancy certificates were issued in late spring.

The Levitt design is superior for a modular system. Ingenious features such as the hinged roof facilitate shipping. Once erected, the structure reveals little of the "modular look," inside or out. Interiors are appealing, with such attractions as sunken rooms,

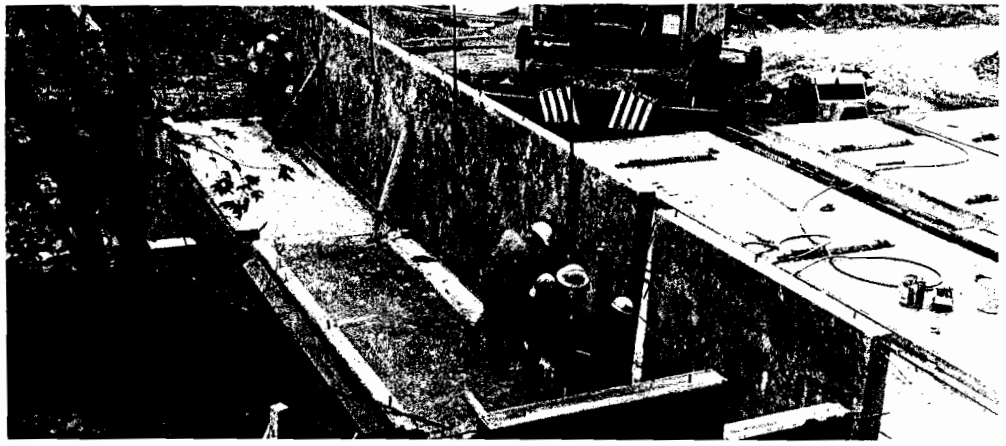


Fig. 18—Alcoa Alumiframe and wet core system

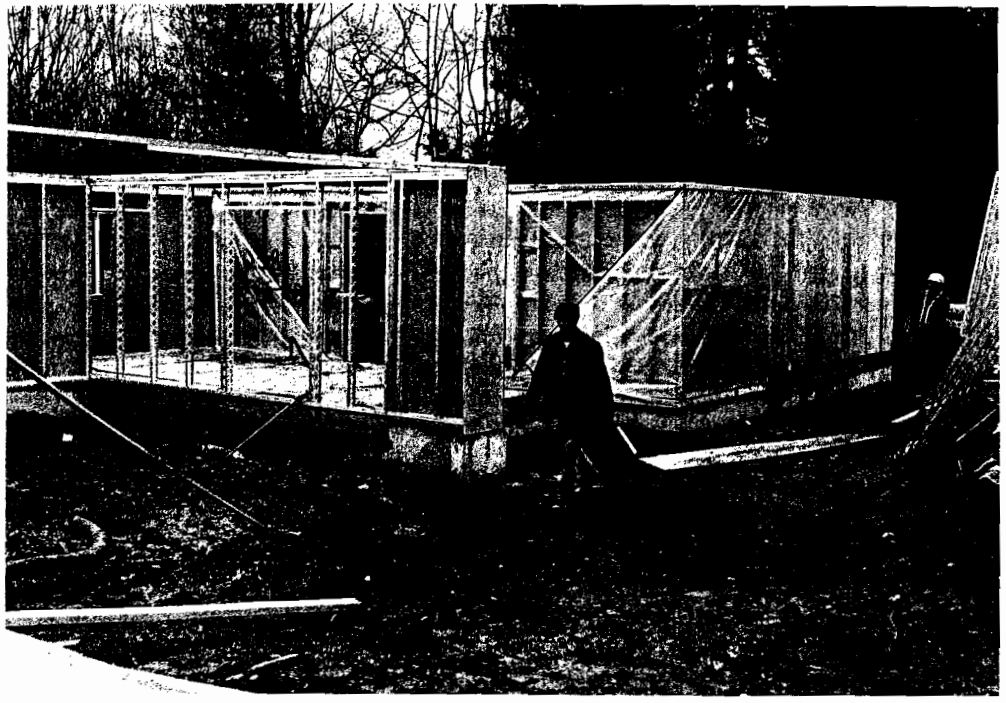


Fig. 19—Tilt-up concrete foundations for MSC

cathedral ceilings, open stairs, and pass-throughs. Layouts, except for basements, are intelligently conceived and meet functional needs. External architecture is well suited to the setting among the trees of the King County site.

Factory standards were marginal for the Pacific Northwest market, thus the basic idea of finishing units in the factory was not successfully demonstrated. Zip-up, with its attendant traffic, caused much wear and tear on the interiors. In retrospect, wall painting and carpeting operations could have been deleted at the factory, because they usually had to be repeated on-site. On the other hand, a shift to less factory finishing and more on-site labor would have tended to negate the advantages of the factory operation. As the on-site portion increases, the unit cost approaches that of stick-building. As the factory portion decreases, the need for the facility also lessens, and the plant investment becomes questionable. In fact, the Battle Creek plant, completed in 1971 at a cost to Levitt of $3 million, is now closed. As competition to conventionally built houses, the Levitt system holds promise but remains unproven.

Although ACSI was ready to start on-site work in July 1971, the intended general contractor withdrew, and the search for a replacement took many months. At year's end, S&S/Lotto became general contractor for the 24 townhouses and for 21 SFDs, and Model/Sato for 41 SFDs.

The cleared and graded ACSI micro-site went unused until February 1972, delaying by seven months the start of foundations. Subsequent construction was also handicapped by weather less favorable than anticipated for the season originally scheduled. The first core modules were placed on townhouse foundations March 14, and by mid-summer some SFDs were nearing completion, in early September, Boeing accepted the first unit, a townhouse. ACSI finished the last of its units late in November.

ACSI construction methods are not radically different from accepted industry practices; therefore, the erection process was straightforward and created no particular problems for labor or supervision. The new features—service cores and Alumiframe—were introduced as subassemblies or components. Although the larger parts required heavier handling equipment, there were fewer moves overall. Compared with stick-building, the ACSI system at this early stage showed no definite time or money advantages, primarily due to factory operating costs. This situation will improve as experience is gained.

Material System's assignment to King County was relatively late, but this did not affect its performance on the site. In January 1971, MSC planned to start erection in August, and this schedule was met. Other HSPs were unable to fulfill schedules projected more than a month or so in advance.

MSC's foundations were pre-cast, tilt-up concrete, a type of construction that has been widely applied to warehouses and other commercial structures but rarely in residences. An experienced subcontractor was found to build the foundations, and the results were good. A crew of about six men and a mobile crane were used. Basement wall panels, which are part of the foundation, were cast and cured on the floor slab, then tilted to the upright position. The foundations of all 10 units were completed, except for backfilling, in October.

Factory problems resulted in repeated delays in delivering the modules to the site. These difficulties involved production start-up and training a labor force at the Sacramento assembly plant. The first King County modules arrived by truck in June 1972, and a cluster of five units—18 modules—were emplaced in the week following June 29. After that came another delay, due to the assignment of higher factory priorities to production of modules for other BREAKTHROUGH sites.

Unlike Material Systems units at other BREAKTHROUGH locations (Indianapolis, Kalamazoo, Macon, and Sacramento), the King County townhouses were free of major defects. The long schedule delays reflected factory production problems, but the units delivered were acceptable without significant rework. During the extended development period, MSC decided that modules for King County would be shipped as unfinished shells. This would simplify correction of the problems being encountered at other sites and lessen the chance of damage in transit. In any event, the only deficiencies found in these units were aesthetic and, therefore, easily fixed. Further, the interior finishing—carpets, painting, etc.—had to be applied only once, avoiding the extra work encountered by Levitt on its factory-finished modules.

Christiana Western Structures, assigned to Sacramento and Macon as well as King County, made a series of design changes that delayed approval of its design almost a year. In the process, Christiana twice replaced its architect, and the innovative aspects of the system did not survive development from concept to working drawings, as production of fiberglass-coated panels proved unfeasible. There was a great deal of negotiating between HUD and Christiana, in which Boeing, as PSD, had no part. HUD encouraged Christiana to change from a panel to a module concept, but the parties could not agree on the cost of a new design. Ultimately, Christiana's approach remained a panel system, not innovative but representing a high development of conventional construction, or stick-building. The best stick-builders today use a number of industrialized techniques to support the on-site construction of houses; Christiana units featured panel framing, pre-cut assembled trusses, plumbing walls, and a high degree of standardization in doors, windows, and hardware.

When design delays stretched on into the summer of 1972, it became clear that Christiana would pace completion of the county site. Accordingly, Boeing

proposed to start development of the micro-site and proceeded to let a subcontract for building the carports in the townhouse area. Late in August, Christiana's general contractor joined the activities in that area. Some false starts ensued, but concrete for the first foundations was poured in September, and, as in conventional building, housing erection started almost concurrently. Houses began to rise rapidly throughout the fall of 1972. Christiana had all 54 units erected by March and completed in May 1973.

Operation and Maintenance

The property was posted against trespassing, but petty vandalism occurred increasingly after the leasehold in the northeast corner was abandoned. Boeing responded by assigning a regular patrol at hours when workers were not on the site. The other BREAKTHROUGH contractors also hired guards to protect the heavy equipment and construction materials. Although minor incidents continued, no large losses were suffered through vandalism.

A smaller subcontract provided for janitorial service in the office and control room trailers and, later, the community building. As the site developed, Boeing hired other subcontractors as required. After each HSP unit was accepted by the developer, it required maintenance—normally limited to regular cleaning—until sold. A more significant job was grounds maintenance, until the home owners association (HOA) assumed that responsibility. Common areas passed to the HOA in the summer of 1973, but Boeing (Keenwood) maintained landscaping around unsold units well into 1974.

HSPs warranted the housing units for one year after acceptance by Boeing. In practice, Keenwood identified defects by periodic surveys or complaints from residents, verified problems, and encouraged action by HSPs, who retained subcontractors to make corrections as needed.

After the HSP warranties expired, householders or new purchasers still were protected for up to a year by the developer. Service experience uncovered no significant problems with basic housing system designs. However, a fundamental, ever-present maintenance concern is the tendency of flat roofs, regardless of design or application, to leak. Imperfect construction and clogging of drains by pine needles cause ponding, which leads to leaks. Squeaking floors plagued most Alcoa townhouses and split-levels, but after much discussion with the producer, Boeing found an economical remedy for this annoyance. Another problem was that the wax seals in the Levitt toilet connections broke down after a month of use and would not function properly until close tolerances were achieved by realigning the fixtures on both sides of the plumbing stacks.

Marketing

Operation BREAKTHROUGH sites were never intended to become federal housing projects. The plan at King County was to sell both the single family houses and the apartments to private buyers, the houses as individual dwelling units and the apartments as "eight-plexes" and "four-plexes" for rental. This plan was followed, except that the apartments were sold as condominiums.

Success of the King County program depended on compatibility of housing at that site with the suburban environment. The peculiar role of the King County site among the nine varied national sites was to represent the suburban housing market, a very important market if industrialized housing is to become viable. At the same time, the interests of the local community had to be protected. Therefore, the site and the housing units had to meet several requirements that were not always harmonious. Early public objections made it necessary to earn a high reputation in the community, meaning good quality housing at a

Weather and Comfort

Lendemain is somewhat sheltered from occasional strong winds, and its residents enjoy the unpolluted air of its rural surroundings. In the mild Puget Sound climate, summer high temperatures average 75° and winter lows 33°. Overcast skies and rain showers are common from October to May, with about 40 inches of precipitation annually. Snow falls only a few times each year and seldom stays on the ground. Because of the moderate weather, BREAKTHROUGH houses at Lendemain do not need air conditioning, large heaters, or other unusual protective measures. The Levitt units, built to a common standard with Kalamazoo, have double pane glass.

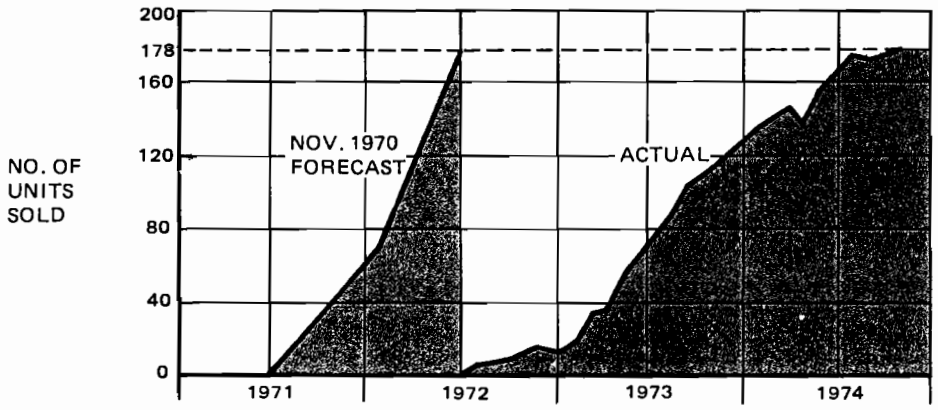


Fig. 20—Market plan compared with actual sales

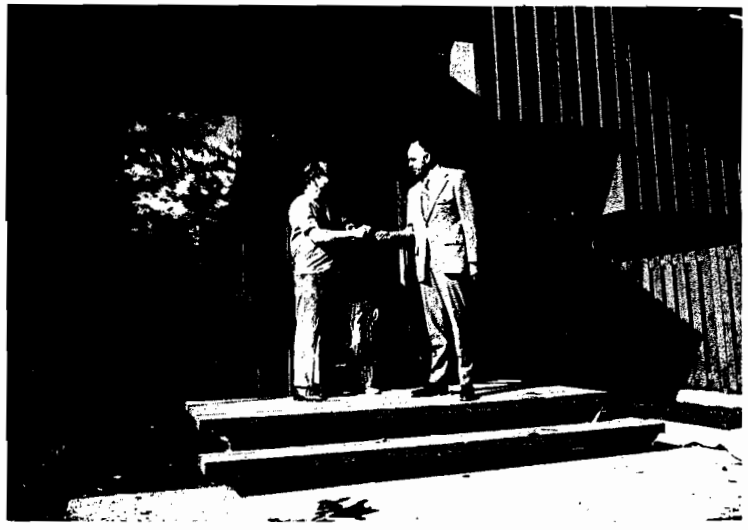


Fig. 21—First home owner receives keys

price that would not be inconsistent with neighborhood values. Since high-density, low income housing would not be appropriate to the site, its use was restrained.

Eckbo/Nolte made the original marketing assessment in the spring of 1970. Later in the year, the developer made a detailed study of bedroom mix and amenities (fireplaces, furnishings, appliances, etc.). The Seattle area economic picture at that time was clouded by severe layoffs at Boeing, the State's largest private employer. Naturally, there was concern that the BREAKTHROUGH houses not add to the abruptly depressed real estate market. Without a normal demand for houses, important aspects of the BREAKTHROUGH experiment would be unanswered.

A market survey was made under subcontract for the developer in October and November 1970. Included with preliminary findings was a projection of the Seattle and "Eastside" (i.e., east side of Lake Washington) housing demand for 1970-74. The Eastside share of the market was expected to improve, with a recovery rate only slightly less than the annual average growth during the previous 10 years. Sales of 70 homes per month were forecast through mid-1972, rising, to 150 per month in the next year. BREAKTHROUGH's 178 units were 17 percent of estimated Eastside sales during the intended market period.

These encouraging statistics were the base for the plan presented to the county council. A market absorption rate of 10 units per month was proposed for the first seven months of sales, July 1971 through January 1972. Because impact on the normal market was minimized, the council accepted the plan (Fig. 20). As events were to prove, the absorption rate was academic; program delays kept the first units from appearing on the market until July 1972, a full year after the agreed-upon date. Recovery of the Puget Sound area economy was well under way by that time, and, while the housing market was far from booming, its saturation was no longer a concern.

Recommendations from the market analysis included unit size, bedroom mix, cost ranges, methods of sale or occupancy, ancillary services, rate of sale, sales organization, and advertising. These recommendations influenced the actual marketing program, but not all were implemented as proposed.

Boeing, not wishing to compete with the real estate industry, intended to have sales handled by an established real estate firm in the site area. From the early community contacts, a good relationship grew between Boeing and the Eastside Brokers Association (EBA), the multiple listing agency for the district east of Lake Washington between the Snohomish County line and Renton, with about 60 member firms and several hundred sales associates. This relationship naturally suggested a solution to selling the county site. Although many individual EBA firms would be qualified to sell the BREAKTHROUGH units, Boeing sought a broader participation. The essential features of the marketing plan called for:

- Boeing to subcontract with EBA
- EBA to hire a project manager and pay salary and office costs

Fig. 22—Finished Levitt units and tot lot

Fig. 23—Alcoa SFDs on "show street"

- EBA to recruit and train salesmen
- All licensed and interested real estate firms, including minorities, outside the EBA area to participate
- EBA manager to establish an office on-site, in space provided by Boeing, and have full charge of sales program
- EBA to pay customary 6 percent commission on sales, including 4 percent for individual member firm making the sale, as in standard multiple-listing policy
- Sales program to be funded from 6 percent commission
- EBA not to act as agent for HSPs

This plan, after first publication, was further developed with refinements calling for:

- EBA to recruit and train salesmen from member firms and from minority real estate companies outside the EBA area
- Sales program to be monitored by a committee of EBA trustees
- EBA to be responsible for fair housing practices
- Boeing-EBA contract to be subject to cancellation for any cause by either party upon 60 days notice

While construction delays set back the marketing start more than a year, Boeing and EBA reached a firm agreement. EBA set up as the sales agency a special purpose organization called Woodland Properties, Inc. (WPI), composed of 50 real estate brokers, each paying $200 for membership. Difficulty was encountered in getting minority participation, although 9 of the 50 memberships were reserved for the Central Brokers Association (CBA), the Seattle Central Area minority agency. CBA wrote to Secretary Romney charging BREAKTHROUGH with discrimination and followed this by asking for 10 percent of the listing fees, and servicing on 10 percent of the mortgage. HUD assured CBA that the Boeing-EBA plan was fair. CBA's interest waned thereafter, and it told Boeing that the reserved WPI positions would not be used.

Firms with EBA and the North End Brokers Association filled the WPI memberships. WPI then assumed the EBA responsibilities outlined in the marketing plan. It was the WPI advertising agency that suggested "Lendemain" (French for "the next day") as the site name.

The units marketed at Lendemain are attractive and fairly priced. After the local economic slump passed, marketing conditions improved and have remained good. Inability to meet sales forecasts, however, has been a problem for a number of reasons. First, the industrialized systems are being demonstrated to determine their practicality and consumer acceptance, not simply as houses that are certain to sell. A variety of configurations is necessary to reach many segments of the market. Some of the units are clearly experimental, and their popularity with home buyers is, therefore, unpredictable. In this context, sales forecasts assume proper but not overwhelming importance. Second, the suburban character and relatively remote location of the site creates for it a particular clientele. Home buyers looking at properties as

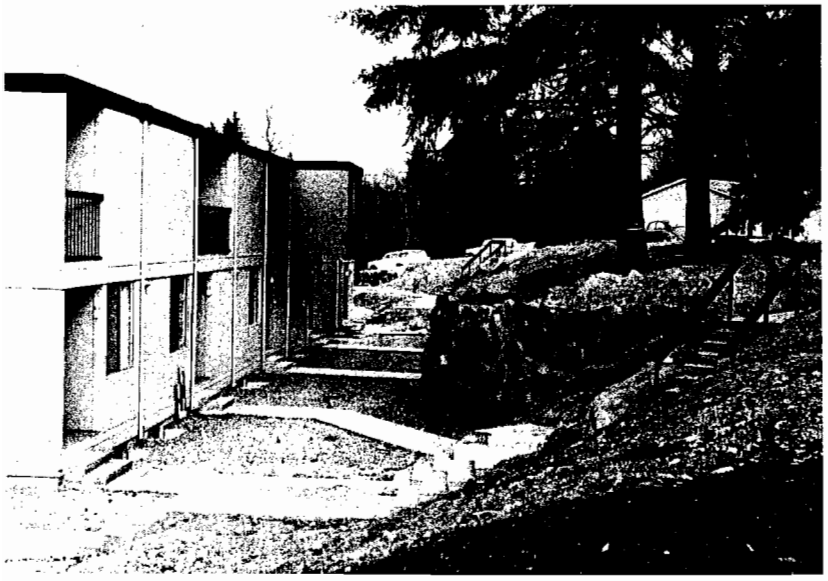


Fig. 24—Material Systems townhouses on side hill

Fig. 25—Christiana completed—spring, 1973

far as 22 miles from Seattle with no public transportation available require special attractions to offset these liabilities. Finally, the national housing shortage is not accurately reflected in Puget Sound area suburban buying habits. The local economic slump which depressed home sales in 1970-71 no longer has a noticeable effect in the Eastside area.

Twenty-eight Levitt units went on sale July 16, 1972. One townhouse was furnished as a model home and was the "Home of the Week" featured by the *Seattle Times* on July 23. About 1,000 people visited the site then, and four sales were made in the first two weeks. The first Levitt residents moved in on August 2 (Fig. 21).

Most of the Levitt units are well landscaped and attractively situated among the trees. A tot lot is located within the micro-site and can be reached from all units without crossing any streets. Exterior architecture fits well with the environment and reveals the box concept only along 124th Avenue, where there is little foliage. Interiors, thoughtfully designed with different levels and openings, belie the modular construction. One significant drawback is the cellar-style basement with no outside access. The small electric furnaces, however, are popular.

In late August, 24 Alcoa townhouses came on the market. A furnished model unit was used for a *Seattle Post-Intelligencer* open house. The units are well built and the interior layouts efficient, but long outside walls, where unrelieved by mature landscaping, suggested a barracks-like appearance to some observers. Plantings improved this aspect.

One of the drawbacks to early sales may have been the unfinished condition of the overall site. Certainly the construction clutter, heavy equipment still working in the Christiana area, and attendant noise, mud, and dust were annoyances.

Availability of the Alcoa SFDs was anticipated with optimism. When the first units appeared on the market in September, three SFDs were furnished for display as model homes. Two of these, facing on 122nd Place were soon phased out to permit establishing 122nd Court as a "show street" with all three model homes situated there (Fig. 23).

Sales in 1972, measured by earnest money agreements, were four in July, two in August, two in September, three in October, and one in November. Two cancellations in December reduced net sales to a total of 10 for the year. The total comprised six Levitt, two Alcoa, and two MSC units. While the hoped-for Alcoa SFD market appeal did not develop, Material Systems was a pleasant surprise. The first sale was made in November, before the units were completed. Plans for an MSC model home were cancelled, because the units sold well without benefit of model display.

Alcoa's SFDs had less market appeal than expected. Prospective buyers complained of the lack of a family room, and the kitchens were smaller and less well-lighted than those in conventional outer-wall locations. In contrast, other buyers readily accepted the compact townhouses, particularly MSC's. The key is in the price ranges. At $28,000 to $35,000, the

Alcoa SFDs are competing with many other attractive, well-built homes in pleasant suburban settings; the Material Systems townhouses at $15,000 to $20,000 are virtually without competition.

MSC units are functional and relatively spacious in comparison with other townhouses, but they are not handsome. The steep bank sloping up to the loop road and a magnificent group of five evergreens tend to mask and enhance these units from the front, making this the best elevation. Location is advantageous, as the Materiel Systems micro-site adjoins the community facilities.

Christiana Western units were the last ones on this site to reach the market. The townhouses and garden apartments became available early in April 1973 and the SFDs by May 1. These modest units were expected to have market appeal, and did. Here again, a lower price range, aimed at a less selective market, offered a sales advantage.

When sales fell behind forecasts, neither Boeing nor WPI was satisfied with the marketing program. HUD also wanted private owners to assume responsibility for all BREAKTHROUGH sites as soon as possible. Under these conditions, WPI first relinquished the responsibility for advertising and lowered the sales commission to 5 percent. Later in the year, it became clear to all parties that the WPI arrangement could not continue. A competition was held to find a suitable replacement; four proposals were received and, in a joint OBR-Boeing meeting, MacPherson's Realty was found to have the best capability for the job. MacPherson's role as developer of Kingsgate, Queensgate, and High Woodlands and as owner of most of the land surrounding Lendemain directly influenced its concern for BREAKTHROUGH's success. Its developments were linked to a healthy, growing neighborhood.

On January 1, 1973, the WPI contract was ended, and MacPherson's became the sales agency. Nine units were sold in January and 23 in February. All Alcoa units were completed by this time, which helped sales, but the new agency made the major difference. Ten units were sold in March, and sales continued at a brisk rate until interest rates became extremely high late in 1973.

Originally, the one Levitt and four Christiana structures were offered for sale to private entrepreneurs who would live in as managers of the 24 rental apartments. When no sales resulted from this approach, OBR, early in 1973, suggested changing to a condominium scheme. Boeing prepared a condominium marketing plan and secured approval from OBR to start sales in September. Consumer acceptance was good, and more than half of the units were sold within four months. When the association of apartment owners held its organization meeting early in 1974, the members expressed pleasure and pride in their property.

Residents of Lendemain are generally representative of a cross-section of suburbanites in the Puget Sound area. The median income is close to that of the broader suburban cross-section, but the range is somewhat wider. There are fewer people with high incomes, perhaps slightly more of modest means (because of the smaller townhouses). Minorities made up 3 percent of the first 400 people who moved in. Based on the early enthusiasm of the home owners association and the condominium owners, Lendemain will be an active community, avoiding the apathy that marks many subdivisions.

GTR for site development – F. Hansen
GTR for planner – C. Gueli
STR – G. Herrin
ACO – L. Chinn
Director of OBR – R. Brockway

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM July 1970:	Start site preparation	1-71
	Start housing construction	3-71
	Finish housing construction	6-71
	End demonstration/marketing	6-72
Interim CPM April 1971:	Start site preparation	12-70
	Start housing construction	6-71
	Finish housing construction	12-71
	End demonstration/marketing	6-72
Actual Performance:	Start site preparation	12-70
	Start housing construction	7-71
	Finish housing construction	5-73
	End demonstration/marketing	10-74

*Earnest money paid for all units

HSP COSTS
(dollars in thousands)

Producer	Cost
Alcoa	$2,105.7
Christiana	985.7
Levitt	968.1
Material Systems	258.6
Total	$4,318.1

HOUSING SYSTEM PRODUCER SCHEDULES

ALCOA CONSTRUCTION SYSTEMS, INC.
62 Single Family Detached
24 Single Family Attached

Phase II Contract:	Start foundations	6-71
	Start erection	7-71
	Complete erection	10-71
	Finish units	11-71
Actual Performance:	Start foundations	2-72
	Start erection	3-72
	Complete erection	9-72
	Finish units	11-72

LEVITT TECHNOLOGY CORPORATION
20 Single Family Attached
8 Multi-Family Low Rise

Phase II Contract:	Start foundations	6-71
	Start erection	9-71
	Complete erection	12-71
	Finish units	12-71
Actual Performance:	Start foundations	7-71
	Start erection	9-71
	Complete erection	11-71
	Finish units	8-72

CHRISTIANA WESTERN STRUCTURES
4 Single Family Detached
34 Single Family Attached
16 Multi-Family Low Rise

Phase II Contract:	Start foundations	7-71
	Start erection	8-71
	Complete erection	12-71
	Finish units	12-71
Actual Performance:	Start foundations	8-72
	Start erection	8-72
	Complete erection	4-73
	Finish units	5-73

MATERIAL SYSTEMS CORPORATION
10 Single Family Attached

Phase II Contract:	Start foundations	8-71
	Start erection	11-71
	Complete erection	12-71
	Finish units	12-71
Actual Performance:	Start foundations	8-71
	Start erection	6-72
	Complete erection	10-72
	Finish units	12-72

SITE IMPROVEMENT COSTS
(dollars in thousands)

Item	Cost
Site clearing	$120.2
Sanitary sewers, grading, and drainage	717.3
Utilities and hook-ups	198.1
Patios, fences, and carports	143.6
Roads, sidewalks, and lighting	241.6
Community center and misc.	125.0
Landscaping	96.6
Total	$1,642.4

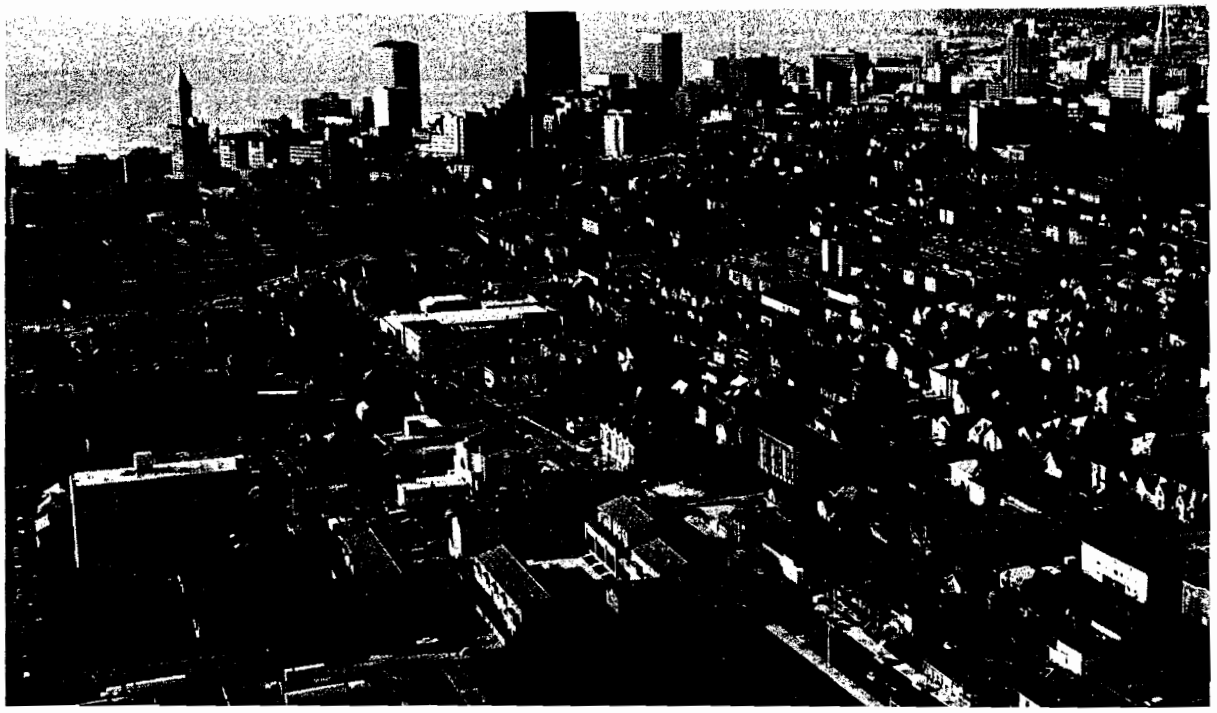
Fig. 26—King County site costs and schedules

3-31-75

Seattle, Wash

Seattle

Site Location: 18th Ave. S. & E. Yesler Way
Prototype Site Developer: The Boeing Company
Prototype Site Planner: Building Systems Development
Housing System Producer: Townland
Total Housing Units: 58



Seattle's Operation BREAKTHROUGH site (lower center) is 1.5 miles east of downtown within the Yesler-Atlantic Neighborhood Improvement Project (YANIP). According to citizen-formulated urban renewal plans for YANIP, the site and three adjoining blocks will become a superblock, the bulk of which is to be developed by the city as a community park.

Introduction

Located on 1.8 acres in the Central Area, the Seattle Operation BREAKTHROUGH site is a block-square development containing 28 garden apartments and 30 townhouses. It is the only demonstration of the Townland housing system, which is well suited to the site's high density of 33 units per acre.

Initially, 80 units were planned, but cost estimates forced reductions, first to 72 units, then to 58. Townland then withdrew from BREAKTHROUGH, and Boeing assumed the role of housing producer. Construction, to Townland's design, began in December 1971 and ended a year later.

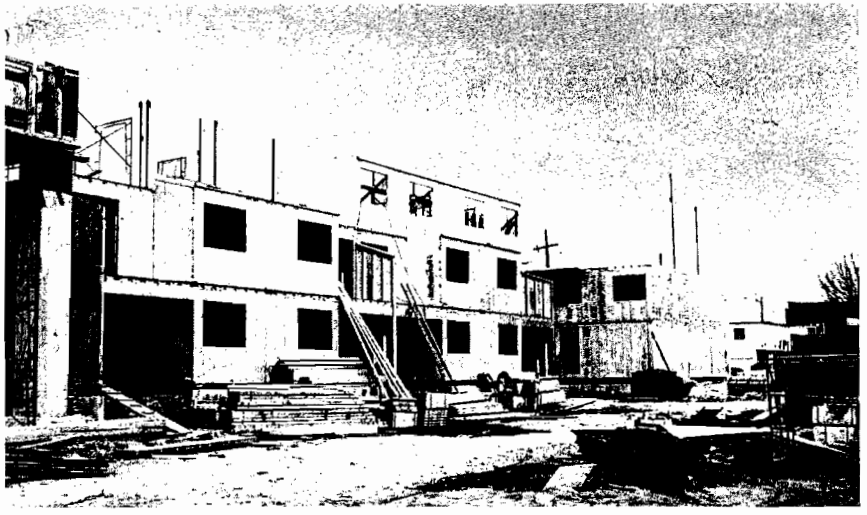
Seattle Housing Development (SHD) proved an effective subcontractor for public relations and marketing. SHD and Boeing chose, by competition, the First African Methodist Episcopal Church as sponsor/owner of the finished project now called Bryant Manor.

Cover:

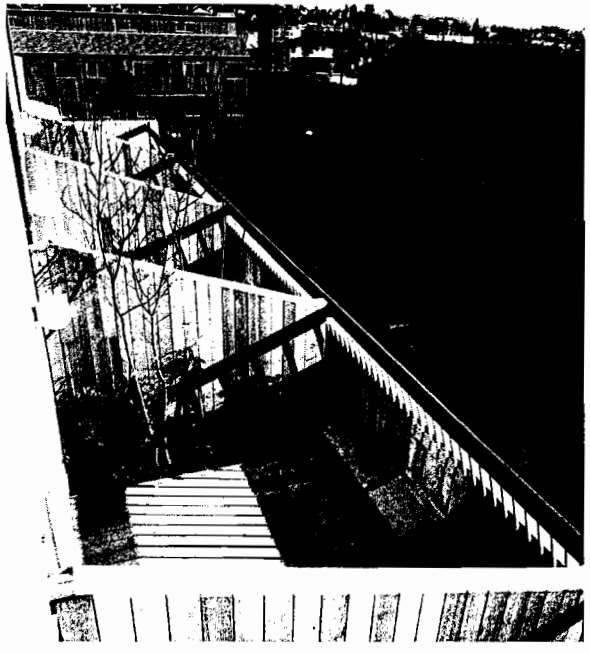
The Seattle prototype site attempts to combine the land economy of attached and medium-rise structures with the amenities and architectural variety of private dwellings.

Community relations and minority employment programs countered potential local resistance and helped gain general acceptance of the BREAKTHROUGH project. A "paint-in" on the site's construction fence involved several hundred Central Area school children.

The Townland system is composed of two parts: (1) a platform on columns known as the supported land system (SLS), and (2) residential units or "infill" that can be located on the SLS or on grade.

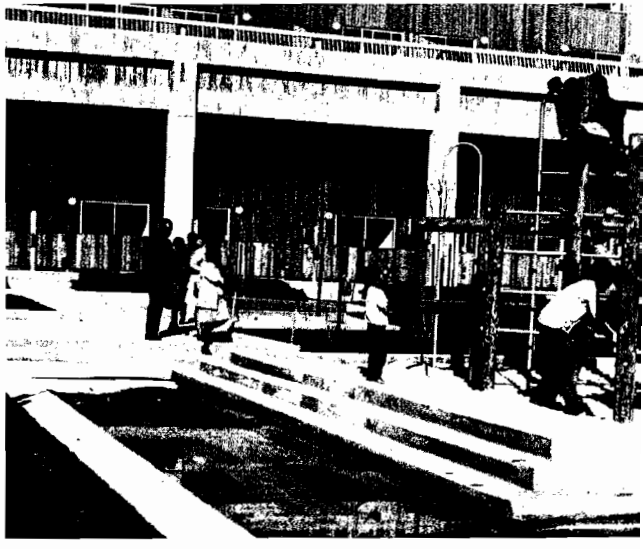


Framing for the housing units is an adaptation of the Rusco system. Factory-cut to size and identified as to final location, the steel channels were assembled using sheet-metal screws and a limited amount of welding. Wall surfaces are conventional, with gypsum board inside and cedar siding over plywood outside.



"Created land" on the SLS can be used for many purposes. At Seattle, the dwellings are flanked by elevated pedestrian streets and backyards.

A secured underground garage provides parking for residents. The site also includes an interior court with a tot lot and a community center, which serve as hubs for social activity.



Bryant Manor, open to all income ranges, achieved full occupancy in January 1973—only three months after the first apartments became available. Most of the 200 residents live in units rented through HUD's FHA Section 236 and rent supplement programs.

Background

On September 8, 1969, Washington Governor Daniel J. Evans presented to HUD a proposal requesting that the central Puget Sound region be considered as a location for Operation BREAKTHROUGH sites and an "aggregated housing market area." The proposal reviewed the housing market and activities in the Puget Sound area and documented support for BREAKTHROUGH. The State of Washington, Puget Sound Governmental Conference, Operation Equality of the Seattle Urban League, and many public and private groups pledged support to provide a basis for success of Operation BREAKTHROUGH.

Three potential prototype sites were specified—two in suburban areas, and one in the Central Area of Seattle. Unlike the suburban sites, the in-city Yesler-Atlantic site was well suited to high-density development.

Survey teams of HUD/FHA engineers and appraisers inspected each of the proposed sites. The teams confirmed the qualities of the in-city location and its high potential as a successful BREAKTHROUGH prototype site, but the two suburban candidates were replaced by a site near Woodinville in an unincorporated area of King County.

HUD ultimately selected both the King County and Seattle city sites to provide a direct comparison of BREAKTHROUGH in urban and suburban conditions within the same metropolitan area (Fig. 1). When these selections were announced on January 9, 1970, Seattle was initially designated as a subsite of King County, although it subsequently was developed independently.

Full cooperation from the City of Seattle was ensured when the city council enacted Ordinance No. 98718 on March 19, 1970. By this ordinance, the city agreed to grant variances from the building, housing, and other codes and regulations and to make the changes in zoning of the site and surrounding area necessary to permit a BREAKTHROUGH development and demonstration.

The one-block site (Fig. 2) is within the Yesler-Atlantic Neighborhood Improvement Project (YANIP), an urban renewal area established in 1960 and included within the boundaries of the Seattle Model Cities in 1967. BREAKTHROUGH was expected to be the first major construction under the citizen-approved YANIP plan. The location had been designated for multi-family housing with an adjoining three-block public park. These developments were to be built on a "superblock" created by closing through

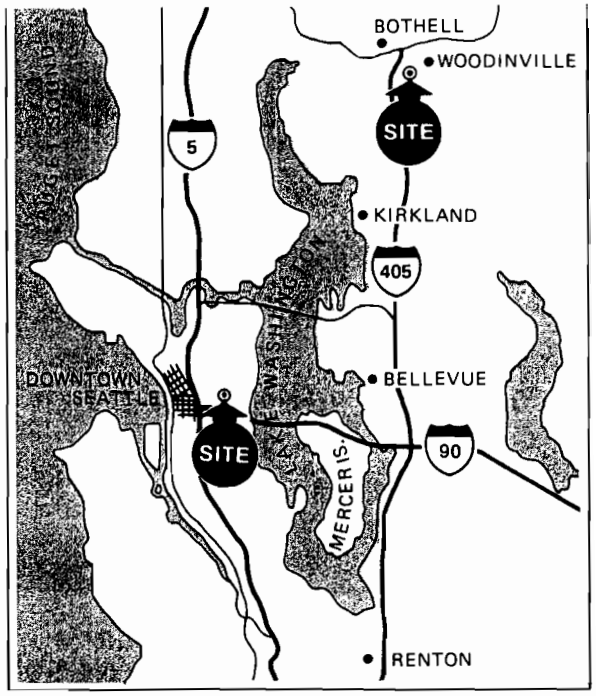


Fig. 1—BREAKTHROUGH sites in Greater Seattle area

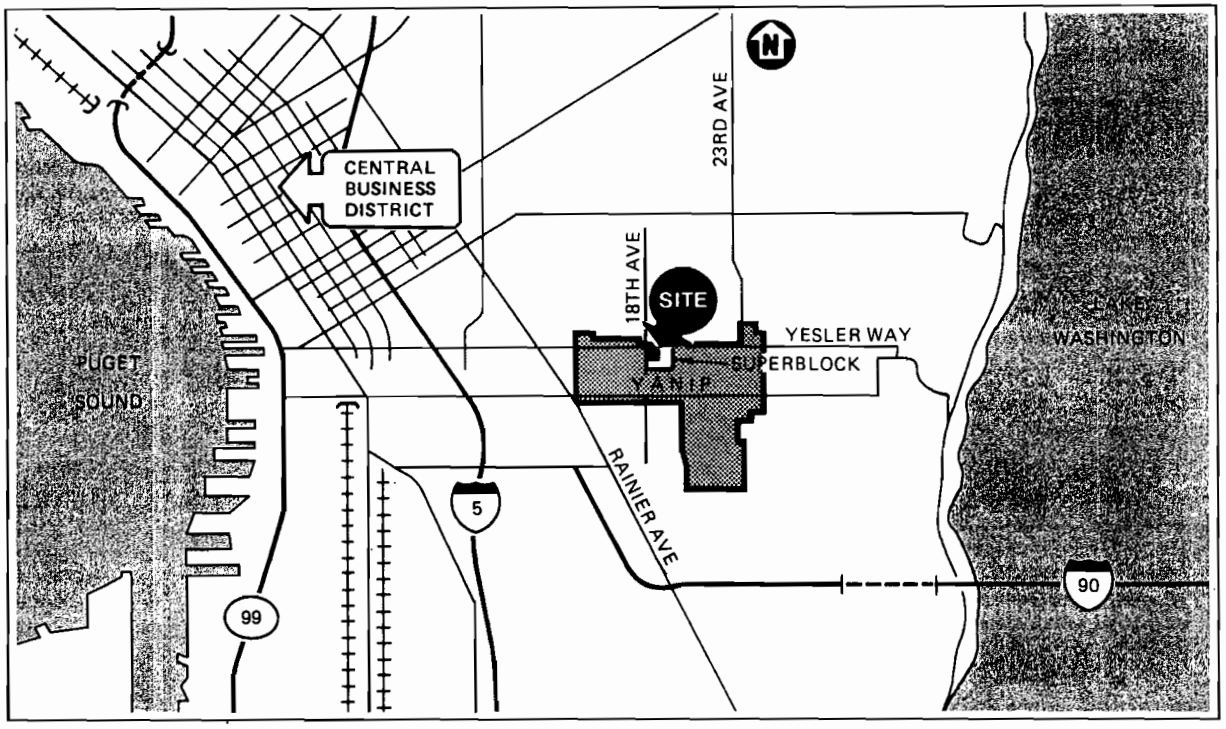


Fig. 2—Site location in Central Area of Seattle

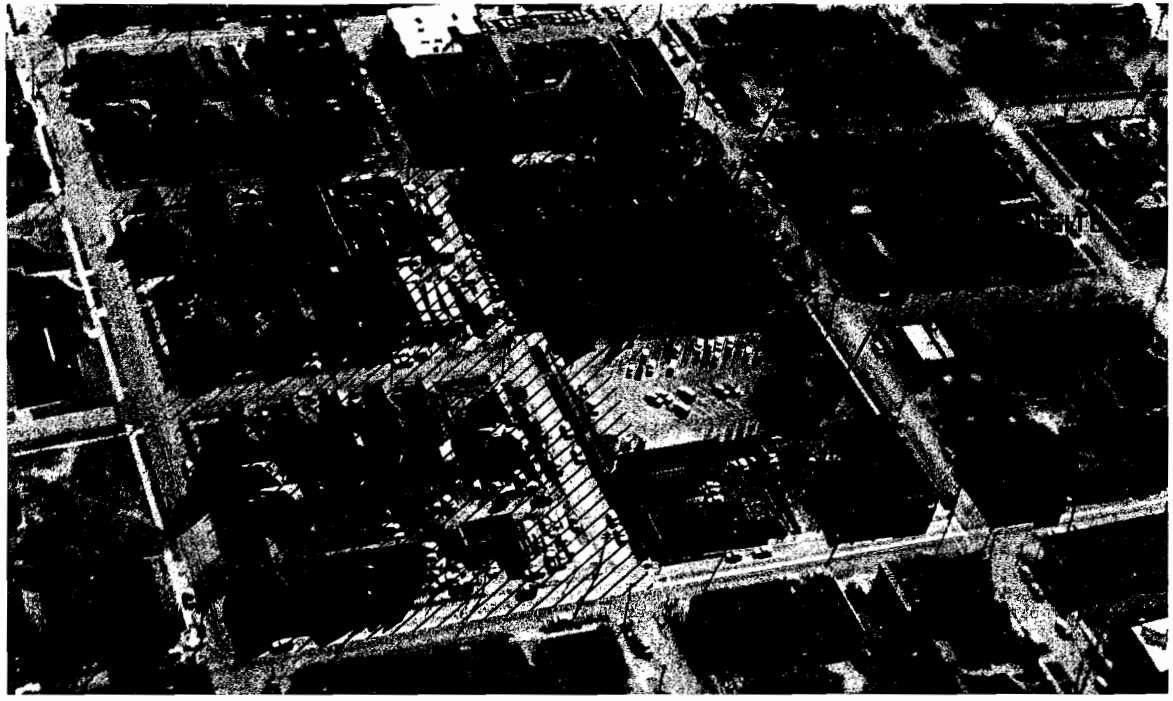


Fig. 3—Site and superblock before development

streets (Fig. 3).

South of BREAKTHROUGH on the proposed superblock, the plan marked for removal a 70-year-old school, lately used as a community college annex. The school gymnasium would become part of the park. East of the school, a large truck garage would be converted to provide additional covered play space.

Across 18th Avenue South from the superblock, two other YANIP-approved developments were planned: the remodeling of a former synagogue into a community cultural center, and the building by the Kawabe Senior Citizens Fund of a high-rise retirement home.

The site lies in a transitional neighborhood between the central business district and residential areas. Commercial and industrial properties intrude on residences, and large areas are in decline. Most of the housing is changing from single family to higher densities: apartments are replacing single family units, and older buildings are being converted to apartments. Of all the residences, 93.9 percent were built before 1939. Residents own 27.5 percent of the houses in the area, as compared with 53.3 percent for Seattle as a whole. The median value of area dwellings is $9,000.

The census tract in which the site is located has 80.5 percent minority residents—42 percent blacks and 39 percent Orientals and other non-whites. Historically, the percentage of minority residents in the area has been increasing. Incomes in the neighborhood are low to moderate (50 percent of the households have annual incomes below $4,000).

Pre-Development Activity

Late in 1969 HUD held a competition for Prototype Site Planner (PSP). Immediately following announcement of the Seattle site selection, Building Systems Development, Inc. (BSD) of San Francisco was named as the planner, with support from Sasaki, Walker and Associates, Inc., of San Francisco, and Murray and McCormick, Inc., of Seattle. After signing HUD Contract H-1210, BSD initiated conceptual planning and preliminary site zoning and code investigations.

The results of these initial investigations were compiled along with land use and conceptual site plans in the BSD report issued March 19, 1970. The report, recognizing the high-density, limited land area constraints imposed on the project, recommended that the entire block be used for BREAKTHROUGH housing and related facilities. Although no Housing System Producers (HSPs) had been assigned to Seattle, four basic site plan concepts for BREAKTHROUGH housing were evaluated: (1) high rise, (2) medium rise, (3) low rise, and (4) combined low and medium rise. The combined low-medium rise concept was recommended because it most closely satisfied density and open space criteria of the YANIP plan.

On June 10, 1970, HUD announced the award of a BREAKTHROUGH Phase I contract to the Keene Corporation of New York. The contract covered design and development of low- and medium-rise housing for the Seattle site using the "Townland" concept—primarily single family attached units erected on a unique "supported land system" (SLS) of elevated platforms. To produce the housing system, Keene formed a consortium, the Townland Marketing and Development Corporation, made up of 12 contributors representing several disciplines.

On the same date, BSD submitted a supplemental report to the Operation BREAKTHROUGH—Washington, D.C., office (OBW) recommending 80 units, including a mix of one- to five-bedroom units. The report also specified land use and design objectives and proposed several residential and related facilities, including 100 on-site parking spaces.

Site Plan

The site plan described in the BSD report and its supplement was modified during development. The number of units planned for the site was reduced from 80 to 72 and finally to 58, with an accompanying reduction in facilities and parking. The number of units to be included in Townland's SLS was reduced to 12, the minimum for SLS demonstration. These actions were taken to ensure that site development would be financially feasible, given a specified amount of HUD funding for the research and development aspects of the prototype site. The bedroom mix was fixed at two-, three-, and four-bedroom units, omitting the one- and five-bedroom units previously planned.

Late in 1971, BSD formulated the final site plan containing 58 units. Featured in the plan are six structures designated building A through F (Fig. 4). One of these, building B, demonstrates the Townland SLS while the other units are on grade. All the structures are arranged to take full advantage of the view of Puget Sound, the Olympic Mountains, and open space adjacent to the site. Each unit has a private backyard or balcony as well as attached storage space.

The units are clustered around an interior court, not visible from surrounding roadways, which includes a tot lot, paved walkways, and lawn. A community center, part of building A, has a large meeting area, kitchen, and offices; downstairs are smaller meeting rooms and service areas. An elevator connects the SLS level to both floors of the community center. Parking for 67 cars is provided in two underground garages. All site utilities are underground.

Housing System

The Townland concept combines the amenities and architectural variety of private dwellings with the land economy of medium- and high-rise structures.

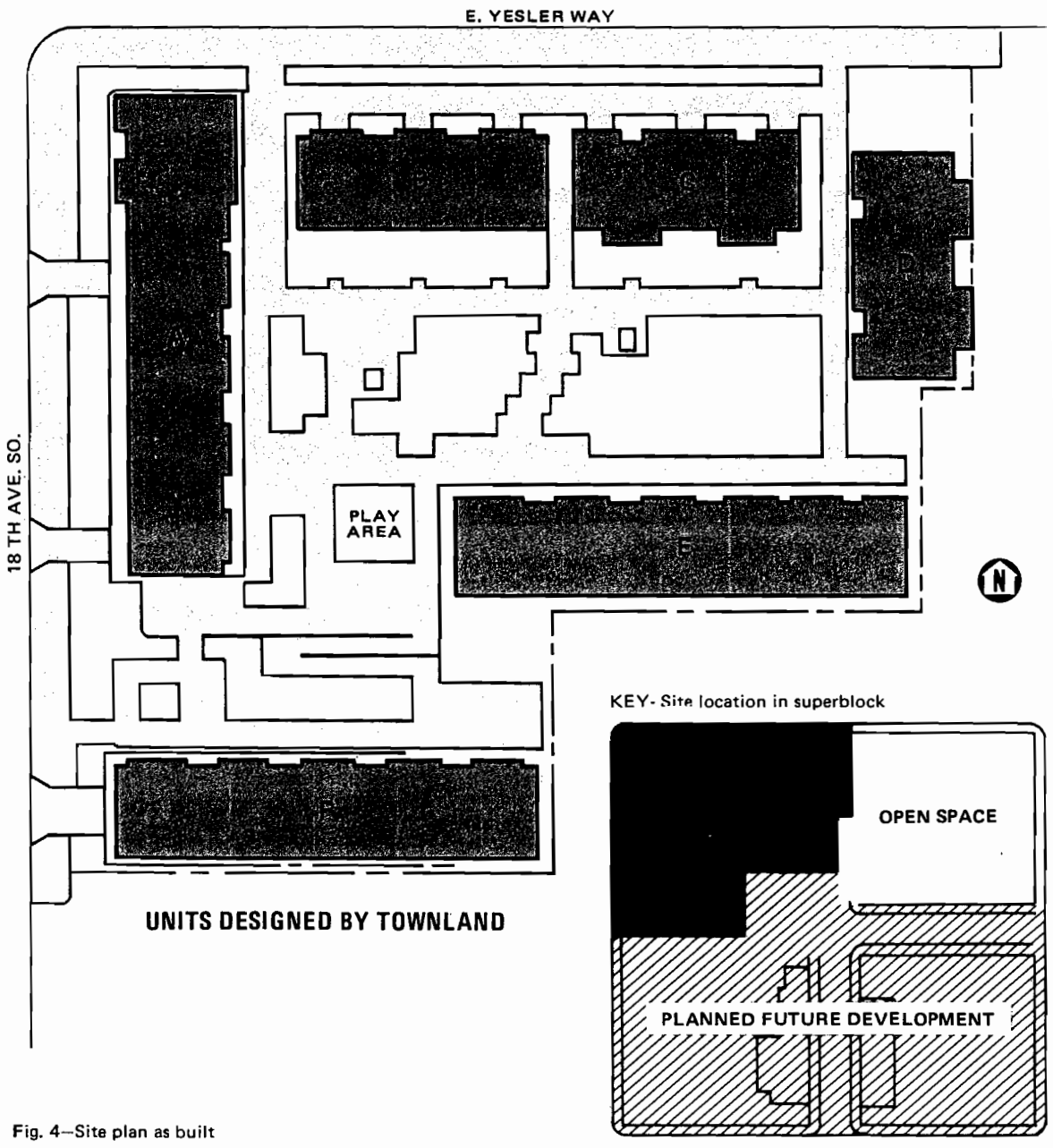


Fig. 4—Site plan as built

	TOWNLAND		
	2 BR	3 BR	4 BR
*SFA (38)	12	12	14
MFLR (20)	10	10	—
Total (58)	58 UNITS		
* SLS units are considered SFA			

Fig. 5—Housing unit mix

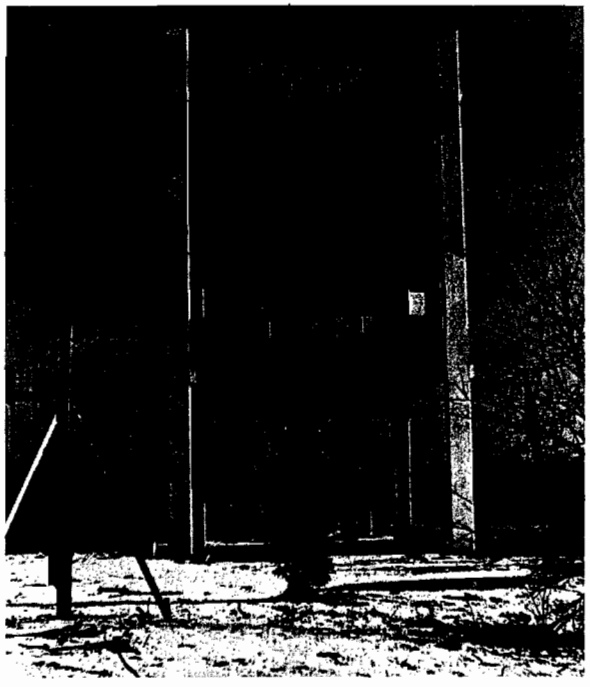


Fig. 6—Townland's development mock-up

This is possible by the creation of "new land," or platforms above ground level, which are complete with pedestrian streets, backyards, utilities, and space for other uses.

Two basic subsystems, the "superframe" and the "infill," make up the Townland system. The superframe is a patented concrete structure which has been given several names, including "megastructure," "high-rise grid," "synthetic land structure," and "supported land system." Essentially, the concrete frame is similar to that of a parking garage, except that the SLS has long spans in both horizontal and vertical directions. Bay spacing in the SLS is 30 feet by 60 feet; separation of the levels is normally two or three stories with "infill" (in this case, dwelling units) designed to fit between each level.

Plans for the SLS called for three basic pre-cast concrete elements:

- Columns—two- or three-story, constant cross-section, main vertical members
- Spandrels—horizontal beams between columns
- Channels—U-shaped horizontal deck members supported by the spandrels

To meet HUD and National Bureau of Standards structural criteria, Townland replaced the pre-cast joint design with a site-cast, reinforced column-to-spandrel connection and added lateral bracing. This forms a post-and-beam frame before placement of the channels. The frame can be either pre-cast (except for the connections) or cast in place. At Seattle, it was cast in place because of considerations of cost, logistics, and development timing. The channels, 3 feet deep and designed to carry utilities as well as support the infill, are pre-stressed members.

For the purpose of the BREAKTHROUGH demonstration, "infill" refers to two- and three-story dwelling units that are independent of the SLS frame. Originally Townland designed volumetric modules of steel or wood for infill. A planned Jersey City BREAKTHROUGH demonstration of this concept did not occur, and a different Townland design was followed for Seattle. There are five different dwelling unit floor plans, some measuring 15 feet by 36 feet and others 20 feet by 36 feet, each two or three stories high. All 58 units were framed with steel channels, an adaptation of the Rusco building system made by Bucoa, Inc. The components are standard items made in Bucoa's factory in Fullerton, California. A 16-inch-wide channel, 3 or 4 inches deep, cold-rolled of 18-gage galvanized steel, is the basic element of floors, walls, and ceilings. Gypsum board covers the interior walls; the outside finish is vertical tongue-and-groove cedar siding over plywood. Lightweight concrete, 1-5/8 inches thick, placed over the floor panelling adds stiffness and sound absorbing qualities to the system. Carpet or vinyl covers the floors.

Pedestrian streets and backyards complete the Townland system. The streets, built on pre-cast concrete planks spanning the channels, have a cast concrete wearing surface. The backyard design allows for earth fill, wood deck, or pavement; at Seattle both wood decks and earth are used.

Prototype Site Developer

The Boeing Company, known primarily for its aircraft and aerospace products, submitted a proposal to be a Prototype Site Developer (PSD) for the two BREAKTHROUGH sites chosen in HUD Region X. It and other finalists participated in an oral interview before HUD's source selection board on June 3, 1970, in Washington, D.C.

Boeing was selected as the PSD for Seattle and King County and signed contract H-1380 with HUD on June 30. Boeing immediately awarded a subcontract to Operation Equality of the Seattle Urban

League, later known as Seattle Housing Development (SHD), for five specific supporting tasks: community relations, affirmative action and Equal Opportunity, marketing, tenant selection, and operational management.

The in-house construction management personnel who prepared Boeing's proposal to HUD were assigned responsibility for developing the site (Fig. 7). Existing Boeing management techniques were used, including program planning, scheduling by means of a critical path method logic network, and a control room system. The control rooms were managerial focal points where information about costs, schedules, configurations, and activities critical to completion of the project could be displayed and problems readily identified. The developer used two of these rooms during development: a small, on-site room operated chiefly as a coordination and information center, and a main control room at Boeing's Space Center, at Kent, Washington, serving as the primary data collection and display center for both the Seattle and King County sites.

Land Acquisition

The City of Seattle owned most of the BREAKTHROUGH site, which it cleared as part of its urban renewal program. On December 16, 1970, by an advance of Research and Technology funds, HUD purchased this property for $36,000 and subsequently deeded it to the Boeing Housing Finance Corporation (BHFC), a special purpose organization.

Concurrent with the urban renewal sale, the city made a formal offer to buy the adjoining property owned by the State Board of Community College Education. This land was to be used for the superblock park, except for a 23-foot strip needed to complete the BREAKTHROUGH site.

The State Attorney General's office advised the city that the State's method of evaluation took into account demolition and replacement costs for the school; therefore, it was worth considerably more than the city offered. During negotiations, the city urged the immediate transfer of the 23-foot strip without regard to the amount of the final settlement for the larger parcel. The State was unwilling to separate the transactions, so to avoid construction delays, federal authorities condemned the 23-foot strip, which HUD acquired in August 1971 and transferred to BHFC in October that same year.

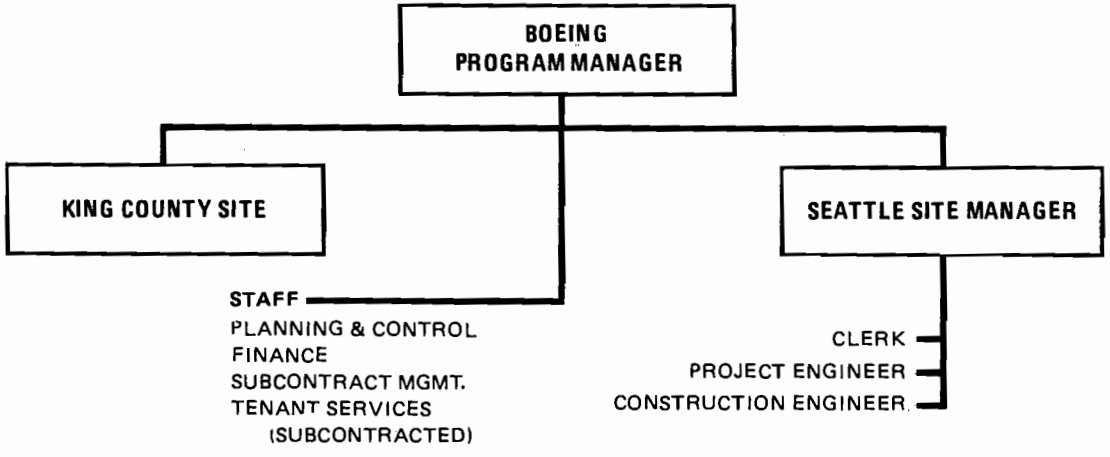


Fig. 7—Boeing Operation BREAKTHROUGH organization

Financing

Boeing initially investigated local lending institutions as possible sources for mortgage financing. In September 1970, however, OBW directed discontinuance of these activities, as it was investigating total program coverage through the Federal Home Loan Bank (FHLB). The FHLB then agreed to provide construction financing for designated portions of the site's development. Pacific First Federal Savings and Loan Association (a member of FHLB) was to be the lead bank.

On December 2, 1970, BHFC applied for project mortgage insurance under provisions of FHA Section 233, pursuant to Section 236. FHA issued a commitment for insurance on December 15, 1970.

In early 1972 the Government National Mortgage Association (GNMA) agreed to purchase the mortgage following construction. This sale was completed in April of 1973.

Site Preparation

A Boeing estimate made in August 1970 showed that the 80-unit complex recommended by BSD in its supplemental report to HUD could not be constructed within target construction costs. Townland's subsequent estimate confirmed this finding.

On September 14, OBW conducted a Boeing-

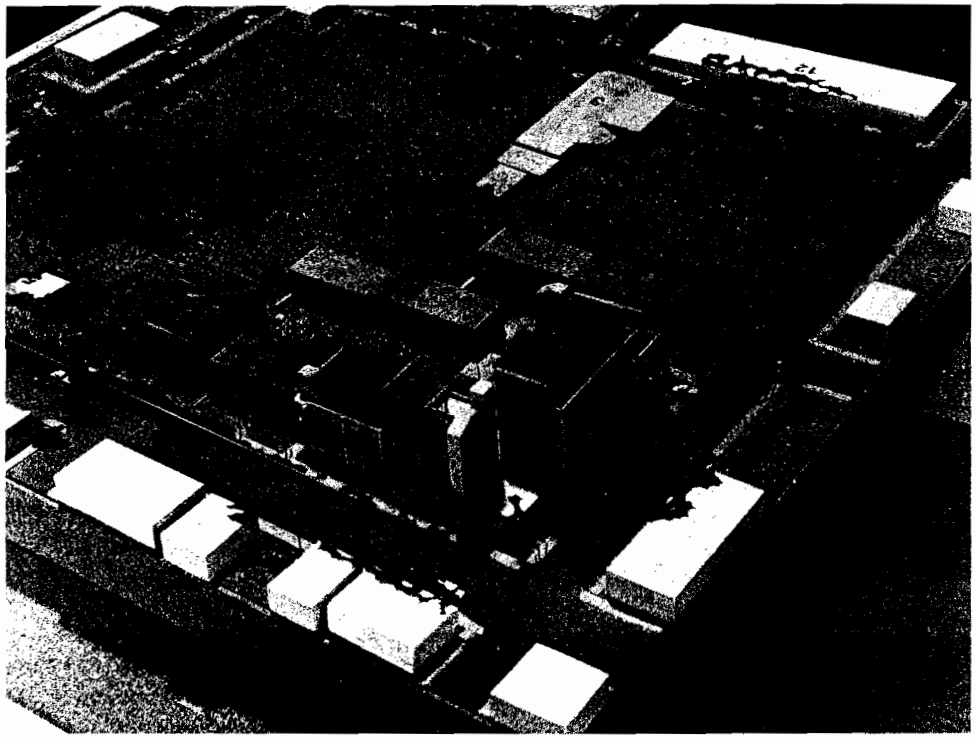


Fig. 8—Model of proposed Townland 72-unit configuration

Fig. 9—Finger and Evans break ground at Seattle

Townland-BSD review of design alternatives in an effort to reduce the estimated construction cost. Study indicated that the project could be developed within acceptable overcost limits by eliminating the SLS. However, that feature was essential to the demonstration of the Townland concept. On October 29, OBW approved a compromise housing configuration that reduced the number of dwelling units from 80 with 27 bays of SLS to 72 units with 9 bays, contingent upon: (1) Townland's ability to obtain bonding, (2) demonstrated financial feasibility of the Townland plan for the BREAKTHROUGH Jersey City site, and (3) negotiation of a fixed price contract with Townland for Phase II construction.

In November the Operation BREAKTHROUGH regional office (OBR), BSD, Townland, and Boeing informed OBW that the compromise housing configuration would not adequately meet planning and design objectives contained in the PSP supplemental report. OBW decided that preliminary planning and design using a revised 72-unit Townland scheme should continue.

Groundbreaking ceremonies, with HUD Assistant Secretary for Research and Technology Harold B. Finger, Governor Evans, and other dignitaries as featured speakers, were held December 17, 1970 (Fig. 9).

Following groundbreaking, the city council enacted a site zoning change from commercial to high-density variable.

Construction Conditions

Through its urban renewal program, the City of Seattle removed existing school and commercial building foundations and an asphalt parking area, leaving only minor ground cover. These operations exposed dense glacial till underlying the property from 1 to 6 feet below the surface. Except for topsoil, debris, and some fill covering the glacial till, foundation conditions were good. The site sloped from the northeast corner (elevation 285 feet) to the southwest corner (elevation 265 feet).

Late in January 1971, Townland submitted to OBW the preliminary 25 percent design for 72 units as required by the Phase I contract. OBW and Townland then used these 25 percent drawings for cost estimating in Phase II contract negotiations, which proved lengthy and were not concluded until March 29, 1971.

These negotiations, directed toward making the Seattle BREAKTHROUGH development financially feasible, resulted in fewer housing units and a new configuration. The contract, which was signed on April 8, and approved by OBW, called for construction of 58 units of housing with the SLS limited to three bays and a single level. It also specified that the infill be framed with steel channels, and listed several items to be completed before OBW would issue a notice to proceed. The four most significant were: (1) HUD receipt and approval of Townland's 95 percent drawings, (2) identification by Townland of its subcontractors, (3) subcontractors' commitment to obtain bonding, and (4) bonding of Townland for its portion of the work. Townland estimated that the changes would result in savings that would make the Seattle development financially feasible.

On June 9, 1971, in accordance with the contract schedule, Townland submitted its 95 percent design to HUD and Boeing for review. A month later, on July 7, HUD advised Townland that the 95 percent design could not be approved without additional corrections, which HUD identified and Townland subsequently made. Final review of the Townland 95 percent design was held during a conference on August 9-12 between HUD, BSD, Boeing, and Townland. HUD approved the 95 percent design and directed Townland to initiate 100 percent design, incorporating several comments. OBW withheld the notice to proceed, which had been scheduled for August 20, pending fulfillment of Townland's bonding obligations.

By the late summer of 1971, the Townland consortium notified OBW that it could not continue on the BREAKTHROUGH program. OBW promptly directed Boeing to terminate the Townland contract and accomplish the construction of the housing units on the site using Townland's design. Boeing representatives met with Townland principals in the latter's New Jersey offices and obtained the documents necessary for work to proceed. The departure of Townland and the subsequent preparations of the PSD to take over these additional tasks caused the scheduled construction to be delayed at least three months.

Meanwhile, the Seattle Engineering Department designed street, sidewalk, utility, and landscaping improvements around the site; these designs were completed in accordance with YANIP plans during the fall.

By October Boeing had formulated three site work contract packages covering (1) site improvements and utilities, (2) yard equipment and (3) landscaping. This work, most of which was done by the general contractor, was accomplished concurrent with housing erection and completed by October 1972.

The Seattle Engineering Department awarded a contract for the improvement of streets, sidewalks, and utilities in the neighborhood, and work started on November 8, 1971. However, the city could not demolish the old school and develop the superblock as intended, which affected BREAKTHROUGH construction. Because of an abrupt drop in elevation at the southern boundary of the BREAKTHROUGH property, Boeing had to build a retaining wall immediately to the south of building F. (Under the original plan, the city would have filled the area, establishing a gradual slope through the new park.) This permitted construction of building F (Fig. 4) while the school kept operating.

Although OBR pressed for a settlement of the park acquisition problem, the city and the State could not reach agreement. Later in 1972, the city did improve that part of the park east of the site, but the overall superblock development remained unfinished. The city implemented its previous urban renewal plans by separating sanitary and storm sewers, widening streets, and planting trees. Aerial utility lines along Yesler Way were removed and placed underground. Existing lines and poles on 18th Avenue South continued to serve the school.

Housing Erection

At the time Townland announced it would not continue in the BREAKTHROUGH program, it had negotiated and awarded contracts to Rusco Building Systems (later Bucoa, Inc.) and Olympian Stone Company. Townland had also solicited bids—but had not awarded a contract—for general construction. Boeing renegotiated with Rusco and Olympian and concluded negotiations for the general construction contract, which was awarded to the low bidder, a joint venture of Howard S. Wright Construction Co. and Model Contractors, Inc. Boeing also negotiated a contract with Warner, Burns, Toan and Lunde (WBTL), the owners of the Townland concept, for design support during construction.

On December 7, 1971, Boeing issued Wright/Model a partial notice to proceed based on Townland's 95 percent drawings and specifications and limited to excavation and construction of foundations, garage and community building structures, and underground utilities. Site work began the following day with the excavation of debris. By the start of 1972, on-site excavation was completed and construction of foundation footings and form work was well underway.

WBTL issued the 100 percent design drawings on January 7, which were forwarded as official contract drawings to Wright/Model. OBW reviewed these drawings and requested changes. Foundation construction was continuing however, and by February concrete work was well underway (Fig. 10). The revised 100

percent drawings were issued in mid-February 1972 as a modification to the general construction contract. On March 15, Boeing issued a complete notice to proceed to Wright/Model for the remainder of the general construction.

Bucoa had started, in January 1972, fabricating the Rusco metal framing components for the housing structures. All parts were cut to length at the factory and tagged and coded for erection. Deliveries to the general construction contractor commenced in the latter part of January and were completed in March. A Rusco technical representative arrived to assist journeyman workers with the erection tasks. The Rusco system was designed for assembly by carpenters, but the union agreement stipulated that ironworkers and carpenters were to share the Seattle work equally.

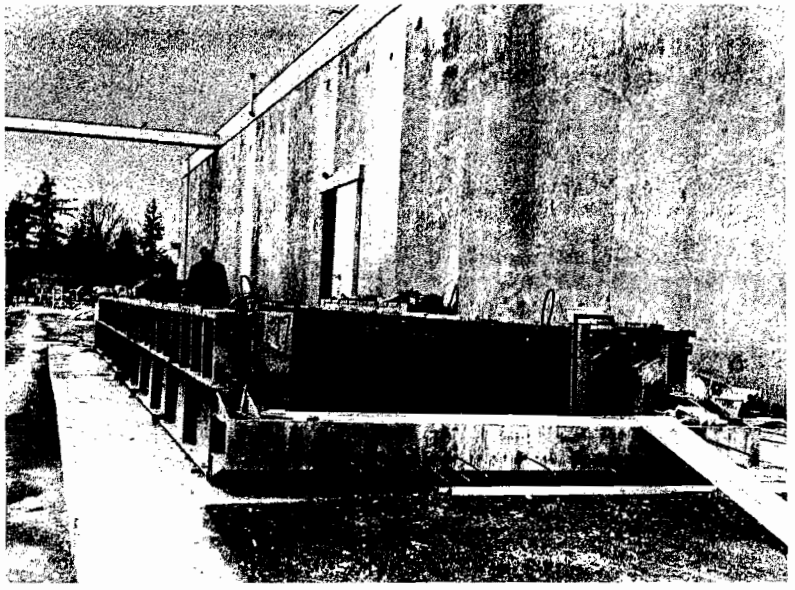


Fig. 11—Townland pre-stressing form

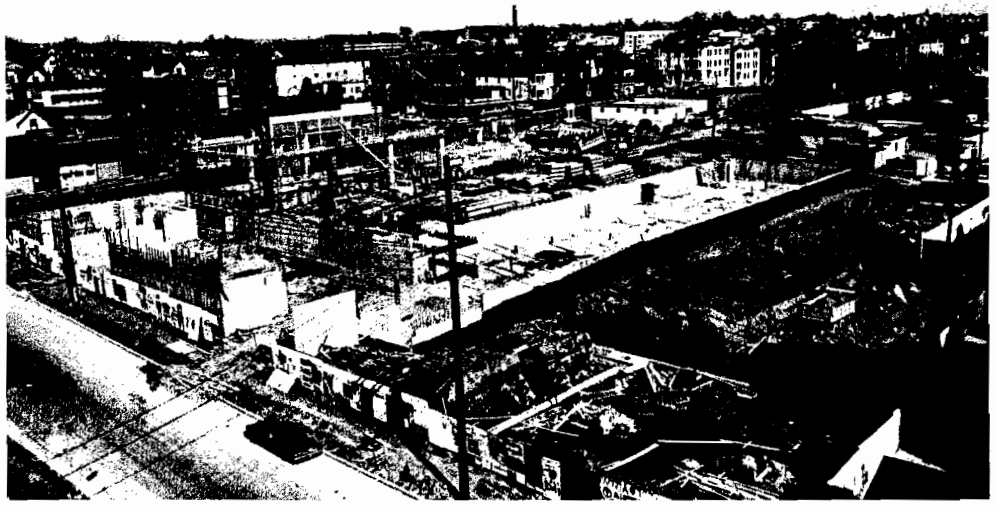


Fig. 10—Initial on-site construction

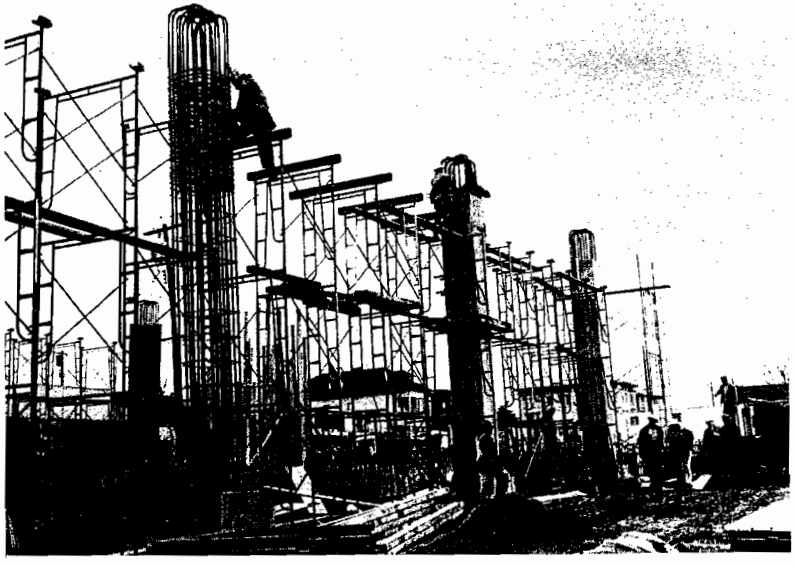


Fig. 12—Cast-in-place SLS columns

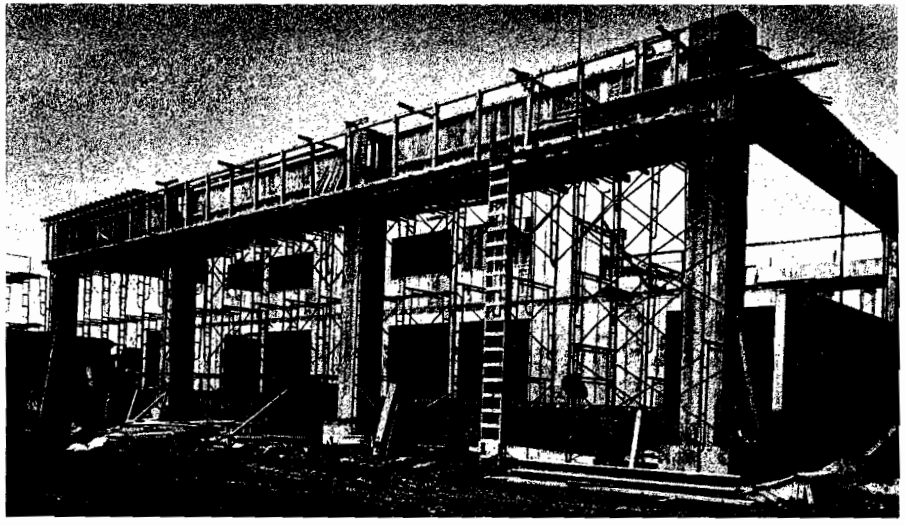


Fig. 13—Construction of spandrel beams

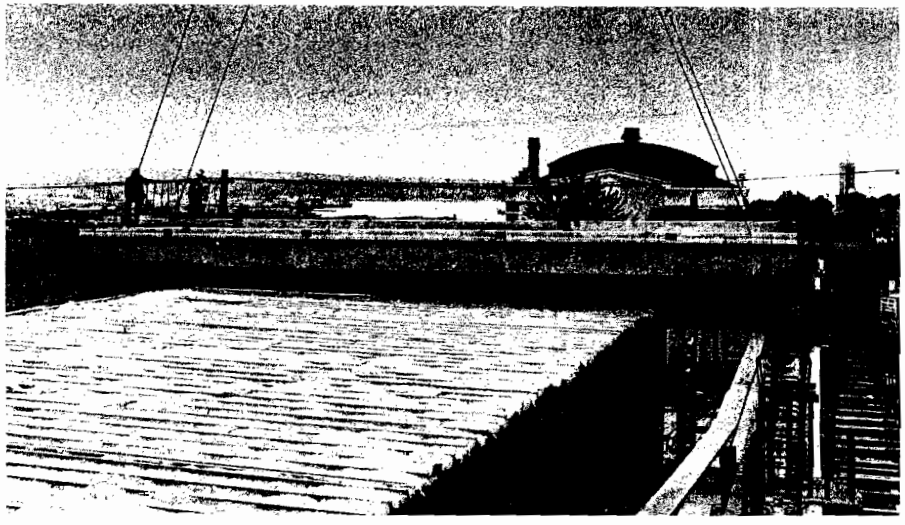


Fig. 14—Placement of pre-cast channels

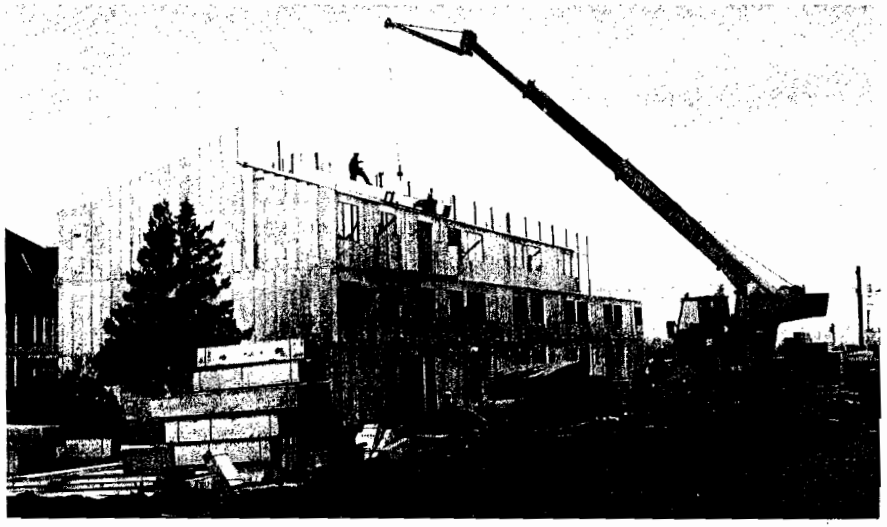


Fig. 15—Erection of Rusco framing system

Descriptions	Building Substantially Completed by (1972)			
	Sep.	Oct.	Nov.	Dec.
8 Townhouses			A	
12 Townhouses			B	
8 Garden Apartments	C			
8 Garden Apartments			D	
8 Townhouses		E		
4 Garden Apartments		E		
10 Townhouses	F			

Fig. 16—Erection schedule (as accomplished)

The Townland-owned pre-stressing form, for the pre-cast SLS channels, was shipped from New Jersey to Olympian Stone Company in Redmond, Washington, arriving in early January 1972. Factory casting of the concrete channels (Fig. 11) for the SLS structure was completed in March along with the on-site pouring of the SLS columns (Fig. 12). Forming of the spandrel beams began, followed by erection of the Rusco metal framing system on buildings B and C (Fig. 13).

By April, erection of buildings D, E, and F, commenced, along with construction of the garage roofs (which double as foundations under buildings A, E, and part of F).

A strike at Olympian Stone caused a 22-day delay in delivery of channels to the site. Later, a jurisdictional dispute between the Teamsters and the Molders unions over in-plant material handling further delayed delivery of channels. Following shipment of the pre-cast channels to the site they were erected in two days (Fig. 14).

On July 28, Wright/Model, the general construction contractor, declared that the project schedule would have to be extended an additional two to four weeks. Adverse weather had caused a two-week delay, primarily in earthwork. Late receipt of complete drawings and the higher-than-normal proportion of apprentice workers used on the job also slowed work.

Despite these delays, BREAKTHROUGH construction continued smoothly through the summer and fall (Fig. 16). The city issued certificates of occupancy by December 1972.

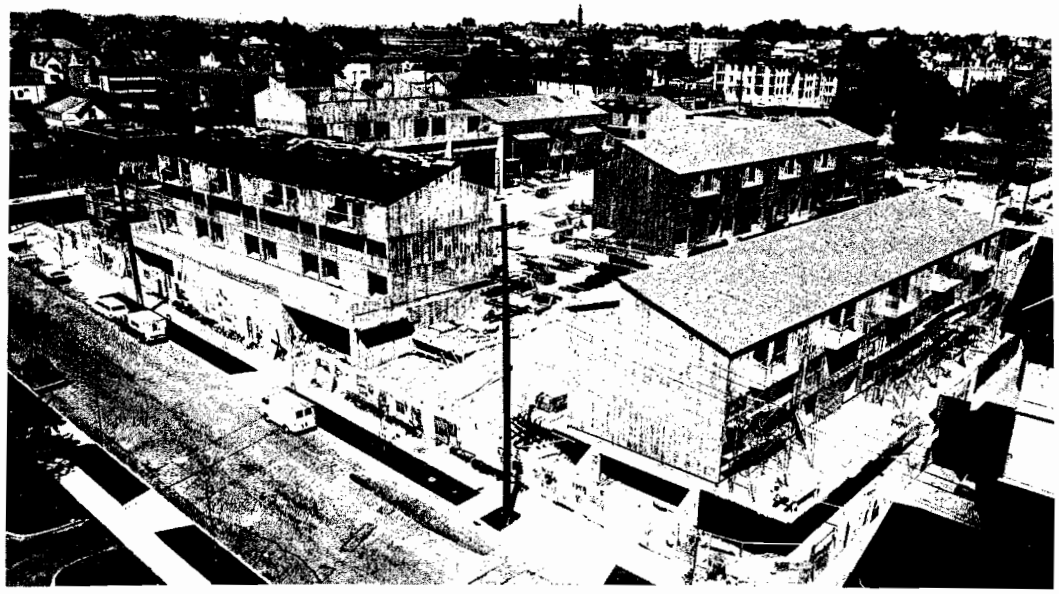


Fig. 17—BREAKTHROUGH site nearing completion

Community Relations

Early planning by the developer and site planner anticipated that the BREAKTHROUGH development might encounter community opposition, a reaction that had been directed at other government projects in Seattle's Central Area. Information and neighborhood involvement were considered critical to a successful demonstration of the site. The YANIP urban renewal area has been in existence since 1960, but, as of the summer of 1970, no construction had resulted. Residents of the area were, therefore, skeptical of development plans and apathetic or even hostile towards requests for participation. These attitudes were evident in early BREAKTHROUGH contacts. Seattle Housing Development (SHD), then known as Operation Equality of the Seattle Urban League, set up meetings with local organizations and Central Area newspapers so that Boeing could explain the purpose, intent, and form of Operation BREAKTHROUGH. SHD also established a BREAKTHROUGH liaison committee of community leaders to aid in informing the community of the BREAKTHROUGH program and its progress, as well as to assist in solving problems encountered during the development of the site. The developer's site manager and engineers contributed to this effort by answering questions and giving presentations to interested parties.

One of the most enjoyable events reflecting community involvement was a two-day "paint-in" by 600 local school children held April 20 and 21, 1971. Boeing and SHD arranged with Black Arts West and the Seattle school system to have 2,000 linear feet of construction fence painted. The children in particular and the community in general enjoyed the activities, which were widely covered by local newspapers and television stations. Decorated with slogans and pictures, the fence remained in place for the duration of the construction period (Figs. 10 and 17). Throughout the construction period it was left intact by

vandals and graffiti writers, even though construction fences have historically been targets for such abuses.

SHD and Boeing informed minority contractors about BREAKTHROUGH and advised them how they might take advantage of the equal opportunities offered by the program. SHD arranged meetings between Boeing officials and the Central Contractors Association (an organization of minority contractors in the Seattle area), where the contractors described their difficulties in obtaining performance bonds and other obstacles to securing contracts. Solutions to many of these problems were found; joint ventures with other minority or non-minority contractors were encouraged. Approximately 15 minority subcontractors and a sizeable number of minority apprentices were involved in construction. The general construction contractor for the Seattle site was a 50-50 joint venture between Howard S. Wright, a major general contracting firm, and Model Contractors, a local minority contractor. Throughout the project, at least 50 percent—and up to a high of 70 percent—of the employees working on the site were minorities.

Operation and Maintenance

A site security program was implemented shortly after groundbreaking to prevent unauthorized visits. The Seattle Police Department and a detective agency subcontracted by the developer patrolled the area, a service that continued until the units were occupied. Lighting was provided for night surveillance of critical areas. Despite a few break-ins, damage and loss from thefts were minor.

Prior to the turnover of the site to its eventual sponsor/owner, the developer conducted a site maintenance program including upkeep of common areas, landscaping, and servicing the community center and completed units. For one year following completion and turnover of the site, Boeing administered the warranty covering the units, community center, and landscaping. Typical problems included water leaks from upper decks and minor condensation, jammed roll-up garage doors, and sand carried indoors from the tot lot.

Marketing

Early in the program, Boeing reviewed all existing marketing information about the area around the site and initiated a survey of the potential housing market. This survey, performed by a local real estate consulting firm, determined that the main market would be among low income residents of the immediate community. The survey report recommended that a selection of two-, three-, and four-bedroom units be provided; that the site contain facilities and amenities comparable to those of single family residences; and that it be designed with emphasis on privacy and individuality.

At the request of OBR, Boeing investigated alternatives for marketing the site and evaluated three methods: condominium, cooperative, and a rental project. The developer did not recommend a condominium since FHA mortgage insurance for this scheme offered considerably lower coverage than was available for the other two. Potential residents were unfamiliar with cooperatives, which have realized only limited success in the Seattle area, so this method was also not recommended. A rental project, with sale to a nonprofit sponsor/owner, emerged as the best option due to the high demand for this kind of housing and the availability of both management and sponsoring organizations. Under this marketing method, FHA Section 236 and rent supplement programs could be used as funding sources. Also, a rental project could be converted at a later date to a cooperative.

In order to implement the recommendation, which was approved by OBR and OBW, Boeing formed the 18th and Yesler Association. The association was specific to the Seattle site and qualified for 100 percent financing as a free-standing, nonprofit corporation.

Starting in October 1970, Boeing and SHD sought out local groups interested in sponsoring the site and met with seven different organizations to tell them of project status and eventual ownership responsibilities. The developer issued requests for proposals in December 1971. Next, Boeing held a meeting to discuss the request and answer questions; the five candidates received copies of FHA's "Management Guide for Section 236 Projects." Following the February 16, 1972, deadline, a committee of Boeing and SHD personnel evaluated the two proposals that had been submitted. In March, the committee recommended to FHA and OBR the selection of the First African Methodist Episcopal Church of Seattle (FAME) as the site's sponsor. FAME, one of the largest churches in the Central Area, was chosen on the basis of its broad experience with housing and counseling and obvious dedication to the community. On May 15, FHA and OBR approved the selection and advised that FAME hire a strong management agent to help assume the initial duties and prepare for complete sponsorship FAME promptly retained SHD for this purpose.

Boeing and FAME planned to commit, through a letter of intent, to the transfer of the site. The conditions of the transfer were revised following discussions with OBR and FHA to preclude a turnover until FAME received 75 percent of the potential monthly rental income. The revised letter of intent was signed in October 1972, in anticipation that the site would be transferred to FAME by the end of November. Later, however, FHA advised that it would withhold approval of such a transfer pending confirmation of economic viability at 95 percent occupancy.

In a ceremony on December 10, 1972, the site was formally dedicated as Bryant Manor, named after Harrison J. Bryant, a bishop in the African Methodist Episcopal Church. Speakers included Theodore Britton, HUD Deputy Assistant Secretary for

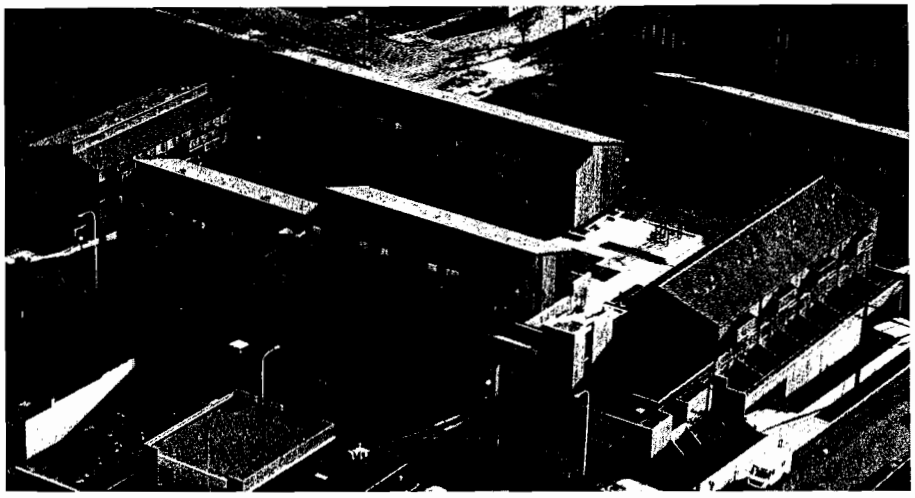


Fig. 18—Completed Seattle BREAKTHROUGH site

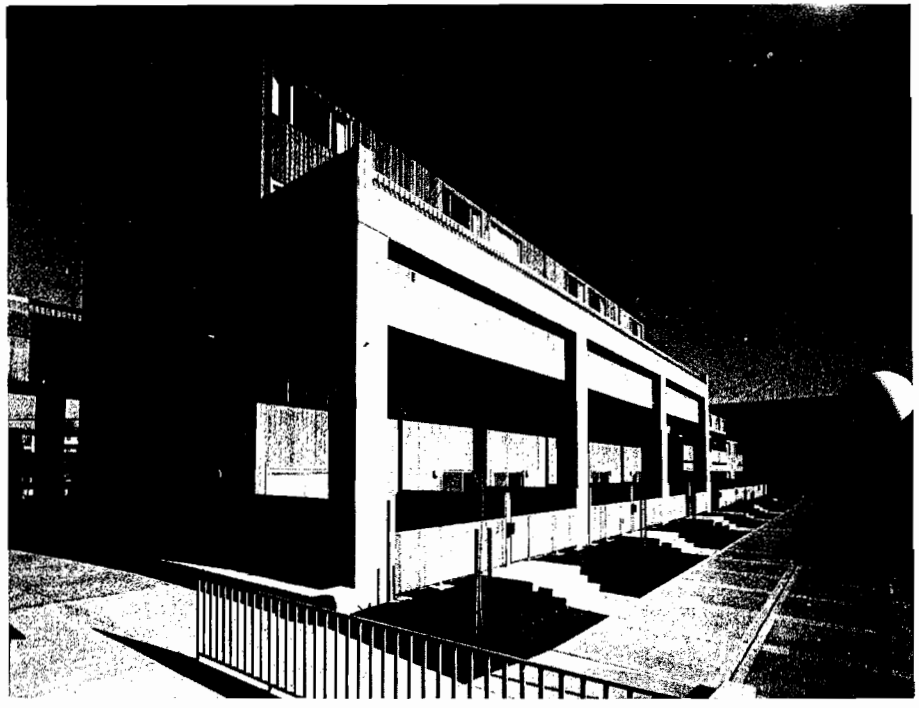


Fig. 19—Supported Land System units

Fig. 20—Ribbon cutting at site dedication ceremony

Research and Technology, and Seattle Mayor Wesley Uhlman. Election of FAME's board of directors to the 18th and Yesler Association on May 11, 1973, marked official transfer of the site.

SHD reviewed the qualifications of prospective tenants and counselled them concerning occupancy, home maintenance and management, legal and financial matters, membership in the tenants' association, and programs available for resident children. Rental of the units began in October 1972, and the site achieved full occupancy during January 1973.

Spurred by a general housing shortage in the area, the site has continued to be successful, with long

Weather and Comfort

The moderating effect of the coastal marine climate is the dominant factor in Seattle weather. Due to the mild temperatures (summer highs average 75° and winter lows 37°), air conditioning and large capacity heaters are not required. The marine influences do cause 150 rainy days per year, so attention to protection from inclement weather, like recessed entryways, was important.

waiting lists. Other reasons for the site's success include the large size of the units; the quality materials and hardware; and the effective security measures such as magnetic locks and keys, washers and dryers in each unit, key-operated elevator, secured parking, and selectively fenced areas.

Each unit is also furnished with a refrigerator, range, garbage disposal, master TV antenna outlet, carpeting, and draperies. At first, monthly rental rates included all utilities except telephone, as shown below. Later, rents were reduced, and tenants now pay for their own utilities.

Two-bedroom garden apartment (990 sq.ft.)	$137.30
Two-bedroom townhouse (1,055 sq.ft.)	157.50
Three-bedroom garden apartment (950 sq.ft.)	162.30
Three-bedroom townhouse (1,520 sq.ft.)	178.50
Four-bedroom townhouse (1,585 sq.ft.)	187.00

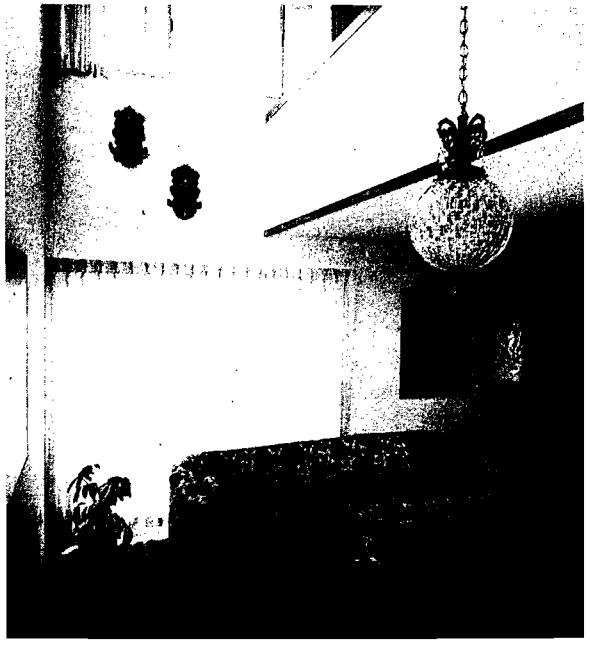
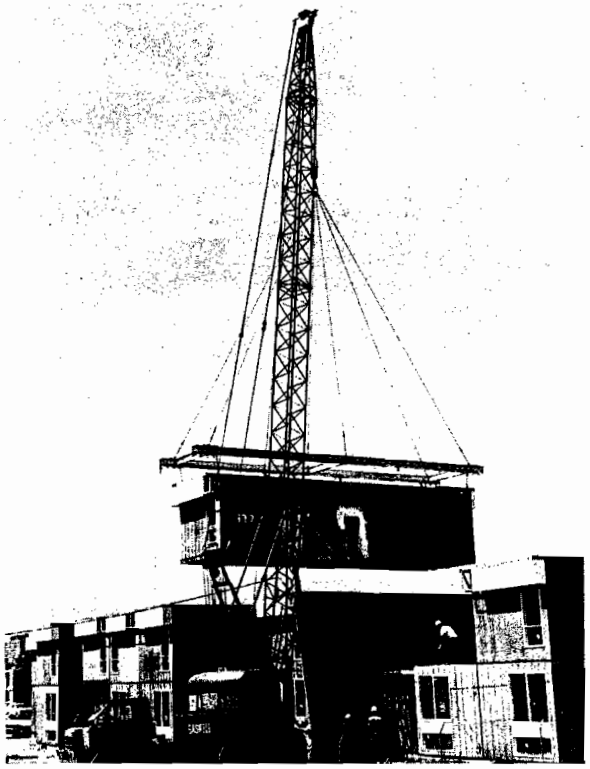
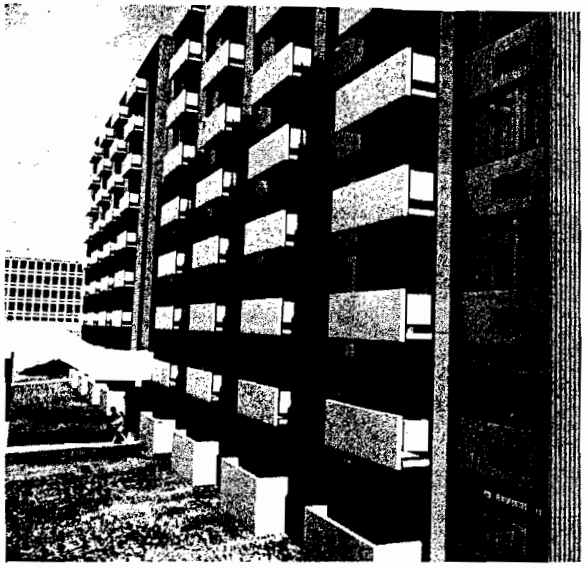


Fig. 21—Interior of 3-bedroom townhouse unit

GTR for site development — F. Hansen
GTR for planner — C. Gueli
STR — T. Uomoto
ACO — L. Chinn
Director of OBR — R. Brockway



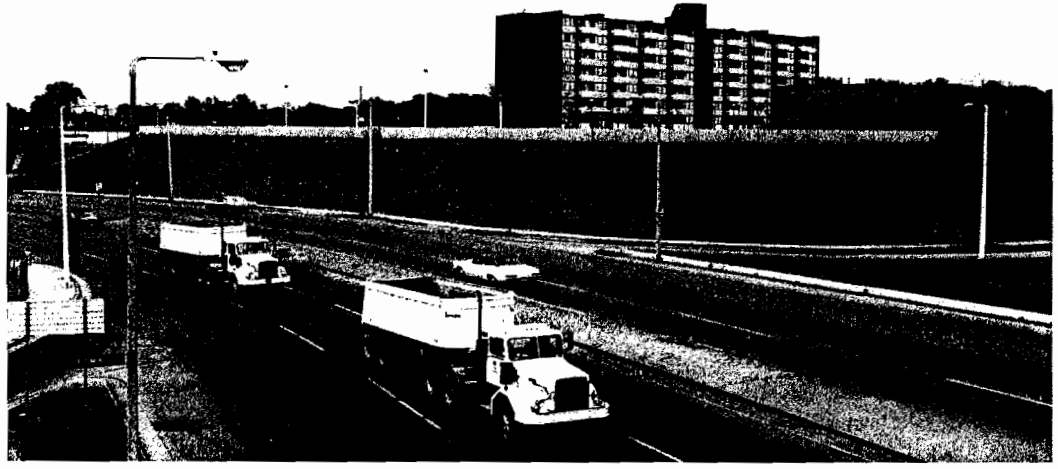
A total of 518 panel, modular, and conventionally built units was constructed, beginning in June 1971. Due to HSP substitutions, erection schedules were staggered, with the last producer completing its units in September 1973.



The conventional 144-unit high rise was built for ASH using standard construction materials and procedures.

East of the acoustical berm a spine, or pedestrian platform, provides open space for recreation and community activities while covering a parking area. It also serves as a pedestrian pathway between the medical center and downtown.

Traffic noise is controlled by an acoustical berm along Danny Thomas Boulevard. The berm is a grassy, earthen barrier with a low concrete wall along its crest. Together, these absorb and deflect sound, reducing the noise level on the site.



A mall on the eastern portion of the site is lined with low-rise townhouses and garden apartments. This interior open space continues the pathway and recreation functions of the spine which it adjoins.

Background

Several groups, including the Memphis Chamber of Commerce and a special committee on housing appointed by Mayor Loeb, campaigned to bring Operation BREAKTHROUGH to one of three potential locations in Memphis. In June 1969, a delegation of local officials made a presentation to HUD Secretary George Romney outlining Memphis' desire to be a part of Operation BREAKTHROUGH and its willingness to cooperate in the program. In December 1969, HUD announced that a Memphis location had been selected as one of the prototype sites.

The site is located a quarter of a mile east of the central business district and immediately west of the University of Tennessee Medical Center (Fig. 1). Jefferson Avenue bounds the site on the north, Madison Avenue on the south, and Danny Thomas Boulevard on the west. The neighborhood includes student housing, a high rise for the elderly, and some higher income housing close to the medical center. Adjacent to the site are light industries, small warehouses, and supply house businesses.

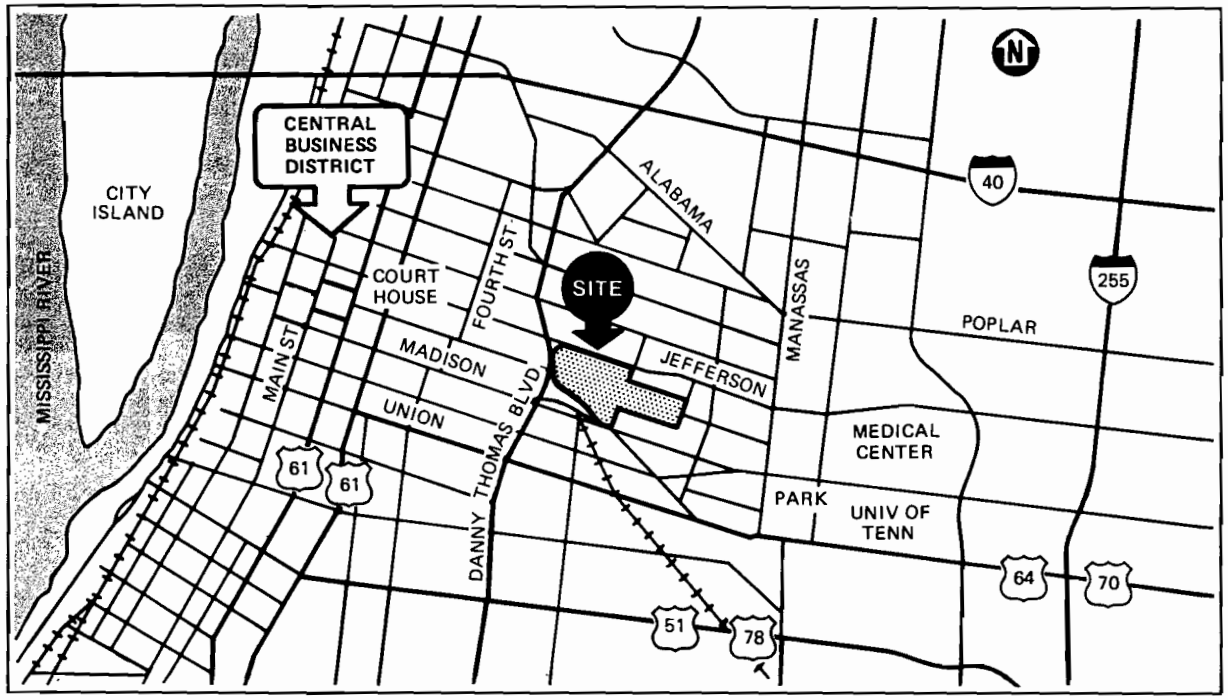


Fig. 1—BREAKTHROUGH site location in downtown Memphis

The site has unique historical significance. In 1853, the Memphis and Charleston Railroad built a depot on what was then a dried-up creek bed. The rail line connected the Mississippi with the Atlantic and was the prize for which the Battle of Shiloh was fought in 1862. After the Civil War, the Southern Railway System absorbed the Memphis and Charleston and built a train yard and freight house where the Operation BREAKTHROUGH development is located today (Fig. 2). The depot became a major hub of commercial business activity, reaching its peak between 1901 and 1926. Southern Railway then moved its passenger service, but the station continued to do a good freight business until the automobile and airplane brought radical changes in transportation. Passenger transportation resumed briefly between 1964 and 1966. At that time, the station was the oldest train depot in continuous use in the United States.

The Memphis Housing Authority (MHA), a city housing authority and urban renewal agency, purchased the land as part of its Court Avenue III urban renewal area. An effort was made to restore the aging building and its surroundings as a historical site, but this effort failed for lack of funds, and the depot was demolished in June 1968. MHA sold a portion of the property to the University of Tennessee.

MHA then became involved in bringing BREAKTHROUGH to Memphis. A special committee on housing, appointed by the mayor, found that the urban location and the need for student housing made the site ideal for prototype demonstration. BREAKTHROUGH also fit well into MHA's development plans for a balanced social and economic housing mix. The BREAKTHROUGH concept and the location gained support from city officials and various groups anxious to bring new development to the area. Fears were expressed, however, that it would be difficult to attract popular support for development, other than low income public housing, in "that part of town." HUD believed the ongoing expansion of the medical center would create a demand for housing in this area, and that a broad social mix could be achieved by providing exceptional facilities. In anticipation of a sale of the land for BREAKTHROUGH, MHA bought back that portion of the site previously sold to the University.

Fig. 2—M&C Railroad depot, circa 1880

Pre-Development Activity

The site was originally zoned for a variety of uses, including high-rise apartments, townhouses, wholesale business, and light industry. Parts of it had to be rezoned for BREAKTHROUGH, which the city did through resolution on October 21, 1969. This resolution was expanded on December 9 to include some general code variances and require HUD approval of each housing system prior to city issuance of specific building permits. All site improvements were subject to local building codes and regulations.

After selecting Memphis for a BREAKTHROUGH demonstration, HUD chose the Louisville, Kentucky, firm of Miller, Wihry and Brooks, Inc., landscape architects and engineers, as the Prototype Site Planner (PSP). In fulfilling the PSP role under contract H-1201, Miller, Wihry and Brooks acted as team leader, supported by Louis and Henry, architects, and Stephen Sussna Associates, planners.

On March 16, 1970, the planner presented its first report to HUD. The report contained results of the initial site investigation and recommendations for the number and types of housing units that would be best suited for the project. Four conceptual site plans were discussed:

Grade-Level	—	Low-key, casual plan
Enclave	—	Focuses all attention on a central plaza
Mall	—	Allows maximum visual penetration and perimeter green space
Spine	—	An elevated pedestrian platform over the parking area; a lifeline link to all other elements of the site

The spine was favored because it solved several inherent site deficiencies and provided a sound basis for arrangement of the housing systems.

The planner advised development of the vacant block north of the site across Jefferson Avenue. This extension of the project would have incorporated commercial services, a swimming pool, and other neighborhood facilities. However, the property was not part of BREAKTHROUGH, and its owner, MHA, planned to use it in the future for additional Court Avenue III urban renewal housing. (During BREAKTHROUGH, the developer did lease the so-called "north block" from MHA as a temporary construction storage and staging area.)

The planner also recommended a large number of units in order to provide living densities that would reduce per-unit costs of land and development. A rental range was suggested, based on a Memphis market analysis, site analysis, FHA programs available, and anticipated residents of the units—primarily elderly persons and medical students. The parceling plan assigned specific areas (micro-sites) to each housing producer for construction. A pneumatic trash collection system was considered, but estimates indicated the cost would be prohibitive.

On May 22, 1970, four months after the PSP started work, HUD named the Housing System Producers (HSPs) for Memphis: General Electric, Stirling Homex, Shelley, and CAMCI. These HSPs then negotiated Phase I contracts covering detailed system designs and worked with the planner to complete micro-site plans. A fifth producer, Material Systems Corporation, was added in September 1970.

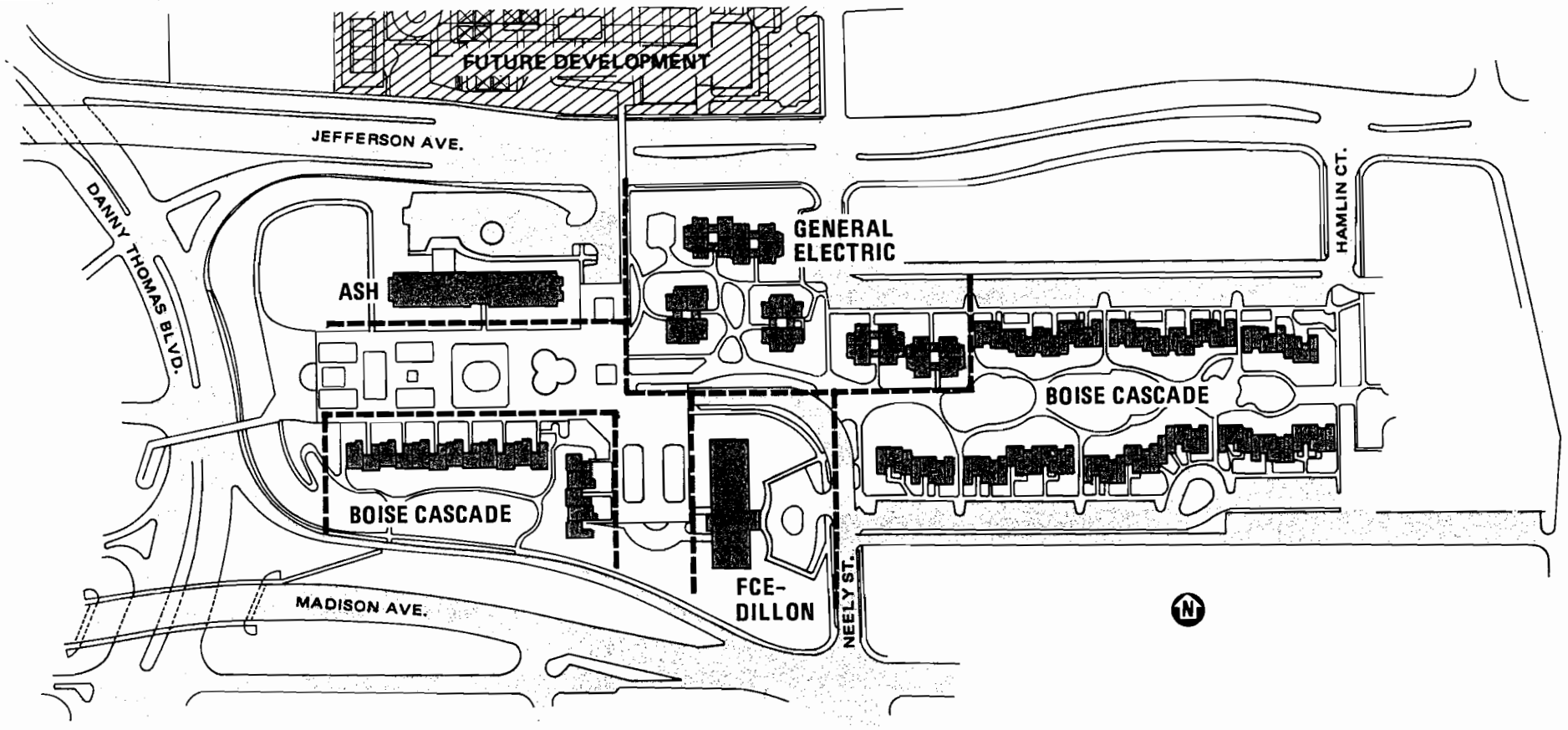


Fig. 3—Site plan as built

Site Plan

The site plan is organized along an east-west axis. On the eastern part, townhouses and garden apartments border a mall. Two high rises and more garden apartments on the western portion line an elevated pedestrian platform called the "spine." The spine allows vehicular and pedestrian activity—normally incompatible functions—to coexist in the site's interior. Automobile access and parking are located underneath, while at the upper level, the spine connects the separate areas of the development with open space for recreational and community uses. It also serves as a pedestrian link west to downtown and north to MHA's future housing.

Major roads surround the project on three sides, creating unacceptable levels of traffic noise. To shield the site, Miller, Wihry and Brooks designed a berm, an earthen barrier planted with grass and capped by a concrete wall. The 30-foot high berm runs along the western end of the spine parallel to Danny Thomas Boulevard. In the northwest corner of the site is a small park dedicated to Thomas Edison, who lived there as a young man, working nights in the nearby telegraph office and devoting days to his inventions.

Four housing systems comprising 518 units are arranged on 15.9 acres. Of the five HSPs originally assigned to Memphis, only General Electric remained to erect its two-story apartment units. Between 1970 and mid-1972, Shelley, CAMCI, Material Systems, and Stirling Homex were replaced by other producers. Boise Cascade constructed two-story townhouses and three-story apartments in the area first designated for CAMCI and Material Systems. Adult Student Housing of Memphis (ASH) used conventional techniques to build a non-BREAKTHROUGH high rise of nine stories on the parcel originally assigned to Shelley. FCE-Dillon constructed the other high rise (13 stories) in place of Stirling Homex.

Although Boise Cascade garden apartments adjoin the spine, they face toward open space on the outer side. Boise's townhouses rim the ground-level mall to the east. The General Electric units are situated among grassy courtyards which, like the mall, serve for play and access. Around the spine are massed the

	ASH			BOISE CASCADE			FCE-DILLON			GENERAL ELECTRIC		
	EFF	1 BR	2 BR	1 BR	2 BR		EFF	1 BR	2 BR	1 BR	2 BR	3 BR
SFA (69)				27	42							
MFLR (99)				27	24					8	36	4
MFHR (350)	2	97	45				132	72	2			
Totals (518)	144 UNITS			120 UNITS			206 UNITS			48 UNITS		

Fig. 4—Housing unit mix

large high-rise buildings. They give definition and a sense of orientation to the site. Their placement minimizes shadows on the spine's community center and recreation areas.

Housing Systems

General Electric Company, Boise Cascade Housing Development, and FCE-Dillon, Inc., were the HSPs that accomplished construction of housing units. Adult Student Housing of Memphis, Inc., a nonprofit corporation, also built a conventional high-rise apartment structure.

General Electric used a closed module system. The floor, ceiling, and roof assemblies were made of wood, the wall framing members of steel, and major portions of the interior wall surfaces of cast plaster. Modules, with all mechanical elements included, were shipped by truck and rail from the GE factory in King of Prussia, Pennsylvania. A crane set the modules in place on prepared foundations.

Three major subsystems make up the FCE-Dillon housing system: (1) the structural elements of pre-cast concrete walls and floors; (2) the heart module, a factory-built service core containing kitchen, bathroom, and utility chase; and (3) the elevator shaft assembly, pre-cast in one-story modules. FCE-Dillon shipped the heart modules by rail from its Akron, Ohio, plant, and a local subcontractor pre-cast the concrete components. The HSP that Dillon replaced at Memphis, Stirling Homex, also had a high-rise system, one using factory-made closed modules.

Boise Cascade's system is made up of factory-assembled modules that have plywood floors, steel-framed wall and ceiling panels with gypsum skins, electrical harnesses, and prefabricated plumbing trees. The finished modules were shipped from Arabi, Georgia, to the site, where they were set on prepared foundations by crane.

In contrast to the industrialized BREAKTHROUGH housing systems, ASH used traditional methods to build its high rise. The structure has hand-laid, concrete block walls, and poured-in-place concrete floor slabs. All equipment was standard and installed on-site.

Prototype Site Developer

HUD selected the Alodex Corporation of Southaven, Mississippi, as Prototype Site Developer (PSD) for the Memphis BREAKTHROUGH project. Alodex is broadly involved in real estate acquisition and development, systems building operations, and urban renewal. Finance, control, administration, and technical services augment these interests.

Alodex's association with innovative industrialized housing is not new. In 1967, the firm thoroughly investigated factory-built housing systems in the

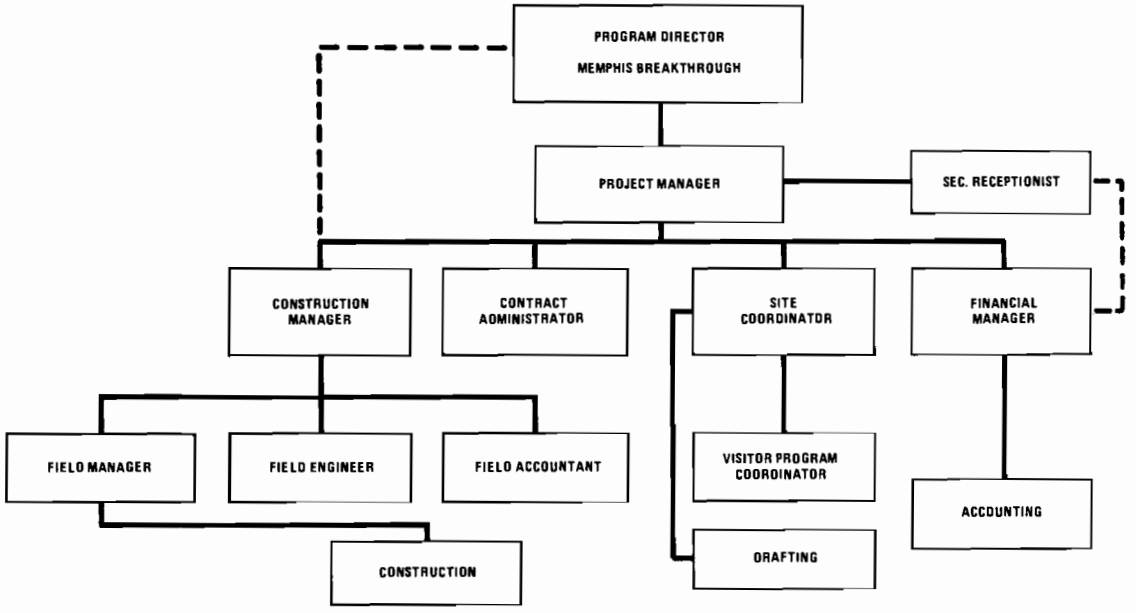


Fig. 5—Alodex BREAKTHROUGH organization

United States and Europe. Prior to BREAKTHROUGH, Alodex submitted proposals to HUD to build several industrialized housing systems but received no funding.

This extensive knowledge of factory-built housing was the major factor that led to HUD's decision to award Alodex a two-year contract, H-1384, on July 16, 1970.

The PSD was to manage overall planning and housing systems construction; all site preparation and improvement construction; and planning for demonstration, marketing, operation, and maintenance. All of the construction activities were to be performed on a competitive bid contract basis. The work was broken down into bid packages with unit price or lump sum contracts.

Alodex established four limited dividend, nonprofit, special purpose organizations (SPOs) to hold title to the property and enter into Phase II contracts with each of the HSPs. These SPOs were Thomas BREAKTHROUGH, Jefferson BREAKTHROUGH, Madison BREAKTHROUGH, and Court BREAKTHROUGH. A fifth SPO, Neely BREAKTHROUGH, Inc., was established to act as a legal entity for all PSD site development work.

Scheduling of site preparation and HSP work was critical because of the sequential nature of those activities. Construction was scheduled by the use of a critical path method (CPM) logic network, as required by the HUD Operation BREAKTHROUGH staff in Washington, D.C. (OBW). An Alodex subcontractor drew up and periodically updated the CPM.

Toward the end of the construction period, OBW consolidated and transferred the tasks of the various PSDs to a single master developer, Boeing Aerospace Company. Boeing assumed Alodex's BREAKTHROUGH tasks, including management of the SPOs, on February 1, 1973. At that time, the site work was complete except for installation of miscellaneous site furniture, equipment, and structures, and administration of the warranty. Boise Cascade, the only HSP still performing construction, was nearing completion of its units.

Land Acquisition

In October 1970, MHA gave Alodex an estimate of the property's worth, based on the market rate for land suitable for high rise development. HUD and the planner, however, had estimated the property value at a substantially lower amount. Subsequent negotiations set the basis for determination of the land's value as a fixed amount for each housing unit to be built. This agreement resulted in the December 19, 1970, HUD purchase of the land from MHA. HUD then transferred the title of the micro-sites to Alodex's SPOs.

Title transfer was delayed due to the required closing of both Court and Neely Streets. This added approximately one month to the time necessary for land acquisition.

Financing

Alodex and OBW arranged initial construction financing from Leader Federal Savings and Loan for all Memphis HSPs except Stirling Homex. Meanwhile Stirling Homex, assisted by OBW, dealt directly with MHA to secure financing. HUD Research and Technology (R&T) funds were to be used for site improvement work such as the spine, community center, and landscaping, as well as for HSP costs in excess of mortgage values.

In March 1971, although R&T funds remained available, the HSP financing arrangements were negated by the withdrawal of Shelley, CAMCI, and Material Systems. Shelley and CAMCI both required factories located within 200 miles of the site because transportation of the pre-cast concrete elements beyond this distance would incur extraordinary costs. Shelley and CAMCI, New York companies, made studies to determine whether the market for their units in the Memphis region was sufficient to justify setting up local factories. Both concluded that they could not feasibly erect their units at Memphis. Material Systems also determined that erection of its planned six units would be uneconomical.

In exploring possibilities of obtaining substitute HSPs, Alodex and OBW tried to retain the site plan as originally conceived. This was important, because rough grading and other site preparation work had already commenced. Furthermore, the original plan had been approved by local officials. On May 3, 1971, Boise Cascade agreed to produce the units planned for CAMCI and Material Systems. A replacement for Shelley was then sought in order to complete the site plan. Various subsidized programs were explored as possible funding sources for the replacement but were found to be outside the budgetary limitations of Operation BREAKTHROUGH. Following discussions with University of Tennessee officials, it became apparent that a substantial market

SPO	Structure(s)	Funding Source
Court BREAKTHROUGH	Boise Cascade	Section 236
Jefferson BREAKTHROUGH	General Electric	College Housing Loan Program
Madison BREAKTHROUGH	FCE-Dillon	MHA
Thomas BREAKTHROUGH	ASH	College Housing Loan Program

Fig. 6—Memphis housing funding sources

existed in the area for student rental units, particularly medical students. OBW asked that principals of Adult Student Housing, Inc., as specialists in student housing, survey the market to determine the feasibility of building a high rise. They concluded that a market existed for rentals and that a high rise could be built within the statutory limitations of the College Housing Loan Program. Subsequently, Adult Student Housing of Memphis, Inc., was formed to provide the units earlier planned for Shelley.

MHA was working directly with Stirling Homex in obtaining financing, and the substitution of FCE-Dillon did not change this funding arrangement.

Complete financing for the Memphis site was obtained from the following sources:

- Turnkey Public Housing Program
- College Housing Loan Program
- Section 236 of the National Housing Act
- HUD R&T Funds

The Turnkey Public Housing Program enabled the Memphis Housing Authority to acquire the 206-unit apartment complex for the elderly. The producer, FCE-Dillon, arranged for the construction financing directly.

On August 24, 1971, ASH obtained a direct loan through the HUD-sponsored College Housing Loan Program to finance construction of 192 apartment units, including a 144-unit high rise, which was to be constructed directly by ASH, and 48 garden apartments by General Electric.

Memphis-Cascade, a limited partnership organized to provide housing for low to moderate income families, obtained a construction loan from Leader Federal Savings and Loan in August 1972. The loan, insured under FHA Section 233 pursuant to Section 236 of the National Housing Act, funded the 120 Boise Cascade townhouse and garden apartment units.

Fig. 7—Rough grading for spine and berm

Site Preparation

Late in October 1970, Alodex leased a building at 425 Madison Avenue to be used for on-site control. The developer initiated soil testing and started discussions with the city on code variance requirements. HSPs questioned many aspects of the site plan and delayed site preparations because their designs were not complete enough to determine engineering and code requirements. This delay was partially due to the limited amount of time allowed the HSPs to complete Phase I drawings, and for the subsequent National Bureau of Standards (NBS) reviews. Also, the attention of the HSPs was diverted from their designs by concern about the Phase II contracts, which at that time had not been negotiated.

Groundbreaking ceremonies were held at Memphis on December 19, 1970. Rough grading and engineering control work then commenced. In the first seven days of work, which was interrupted by poor weather, excess material on the site's east end was graded into the berm and park area on the west end (Fig. 7). Preliminary agreements for utility service were made with Memphis Light, Gas and Water Division, whose representative advised that no problems would be encountered in obtaining all required utilities, because adequate utility lines surrounded the site. OBW, the developer, and the planner chose electricity as the energy source for the project.

Poor soil conditions dictated the use of piling, which caused delays and increasing costs throughout the early portion of development. Through the summer and early fall of 1971, over 150 piles were drilled and grouted for the foundations of the spine and the two high-rise structures. Construction of the spine occupied the next 10 months. During that time, the developer made preparations to construct a community center building on the spine. Made up of three connected circular modules erected on the spine deck, the community center was not a BREAKTHROUGH structure, and some delays were encountered because it was not subject to BREAKTHROUGH code variances.

Two pedestrian overpass bridges, which connected

the spine with the far side of Danny Thomas Boulevard and Jefferson Avenue, were not completed until late in the development. The Jefferson overpass was initially postponed when it was determined that construction would hamper movement of HSP equipment to and from the staging area north of the site. Because it did not cross a federal highway, the Jefferson overpass should have been a State-funded project; however, the State did not have enough funds available for its construction. After months of delay, an agreement was reached whereby MHA designed the structure, initiated construction, and funded the project from MHA urban renewal funds; the overpass was completed in February 1974.

Similar difficulties were experienced with the Danny Thomas Boulevard overpass. After months of negotiations, a joint project was agreed to and was funded 25 percent by the City of Memphis, 25 percent by the State of Tennessee, and 50 percent by the federal government. The State Highway Department subcontracted the work, which was completed in November 1973.

Community Relations

The community relations program was low-key because there was little public opposition to BREAKTHROUGH. The entire project experienced only one week's delay from a labor dispute, caused by a Memphis area general strike not specifically directed at the BREAKTHROUGH development or any of its participants.

With the help of HUD's Registry of Minority Contractors, the developer began its Equal Employment Opportunity task by preparing a bidders list for work on the site. Names of additional minority firms were requested and received from the Memphis Chamber of Commerce and the local chapter of the National Association for the Advancement of Colored People (NAACP). In January 1971, Alodex approached the city council through Councilman Fred Davis for suggestions on involving minorities in the local BREAKTHROUGH program. Councilman Davis recommended that a seven-man committee representing the Urban League of Memphis, NAACP, LeMoyne-Owen College, Community Action Group, Legal Aid, Tennessee Department of Employment Security, and the council (with himself as council representative) be set up for the EEO task. Alodex agreed, and funded the committee as a subcontractor. The Citizens Committee for Equal Employment Opportunities (CCEEO) had three main goals: (1) placing minority individuals on BREAKTHROUGH payrolls, (2) negotiating BREAKTHROUGH contracts with minority construction companies, and (2) maintaining fair housing opportunities.

The committee asked several minority contractors to bid for various construction activities on the project. Despite initial skepticism, many participated actively in BREAKTHROUGH. Over half of all site

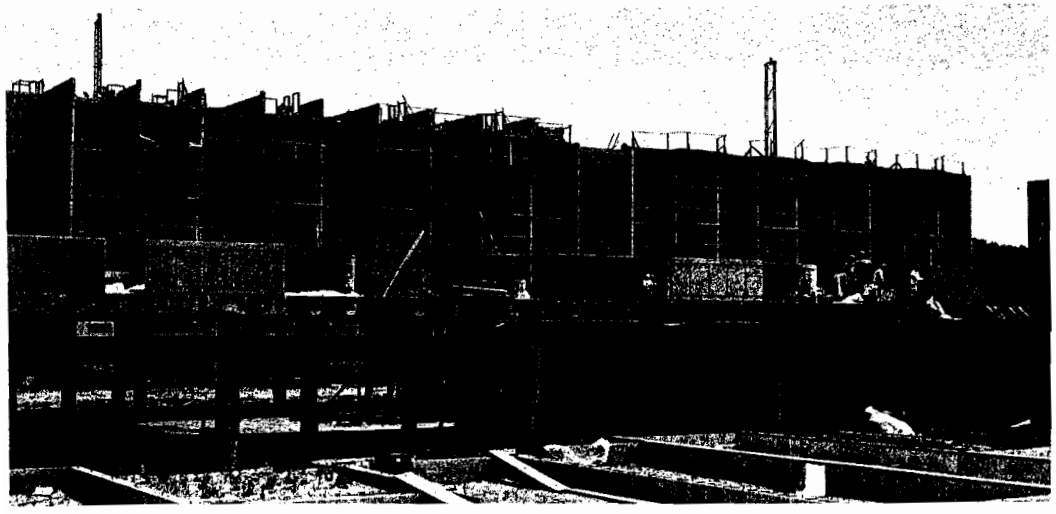


Fig. 8—Construction of spine between housing systems

Construction Conditions

Prior to development, the site was a natural trough, sloping west and bordered on three sides by roadways. Drainage was not good; the soil is predominately clayey silt, although much structural fill remained from the previous railroad yard. Only a radio antenna and a small service building were on the property at the start of construction.

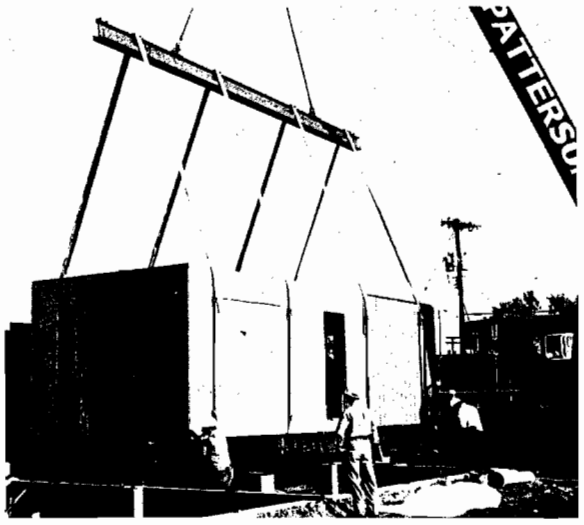


Fig. 9—General Electric module emplacement

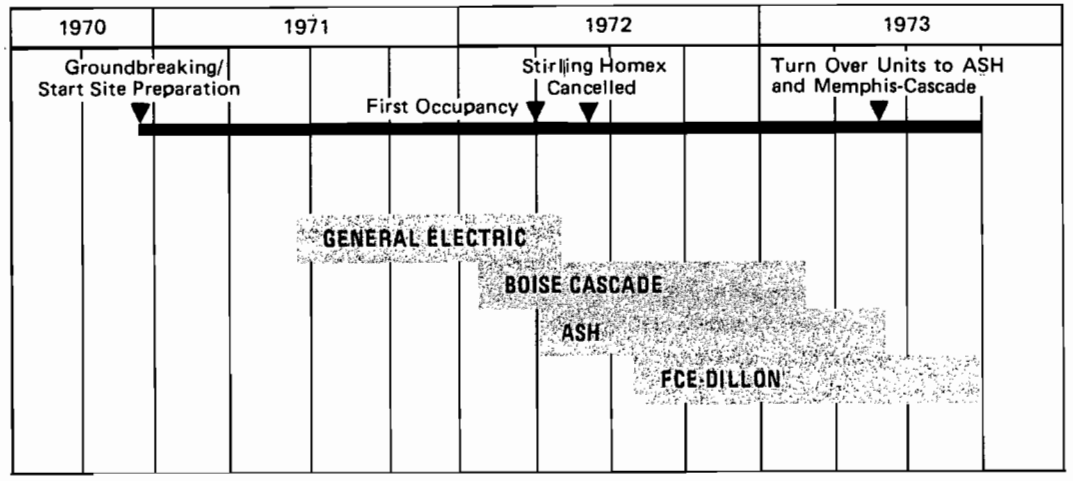


Fig. 10—Progress of housing construction

development personnel throughout the entire program were minorities.

The major reason for the successful minority representation in the Memphis BREAKTHROUGH was a construction management seminar, or workshop, for minority contractors. Established through a meeting held between the CCEEO, HUD Assistant Secretary Harold Finger, and the Site Technical Representative, the workshop was conducted by Memphis State University's engineering school staff, under contract with CCEEO. The first session, held between February 15 and June 30, 1972, was so successful that another was held in August and September to cover financial and accounting procedures and fiscal management. In all, 27 minority contractors attended these classes.

Housing Erection

By arrangement, Alodex provided the city with data on each housing system and lists of code variances derived by the HSPs from their design drawings. This procedure did not move as rapidly as planned, but city officials did gain a working knowledge of each system. The withdrawal of Shelley, CAMCI, and Material Systems created an added burden of studying the Boise Cascade system and the conventional ASH building. The city took this opportunity to reassess the method used to obtain code variances. In a meeting on April 27, 1971, the city and the PSD agreed that the city building staff would review each HSP's complete plans and specifications for compliance with local codes. The staff was to notify HUD of its findings and, after receiving data supporting HSP- and HUD-proposed variances, recommend to the city council approval or disapproval.

The General Electric Phase II BREAKTHROUGH contract was forwarded to Alodex for review in March 1971. Alodex requested several changes, and these were worked out between OBW and General Electric. The developer and General Electric then signed the contract and agreed that the units would be completed approximately 260 days after receipt of the notice to proceed.

Late in April 1971, General Electric received a conditional notice to proceed—conditional because necessary variances had not gone through the newly established channels and had not, therefore, been approved officially by the city. Thus, with some risk involved, General Electric proceeded in anticipation of definite approval. Since GE was planning to go ahead, OBW established January 1, 1972, as the completion date for its contract. The first HSP activity on the site began in May 1971 when GE moved its site trailers to the north block staging area. The producer planned to start foundation work early in June but waited until borings confirmed soil compaction requirements.

In June and July 1971, because General Electric's drawings and specifications were still undergoing HUD/NBS review and changes, the city could not issue GE a building permit. Nevertheless, GE began work at its own risk.

Later in July, General Electric unloaded eight modules at the north block staging area and found that the units had sustained some minor damage. GE submitted its 100 percent plans and specifications to

the city in August. Review by the building department was expected to be complete by mid-September, assuming prior receipt by the city of a HUD letter of certification. The city council issued a building permit, dated September 21, for erection of the GE housing units; however, a certificate of occupancy was withheld pending HUD certification.

GE started erection with 48 modules. These were set in three days, commencing September 21, 1971, and progress continued smoothly and rapidly to conclusion. During October, 35 more modules were erected, completing approximately 75 percent of GE's first structure and substantial portions of its second and third. By the end of October, GE had set 83 modules out of a total of 136. General Electric completed its factory production of Memphis modules on November 2 and finished emplacing the remaining 53 modules on November 12. Assembly, finish work, and minor corrective work were the activities yet to be completed.

On February 24, 1972, HUD notified the city that these BREAKTHROUGH units were constructed in accordance with plans and specifications, and furnished documents certifying HUD responsibility. In March the city issued a certificate of occupancy. A milestone was reached on March 31 with occupancy of 16 of the General Electric garden apartments. Occupants were warned, prior to moving in, of the problem of living in an incomplete construction area, with mud, dust, noise, and unfinished items of work as temporary annoyances. The occupants understood and accepted these conditions.

In April the remaining 32 General Electric apartments were turned over to ASH. Only "punch-lists" (listing unfinished tasks) and warranty items remained. Alodex issued a contract change order covering General Electric's final project responsibilities and establishing the producer's completion date as April 30, 1972.

Concurrently, Boise Cascade made plans for the erection of its units. Its Phase II contract was signed on May 3, 1971, but actual site work was not planned to start until at least December 1971, and, in fact, did not start until late January 1972. Factory production for Memphis was scheduled after the production of similar modules for the Macon Operation BREAKTHROUGH site, where Boise was also erecting units. Production and shipment of the modules was to be complete by June 1972.

In November 1971, Boise Cascade obtained a notice to proceed with foundation construction and a partial notice to proceed with erection of garden apartment units. The conditions imposed were compliance with the Operation BREAKTHROUGH guide criteria, and with certain recommendations made in the critique of Boise's Macon BREAKTHROUGH units. A decision on the townhouse units was not made at this time, because Boise did not submit the 95 percent drawings until December 17, 1971.

In the fourth week of January 1972, Boise Cascade began its on-site activities by installing a site trailer and starting engineering control work. Concrete block foundation walls were started shortly

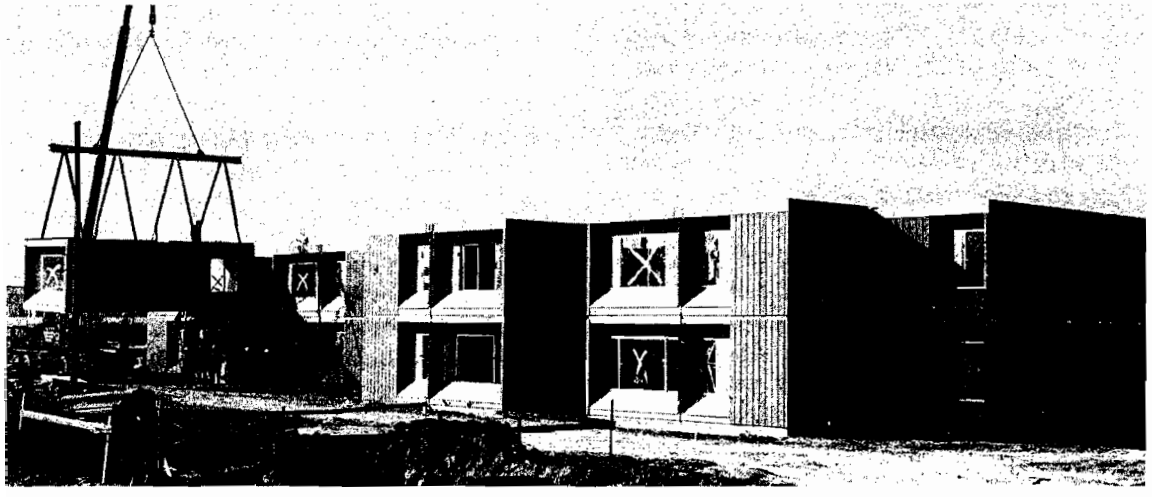


Fig. 11—Erection of GE units continues

Fig. 12—Boise Cascade townhouse foundations

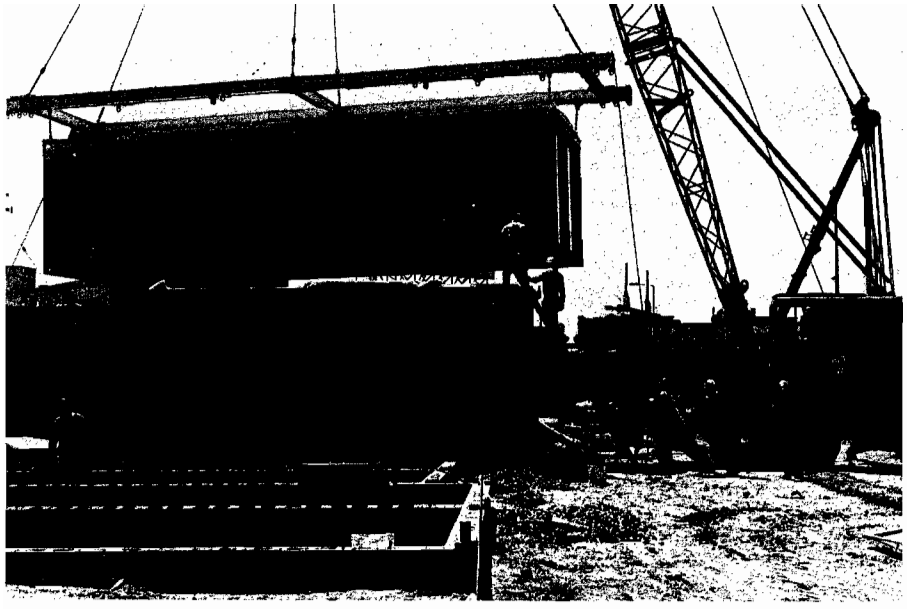


Fig. 13—Erecting a Boise Cascade garden apartment

Fig. 14—Erecting a Boise Cascade townhouse

Fig. 15—Boise Cascade apartments near completion

thereafter (Fig. 12). In mid-February, the firm received a notice to proceed on the east block townhouse units; however, its work was limited to construction of foundations and procurement of building materials.

During March, the foundation work on the garden apartment units was completed, and the HSP received a notice to proceed on the townhouse units. While awaiting arrival of the garden apartment modules, Boise began work on the townhouse foundations. On April 25, its first six modules arrived at the site, slightly damaged in transit but basically in good condition. Erection started the next morning, and by mid-afternoon the six modules had been set. The west block garden apartment units were completed on June 12. Townhouse erection commenced soon thereafter and continued through July and August, although module deliveries were slow. Alodex inspected most of the units erected by mid-September and drew up a punch-list so that the producer could continue work while waiting for the remaining 20 modules. These arrived and were erected in October. Exteriors were then stained. Boise Cascade, however, put primary emphasis on preparing the garden apartment units for occupancy. By November 6, 1972, all of the apartments received a certificate of occupancy and were turned over to Memphis-Cascade. The townhouse units were completed in November and received a certificate of occupancy on February 28, 1973, when they, too, were turned over to Memphis-Cascade, their owner.

Stirling Homex forwarded its 95 percent drawings and specifications to OBW in late August 1971. After initial NBS review, additional information was requested from the producer about structural load calculations, heating-ventilating-air conditioning, elec-

trical loads, and some catalog hardware. Of further concern, particularly to the developer, was Stirling Homex's intention to use gas in its building, even though there were no plans to provide the development with gas. By telegram of September 30, 1971, HUD rejected Stirling Homex's 95 percent drawings as incomplete, due to the absence of the additional material requested by HUD and NBS. On October 26, Stirling Homex delivered amended 95 percent drawings to HUD and NBS; however, these did not include wind-loading calculations, without which a conditional notice to proceed could not be authorized. After receiving these calculations, OBW, on December 22, 1971, issued a conditional notice to proceed on foundation construction. Stirling began foundation work early in January 1972 with construction of concrete piling.

While this work was in progress, Stirling Homex and the developer held several meetings about changes in the method of erection. Stirling had planned to use an innovative jacking system that would permit its structure to be built from the top down. These plans were changed in favor of conventional methods; consequently, crane access to the micro-site became a severe problem. Stirling claimed that not having crane access along the perimeter of the building where the spine was to be located would cost additional money and delay construction. Original site plans did not include any space requirements for crane location, and after Stirling abandoned the jacking system, it gave Alodex no indication of a special need for construction space until December 1971, well after award of the spine construction contract. Alodex maintained that, because Stirling initiated the change, it was Stirling's responsibility to find a solution at no additional cost to the development. Alodex also noted that Stirling was aware of the spine construction schedule and did not cooperate with coordination attempts. Negotiations continued in

Fig. 16—Topping out FCE-Dillon high rise, March 1973

February 1972, while Stirling completed the piling and began construction of concrete slabs capping the piles.

In March, Stirling advised Allen & O'Hara, an Alodex subcontractor for spine construction, to stop work pending further information; nevertheless, the developer and its subcontractors continued to work while waiting for HUD direction. In May, Alodex was advised that Stirling and HUD had reached an accommodation to release Stirling from the Memphis BREAKTHROUGH site. The settlement with Stirling called for no cash penalty, and Stirling agreed to provide a clear title to improvements begun on the property. A project coordinator with Stirling said, "Difficulties in development were tied up with our corporate position at this time. We could not construct this building within the financial framework." On July 10, 1972, Stirling Homex Corporation filed for bankruptcy under Chapter 10 of the federal bankruptcy law.

HUD recommended that Stirling Homex be replaced with a BREAKTHROUGH HSP, since the Memphis project already contained one conventional high rise. HUD approached several potential HSPs that could erect suitable units but only Rouse-Wates and FCE-Dillon showed interest. On June 2, 1972, a general meeting was held in Memphis to consider the replacement. Representatives of Rouse-Wates, FCE-Dillon, MHA, Allen & O'Hara, OBW, the Operation BREAKTHROUGH regional office (OBR), and Alodex attended. The HSPs were asked to submit turnkey proposals for design and construction by June 26, 1972.

FCE-Dillon's proposal was found to be in the best

interest of HUD and the BREAKTHROUGH project. Following HUD approval, FCE-Dillon signed a turn-key contract with MHA, and the two immediately began working together on details necessary for plans and specifications. This was a test of BREAKTHROUGH Phase III, where a critically examined and proven BREAKTHROUGH Phase II system was constructed directly for its ultimate owner without HUD acting as an intermediary.

FCE-Dillon planned to use as much of the piling constructed by Stirling Homex as possible, but had to remove the slabs built on the piles as they did not match the requirements of the new structure. During the fall of 1972, additional piling was constructed and the existing concrete work replaced. The FCE-Dillon heart modules and panels arrived on-site in December and January and were quickly erected during February and March 1973. Erection of the 206-unit, 13-story high rise proceeded smoothly and took a little over one month more to complete (Fig. 16). Dillon then proceeded with interior finishing, sidewalks, driveways, and landscaping. Development of the high rise and the surrounding micro-site was completed by September 1973.

Concurrent with erection of the BREAKTHROUGH systems, ASH proceeded with construction of a conventional high-rise building. This structure was totally constructed on-site, in direct contrast to the factory-produced housing systems. Soil testing for the building began in January 1972 but winter weather delayed preliminary site and foundation work for several weeks. After materials arrived, concrete block walls were hand-laid, and concrete floors were cast in place. Conventional construction techniques were also employed in finishing the structure which took approximately one year to complete.

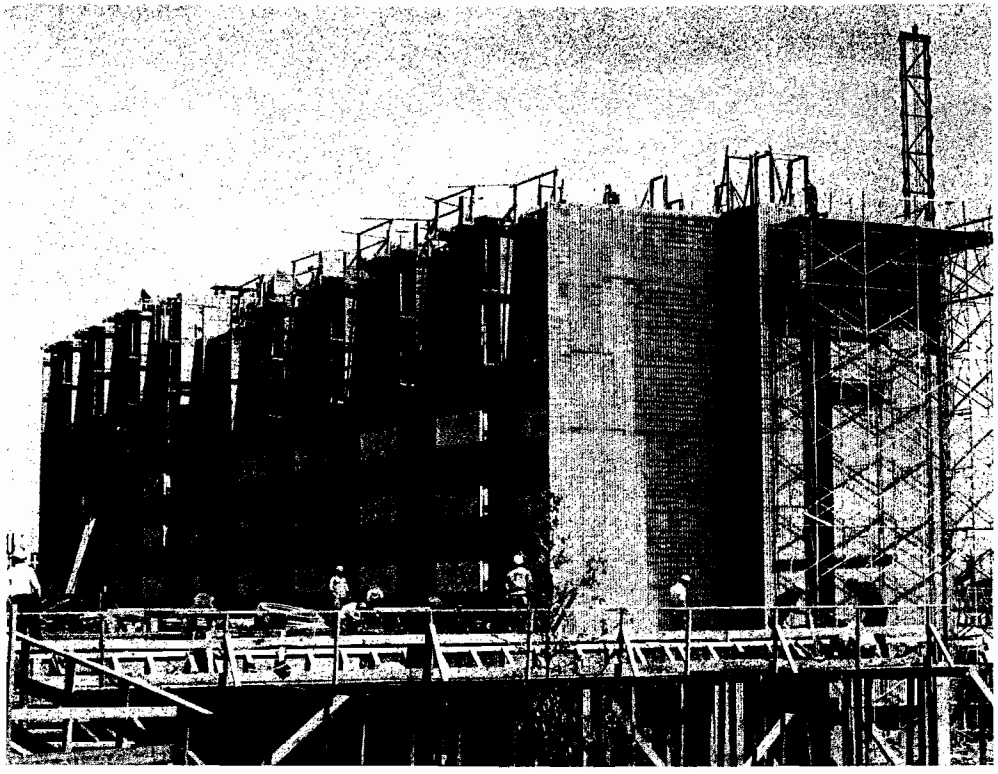


Fig. 17—ASH building under construction next to spine

Operation and Maintenance

Since the Memphis project was sold, in part, even before construction, an operation and maintenance program was not required of the developer. The owners, ASH, Memphis-Cascade, and MHA, had their own operation and maintenance programs; the developer was responsible only for site safety, security, and the construction warranty. Alodex provided guard services on an "as necessary" and "on call" basis. There were no significant security problems even though the neighborhood had previously been an area of high crime incidence.

Boeing, as Master Site Developer, administered the construction warranty which guaranteed the integrity of the BREAKTHROUGH units and other structures, like the community center and the spine, as well as of the landscaping. Items repaired under warranty included roof leaks and squeaky floors in the GE units, plumbing and air-conditioners in the Boise Cascade units, and a split column under the spine. The developer did not administer the FCE-Dillon and ASH building warranties because the buildings were constructed directly for their owners.

Marketing

Initial marketing plans developed by Alodex sought a broad social and economic mix of residents. CAMCI and Material Systems units were to have been FHA Section 236 low income, multi-family housing. The Stirling Homex high rise was to have been for the elderly. General Electric and Shelley units were to have been moderate and high income housing. These plans were revised, however, when HSP substitutions and changes in financing introduced the student and elderly housing mix that now exists.

The ASH apartment units are rented, in compliance with the regulations of the College Housing Loan Program, to University of Tennessee students and other qualified university personnel.

The General Electric garden apartments, also owned by ASH, are usually rented to medical students with families.

The Boise Cascade garden apartments and townhouses, owned by Memphis-Cascade, are rented to a racially balanced segment of younger and middle-aged applicants, mostly students, who meet income limitations. Large families generally occupy the more spacious townhouses.

The FCE-Dillon high-rise apartments, owned by MHA, are rented as public housing to elderly persons. These tenants must be over 62 years old (unless they are disabled) and meet income limitations.

No public marketing effort was required to find tenants. The medical center creates a large demand for housing, and ASH and Memphis-Cascade currently have waiting lists for their units. Similarly, MHA identified a shortage of public housing for the elderly. After the 206-unit FCE-Dillon high rise was fully occupied, a waiting list of 900 people still existed.

The units are also in demand because of the facilities and amenities at the site that are unusual to in-city developments. These include generous green space, on-site parking, children's play areas, the spine,

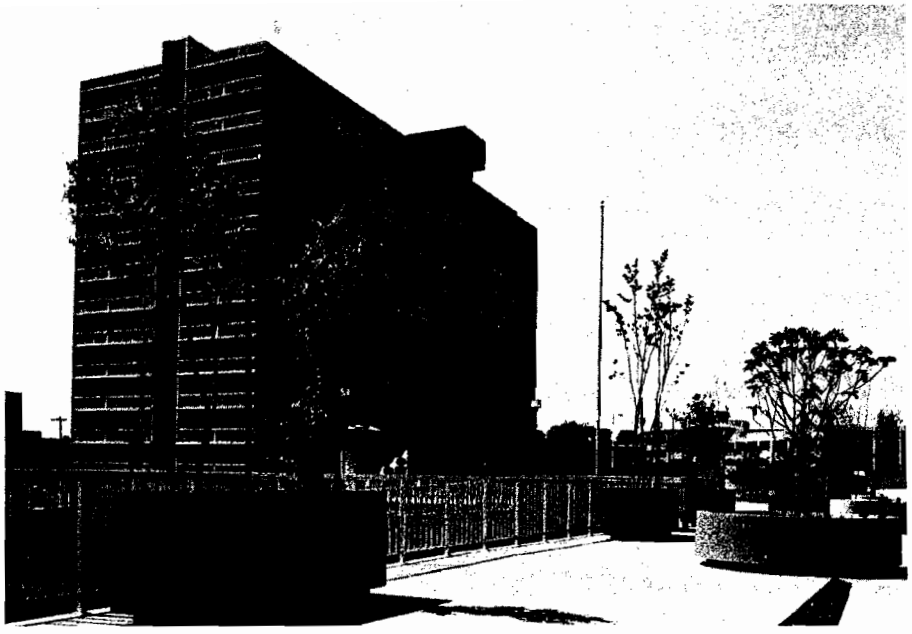


Fig. 18—Finished 13-story FCE-Dillon building

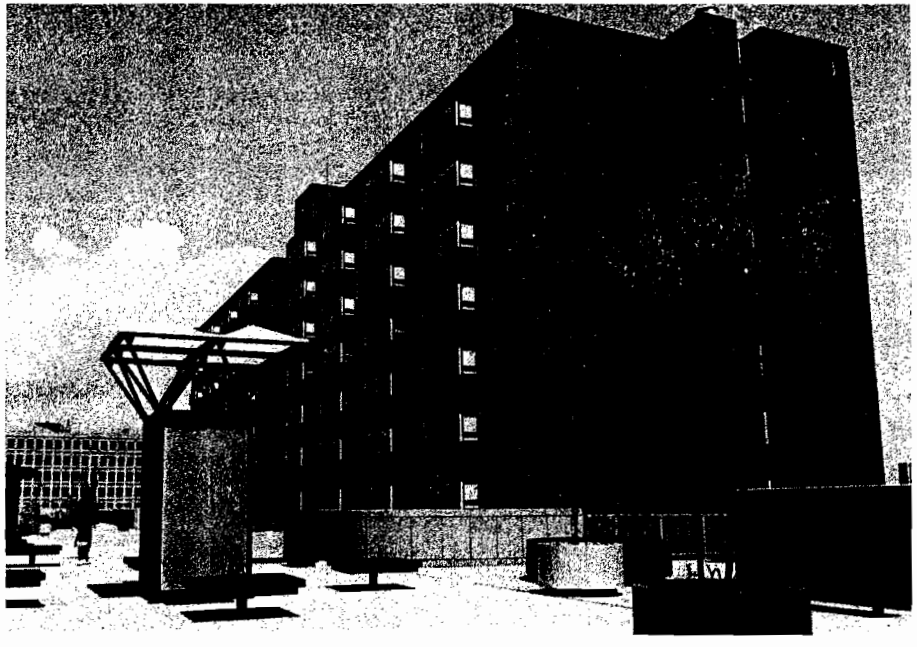


Fig. 19—Finished 9-story ASH building

Weather and Comfort

The prevailing southerly winds carry weather disturbances from the Gulf of Mexico to the Memphis area, depositing an average rainfall of 50 inches. Summer temperatures average 80°, winter temperatures 43°. To combat the average relative humidity of 70 percent in combination with the higher summer temperatures, all units on this site have air conditioning. Children use a large fountain as a wading pool. Although Memphis generally does not have a severe air pollution problem, exhaust from nearby traffic is sometimes evident.

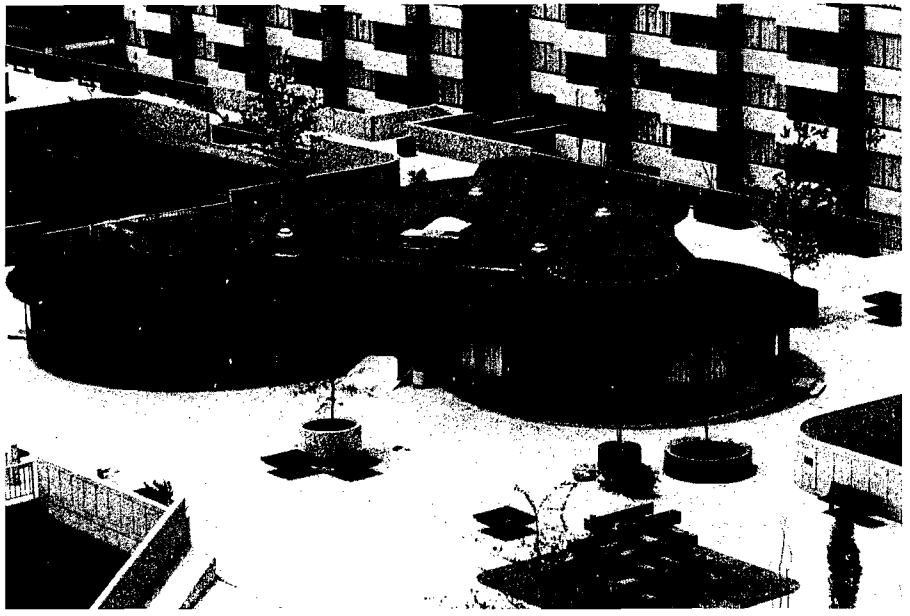


Fig. 21—Community center on the spine

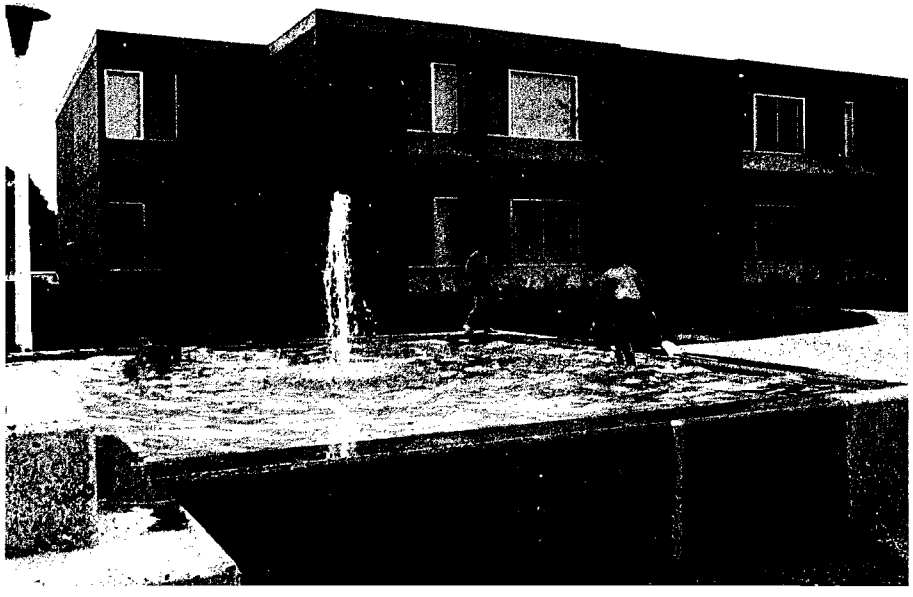


Fig. 20—General Electric units and adjacent courtyard

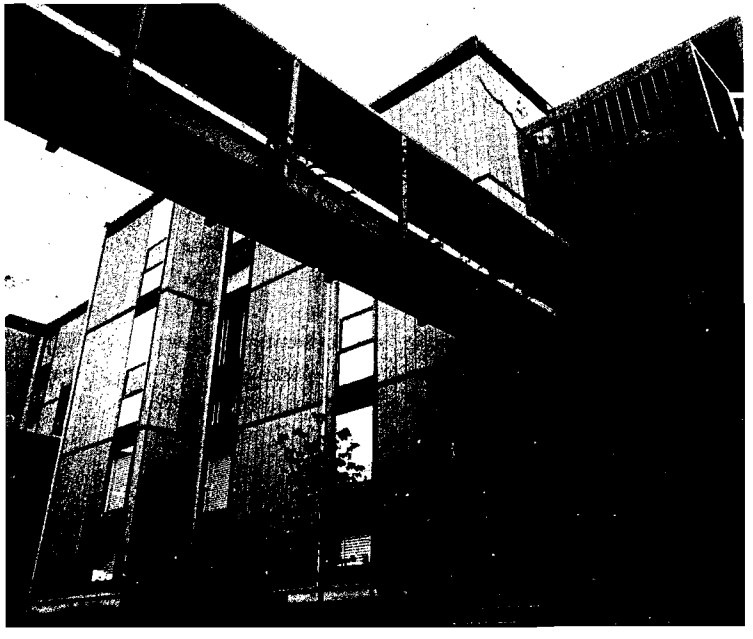


Fig. 22—Boise Cascade units with connection to spine

Fig. 23—Berm at southwest corner of site

the community center, and the acoustical berm. The spine serves as a unifying element. It allows non-interfering vehicle access and pedestrian open space in the interior of the site. It provides a cover for parking and a platform for community facilities—among them the activity building, with meeting rooms, a self-service laundry, and recreational areas. The berm, adjoining the spine, protects the residents from traffic noise. An acoustics consultant verified its effectiveness by taking measurements at six locations before and after development. The initial survey showed that noise levels exceeded the HUD/NBS interim standards of normal acceptability, i.e., 65 decibels for more than 8 hours in a 24-hour period. Following the completion of construction, these levels ranged from 53 to 58 decibels, a significant decrease. For example, the berm reduced the sound of a passing truck about 17 decibels. This lower noise level has become an important marketing asset. Taken all together, the BREAKTHROUGH site's amenities result in a fine in-city living environment.

GTR for site development – W. Wilcox
GTR for planner – M. Chateauneuf
STR – R. Hall
ACO – D. Murray
Director of OBR - J. Mills

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM August 1970:	Start site preparation	9-70
	Start housing construction	1-71
	Finish housing construction	3-72
	End demonstration/marketing	7-72
Interim CPM May 1971:	Start site preparation	12-70
	Start housing construction	6-71
	Finish housing construction	6-72
	End demonstration/marketing	Unknown
Actual Performance:	Start site preparation	12-70
	Start housing construction	6-71
	Finish housing construction	9-73
	*End demonstration/marketing	9-73

*All units turned over to owners 2-73

NOTE

FCE-Dillon and the ASH builder signed turnkey contracts with the owners—Memphis Housing Authority and ASH of Memphis, respectively—not with BREAKTHROUGH.

HSP COSTS

(dollars in thousands)

Producer	Cost
ASH	$2,483.0
Boise Cascade	2,289.6
FCE-Dillon	3,471.5
General Electric	1,296.7
Not contracted to HSPs	14.3
Total	$9,555.1

HOUSING SYSTEM PRODUCER SCHEDULES

(ASH)	144 Multi-Family High Rise	
Phase II Contract: (see note)	Not with BREAKTHROUGH	
Actual Performance:	Start foundations	3-72
	Start erection	N/A
	Complete erection	N/A
	Finish units	5-73
FCE-DILLON, INC.	206 Multi-Family High Rise	
Phase II Contract: (see note)	Not with BREAKTHROUGH	
Actual Performance:	Start foundations	7-72
	Start erection	2-73
	Complete erection	3-73
	Finish units	9-73
BOISE CASCADE HOUSING DEVELOPMENT	69 Single Family Attached 51 Multi-Family Low Rise	
Phase II Contract:	Start foundations	1-72
	Start erection	3-72
	Complete erection	5-72
	Finish units	6-72
Actual Performance:	Start foundations	1-72
	Start erection	4-72
	Complete erection	10-72
	Finish units	2-73
GENERAL ELECTRIC COMPANY	48 Multi-Family Low Rise	
Phase II Contract:	Start foundations	6-71
	Start erection	9-71
	Complete erection	11-71
	Finish units	2-72
Actual Performance:	Start foundations	6-71
	Start erection	9-71
	Complete erection	11-71
	Finish units	4-72

SITE IMPROVEMENT COSTS

(dollars in thousands)

Item	Cost
Spine	$ 872.9
Sidewalks	65.6
Site preparation	213.9
Site amenities	96.8
Water and sewers	212.8
Lighting	31.3
Landscaping	79.6
Activity building	94.8
Miscellaneous	8.7
Total	$1,676.4

Fig. 24—Memphis site costs and schedules

3-31-75

Indianapolis, Inc

Indianapolis

Site Location: W. 21st St. & N. Tibbs Ave.

Prototype Site Developer: Urban Systems Development Corporation (USDC)

Prototype Site Planner: Skidmore, Owings and Merrill

Housing System Producers: FCE-Dillon, General Electric, Home Building, Material Systems, National Homes, Pantek, Pemtom, Scholz

Total Housing Units: 295

Introduction

The Indianapolis BREAKTHROUGH site is located about four miles from downtown on the northwest periphery of the city, adjacent to the Indianapolis Motor Speedway, scene of the famous 500-mile race. Before BREAKTHROUGH, the site itself was an open field in a neighborhood of modest single family homes.

Many building configurations and the flat, featureless land required a creative site plan to be workable and aesthetically pleasing. Despite varied problems during development, the finished project—now called Park Lafayette—has received a national design award.

Unit-by-unit sales began in June 1972. Results were such that HUD changed the marketing policy and sold the entire site at the end of the year. Adult Student Housing of Indianapolis, Park Lafayette Limited, and Park Lafayette Incorporated now own and operate various aspects of the BREAKTHROUGH project. Many of the 1,400 residents attend nearby universities; 192 townhouse and apartment units are rented to students. There are 103 single family detached units rented on the open market.

Cover:

Park Lafayette is a collection of five small, distinct neighborhoods. Each contains about 50 units oriented to a central court. The discontinuous road network, one of the site's major design features, provides entry to specific points while eliminating through traffic.

The planner designed the 42.9-acre BREAKTHROUGH project to be the self-contained first stage of an ultimate 120-acre development. A public park was built adjacent to the southeast corner of the site by the city.

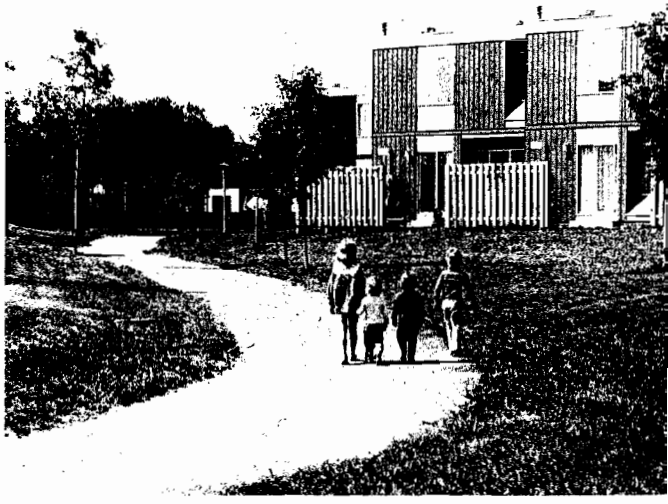
A dispute over land acquisition threatened to divide public opinion even before site work could begin. However, the support of UNIGOV (the metropolitan Indianapolis government) prevailed, and Mayor Lugar led groundbreaking ceremonies on December 16, 1970. Some stubborn resistance to BREAKTHROUGH lingered on, more an embarrassment than a hindrance.

When site preparation started in the spring of 1971, an important job was the ambitious ground sculpturing, planned to give visual interest to the existing flat terrain.

Indianapolis had more housing producers—eight—than any other BREAKTHROUGH site. One result is the wide variety of architectural styles, some of them in clear contrast to the usual midwestern homes.

Open space served as a design element for structuring the complete development. The park-like areas knit the site together.

Housing construction at Indianapolis began in August 1971 and continued through the difficult winter weather. Six of the eight systems used volumetric modules, which lend themselves to rapid erection. Finishing operations extended completion of all 295 units until mid-1973.



Pathways run throughout the site, connecting open spaces and living areas. Overall density is 6.9 living units per acre.

Background

Indianapolis, a steadily developing city of about 900,000 people, has a balanced and diversified economy combined with a growing manufacturing base and an unusually large service sector. The city's location on a flat plain presents few natural barriers to expansion. Generally, Indianapolis is cautious about undertaking large-scale, federally-assisted programs. In a sense, it learns from the mistakes of others, and by the time of Operation BREAKTHROUGH, Indianapolis had smooth-running urban renewal, public housing, and Model Cities programs as well as other public assistance efforts.

In September 1969, Mayor Richard G. Lugar offered HUD 10 places near Indianapolis for consideration as BREAKTHROUGH prototype sites. These were reviewed by HUD's selection committee, and Secretary Romney announced the chosen site in January 1970.

The site is located within city limits on a 160-acre tract of land about 4 miles northwest of downtown Indianapolis. This puts it within a 15-minute drive, at any time of the day, from the downtown City-County Building or the metropolitan airport to the southwest. The Indianapolis Motor Speedway is a half-mile away.

This property has an interesting history. Marion County originally bought it in 1832 as the intended location for the County Poor Asylum, but it became a paupers' graveyard, though never deeded as such. In 1937, the land was given to the State as a site for the Central State Hospital rehabilitation center and farm for mental patients. In 1967, the Indiana General Assembly returned the land to the county with the condition that 40 acres be leased to the Marion County Association for Retarded Children. On that leasehold, which is the northeast corner of the 160 acres, the association built a school.

The abandoned buildings of the former State farm were clustered in the northwest quadrant. Overall, the site was relatively flat, with some large trees near the farm buildings and a few others on the periphery. Gas, water, electricity (including street lights), and telephone services were available and could be extended onto the site. However, sanitary and storm sewer systems were not in and would have to be installed by the developer and turned over to the city upon completion for operation and maintenance.

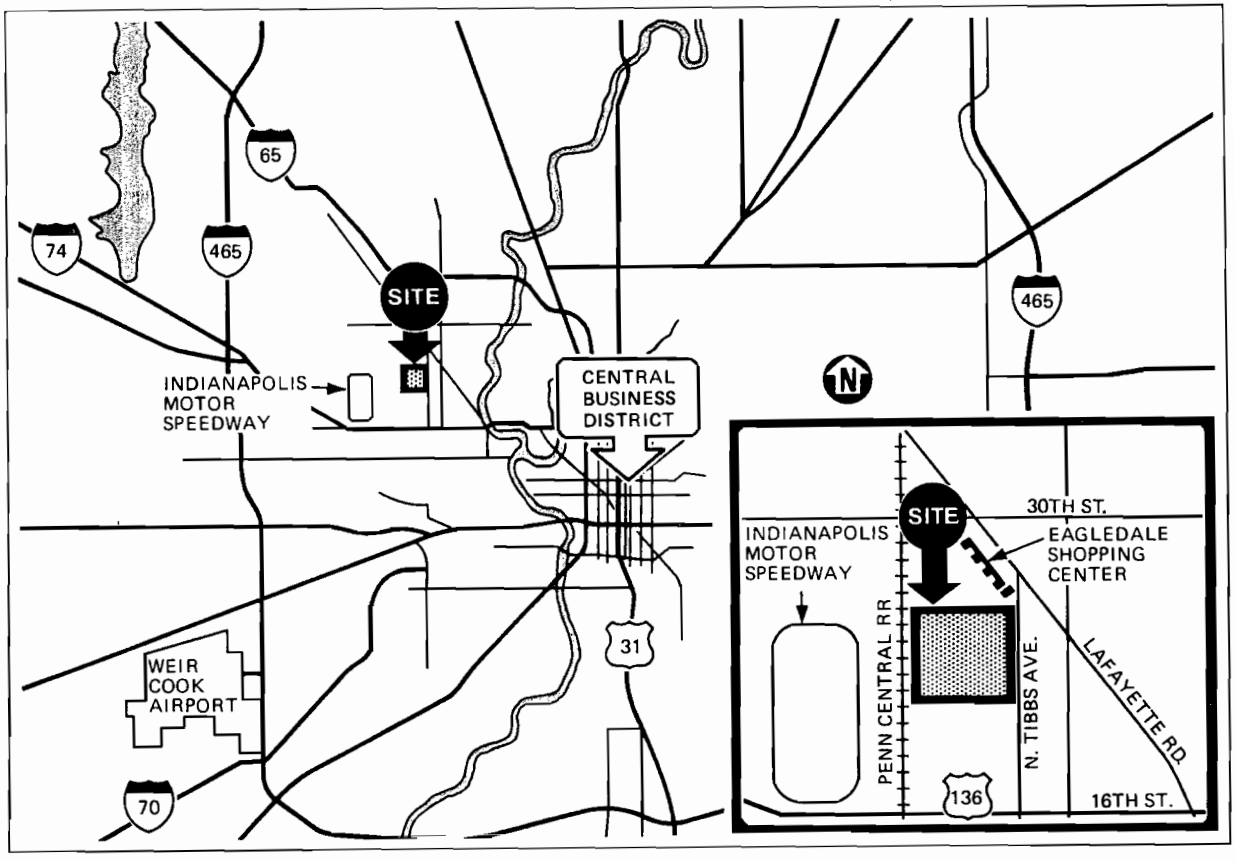


Fig. 1—Indianapolis and the BREAKTHROUGH neighborhood

The area surrounding the site on all sides is permanently developed and not likely to change in the near future. The Standard Oil Company tank facility to the north is a well-maintained operation with low employment and little traffic. It creates no smoke or noise problems. Located alongside the tank storage is the Eagledale shopping center, which includes a wide variety of shops. On the west is the Penn Central Railroad, carrying an average of two high-speed freight trains per day. Beyond the railroad is a public golf course belonging to the Speedway and, beyond that, the race track itself.

To the east across Tibbs Avenue and south across

21st Street there are large, lower-middle class neighborhoods made up of single family homes built in the late 1940s and the 1950s, standing on 4,000 to 7,000 square foot lots. These are small, mostly wood-framed houses in the $9,000 to $15,000 range (1970 prices). Some are well maintained and show their owners' pride in possession; a few are run-down, with unkept lawns sprouting around battered automobiles. Traditionally, housing turnover has been low, with many original owners still in residence.

Pre-Development Activity

HUD selected Skidmore, Owings and Merrill of Washington, D.C., to be the Prototype Site Planner (PSP) for the Indianapolis BREAKTHROUGH site. The PSP contract (H-1204) was dated January 12, 1970. Serving as principal consultants to the planner were: Marcou, O'Leary and Associates (planning and development programming); Jeperson-Kay Systems, Inc. (building systems consultants); and Snyder, Blackburn Associates (architects).

Skidmore, Owings and Merrill (SOM) directed its initial effort toward the preparation of a conceptual plan. This required making a number of concurrent studies on the physical characteristics of the site, the metropolitan housing market, neighborhood characteristics, and circulation patterns. An important element of the planning at this point involved liaison with the community and the local government officials. Their input and cooperation were essential if the ultimate project was to succeed. Heavy emphasis was placed on providing a BREAKTHROUGH project that would respond to the community's needs and concerns.

Local involvement with the planning process began with briefings that SOM gave to the mayor and his key staff members on the intent, scope, and potential impact of BREAKTHROUGH on Indianapolis. These were followed by presentations to community leaders and later to concerned citizen groups. Information released to the mass media focused initially on the planned development and overall aspects of the BREAKTHROUGH program.

SOM first conceived of the BREAKTHROUGH site as a prototype community of about 150 to 200 dwelling units. The planner envisioned a second step, using Phase III housing systems, to create a ultimate development of 800 to 900 units with complete recreation facilities, a community center, and schools. These facilities would have been used both by BREAKTHROUGH site residents and the people in the neighborhood. This rather extensive concept went through many evolutions before preliminary planning of the site was completed.

All through the planning stage, three vital points were emphasized in briefings and news releases regarding the disposition of the completed BREAKTHROUGH project. There would be no public housing or high-rise buildings, the majority of the units were to be single family dwellings, and all units would

Fig. 2—Site before start of construction, early 1971

be sold to individual buyers.

Other important actions were necessary early in the project's development. An ordinance of cooperation was required from the responsible authorities, the land had to be zoned for the use intended, and the property had to be acquired.

Acquisition of land for the site was a problem, partly because of fragmented responsibilities in the interim UNIGOV. However, the mayor and the director of the Department of Metropolitan Development were deeply committed to the project and, at the local level, they were BREAKTHROUGH's most active and effective supporters. One local television station supported BREAKTHROUGH, and the two newspapers were divided.

On February 16, 1970, the joint city-county council passed a special resolution (signed by the mayor two days later), pledging the cooperation of the City of Indianapolis with HUD for the development of the BREAKTHROUGH project. An important part of the resolution granted such variances from the building, housing, and other codes and regulations as might be necessary for construction. In March, the Division of Planning and Zoning of the Metropolitan Development Commission approved SOM's application to rezone the site from its designation of A-2, Agricultural, to a classification that allowed a planned unit development.

SOM evolved a master plan (Fig. 3), in which BREAKTHROUGH, as a first stage, would develop approximately 43 acres of the southeast quadrant of the 120-acre site. The 300 housing units were distributed about as follows: 35 percent single family detached, 25 percent single family attached, and 40 percent multi-family low rise. Density was comparable to that of the surrounding neighborhood. The external and internal circulation systems were designed to reduce vehicular traffic flow within the site and to increase pedestrian safety.

The master plan included community facilities, a school, and a park to serve not only the BREAKTHROUGH residents but also the surrounding neighborhood. Location of the community center was determined by the overall needs of the ultimate 120-acre site. Open space became a major design element of the site plan.

HUD originally assigned nine Housing System Producers (HSPs) to Indianapolis: Ball Brothers Research Corporation (the system later called Pantek), Forest City Enterprises (later FCE-Dillon), National Homes, Pemtom, Scholz, Home Building Corporation, Material Systems Corporation, TRW Systems, and Republic Steel. In October 1970, HUD's Operation BREAKTHROUGH Washington, D.C., headquarters (OBW) held a site review meeting with the planner and the developer. After studying the proposed site mix and HSP assignments, the group decided to delete TRW and Republic Steel because of cost limitations. Since General Electric wanted to demonstrate its system at Indianapolis, and its cost estimates were within the budget, OBW named GE as the eighth producer.

Site Plan

The site plan focused on the need to consider the BREAKTHROUGH project as a community within a community rather than a collection of individual dwelling units. During conceptual planning, SOM identified the design parameters that would influence the site plan:

- Community concerns
- Efficient patterns of land use, density distribution, circulation, and use of open space
- Harmonious integration of the diverse physical forms of the many different housing systems
- Continuity of development from the 42.9-acre BREAKTHROUGH project into the 120-acre ultimate site

Two community concerns became major design inputs to the site plan. The first was to provide organized recreation space that the surrounding area almost totally lacked. The second was to provide owner-occupied rather than rental units.

A public park, to be shared by BREAKTHROUGH and neighboring area residents, was located on a 10-acre tract in the southeast corner of the site. The park was to be constructed, owned, and maintained by the Indianapolis Department of Pools and Recreation. It would include outdoor athletic fields, a picnic area, and playground equipment.

Facilities built on the BREAKTHROUGH site itself for the exclusive use of BREAKTHROUGH residents are small tot lots in each residential cluster, and a community center. The latter, placed with regard for the ultimate development, comprises a clubhouse and swimming pool. A management office is provided in the clubhouse for maintenance and sales functions.

As planning progressed, there were many changes in the site mix, but the high proportion of single family dwellings answered local concern about home ownership. The final figures showed 82 percent single family units and 18 percent multi-family units. The design put the SFDs on the outer fringe of the BREAKTHROUGH development to provide an easy transition from the single family dwellings in the existing community to the site's higher-density SFAs and MFLRs.

The placement of dwellings created small, distinctive courtyard neighborhoods which contain about 50 units each. SFDs are set on minimum lots; some have one building wall forming a property boundary (the zero lot line concept). Compact private yards, defined by adjacent structures, save enough land area to allow a substantial open space or court in the center of each housing cluster. Apartments and townhouses are adjacent to the major interior open spaces. This arrangement meets the design goal of providing a variety of housing types and densities in a single coherent

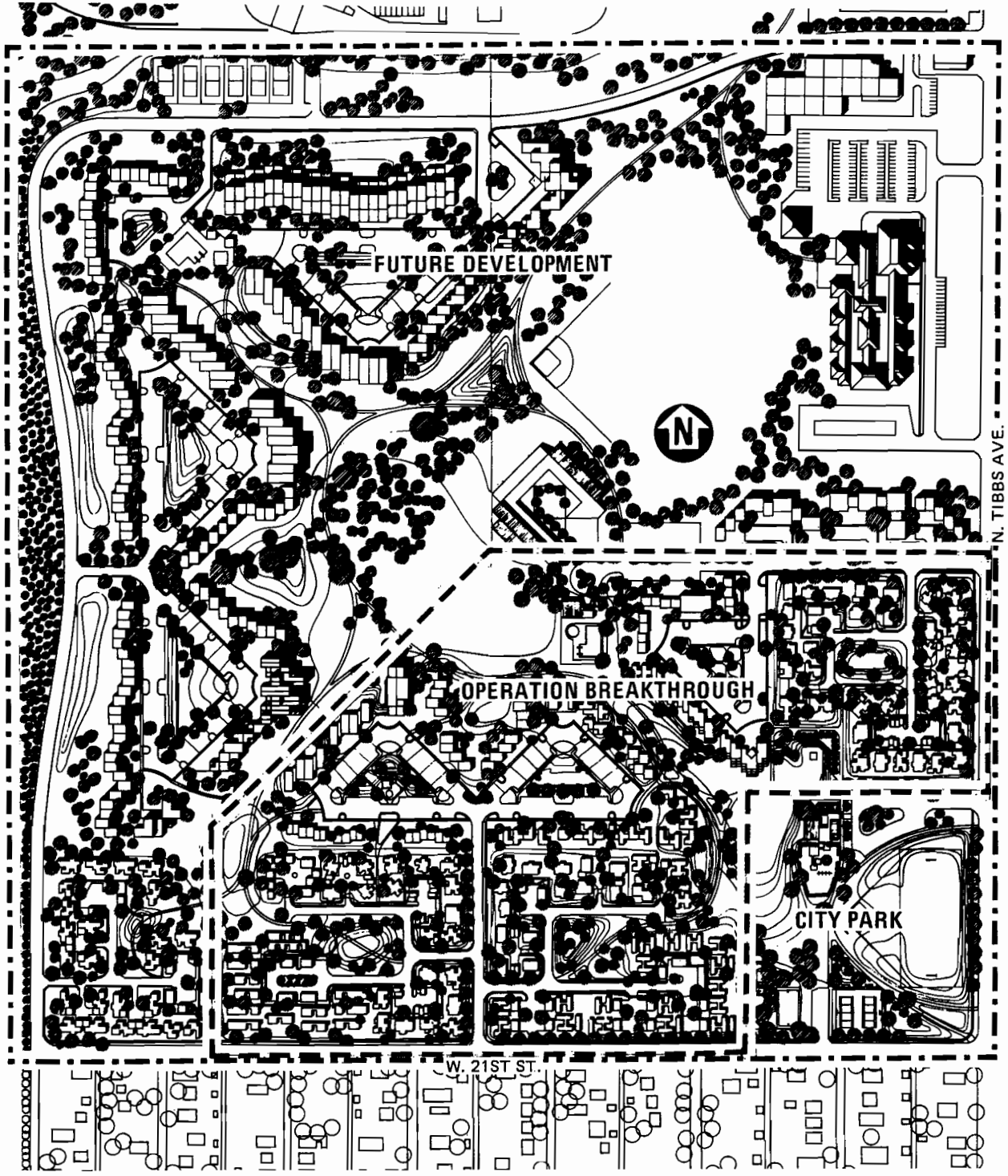


Fig. 3—Master plan for 120 acres, including BREAKTHROUGH

neighborhood.

An extensive open space network is the major factor organizing the site plan. It frames and unifies the placement of the various housing systems, the roads, the walks, and the other ancillary elements. A connecting series of park-like areas links all parts of the site and leads to the community center on the north and to the city park at the southeast corner. An internal pedestrian system with an 8-foot-wide asphalt pathway runs throughout, separated from vehicular traffic. Landscaping with trees and shrubs along the edges further defines the site and punctuates points of entry.

Because of the naturally flat land, the plan called for extensive artificial contouring to create interest. Grading separates the parks from the housing and allows distinct and natural congregation areas. The continuous flowing contours also help tie together the diverse forms of the many different building systems. Contouring in the SFD areas of Home Building, Pantek, and Material Systems increases from subtle to pronounced as one moves toward the interior of the site. In the center of the site, the Pemtom units are placed along a low ridge line. An elevated grade provides a second floor entrance to the five-story FCE-Dillon building.

One of the unusual and most discussed elements of the site is the discontinuous internal road system. Each road leads to a housing cluster (or to the community facility) and terminates at a parking lot, eliminating through traffic. City streets form an exterior loop allowing entry only to specific site destinations. Through minimum right-of-way widths and careful layouts, about 18 percent of the land is used for roads and parking—less than half the area used in conventional subdivisions of comparable density. Parking space was allocated throughout the site on a basis of two cars per dwelling.

The plan reflects other considerations as well.

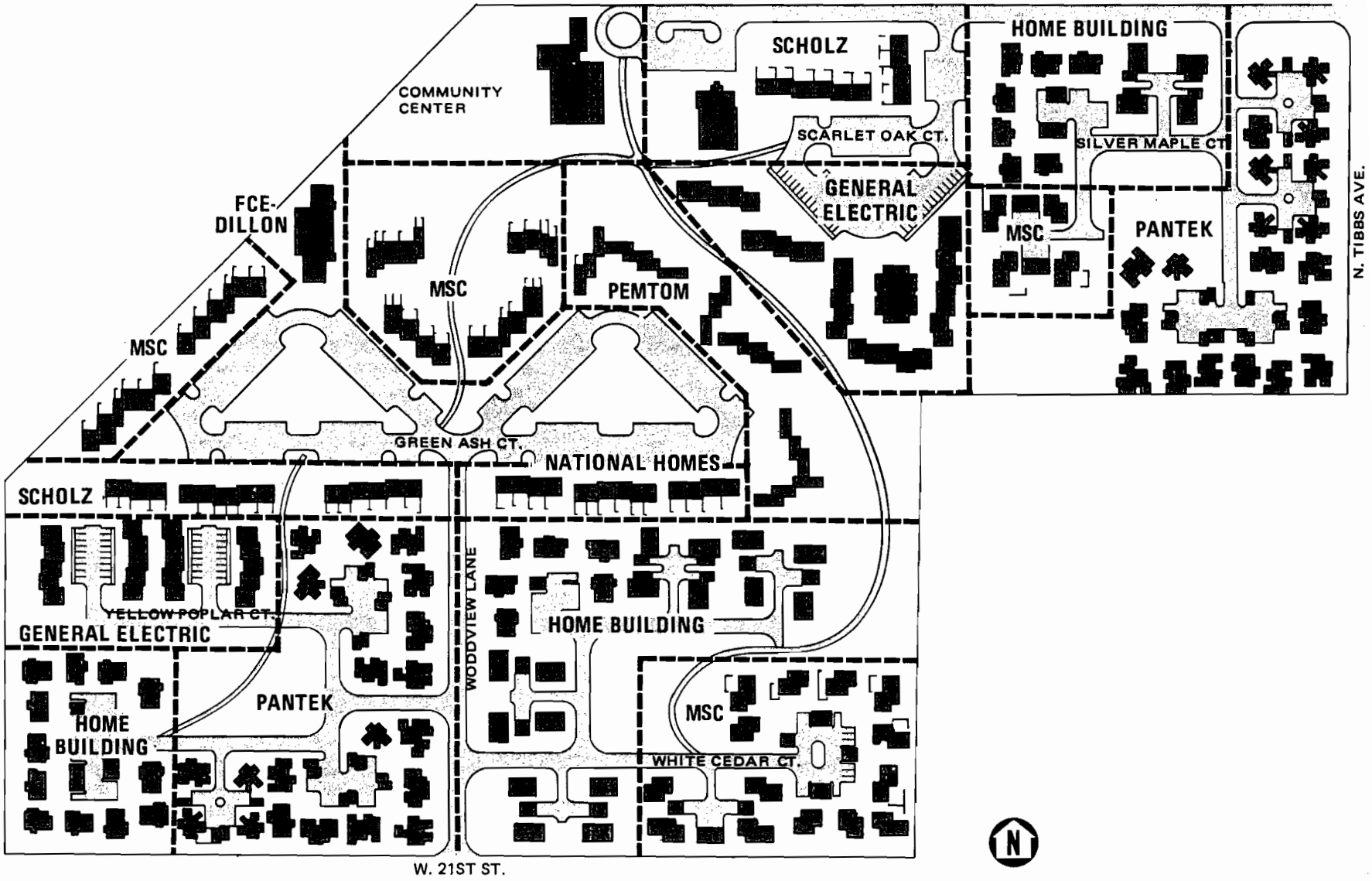


Fig. 4—Site plan as built

Because the site was to be a showcase for housing systems, it was desirable that a wide range of systems be easily viewed from a central location. By preparing a master plan for the entire 120-acre tract, SOM intended that future development would follow as a logical extension of the 42.9-acre BREAKTHROUGH site. To avoid increasing the burden on the community's existing schools and parklands, that plan included major educational and recreational facilities. The basic criteria that were followed in the detailed design of the BREAKTHROUGH project were also intended for the planning of the remainder of the site.

The Indianapolis BREAKTHROUGH site won the Honor Award from the American Institute of Planners during its 1972 annual convention. Features judged included design elements of the site as well as the residences.

Housing Systems

Indianapolis had the largest number of HSPs assigned to a single site in the entire Operation BREAKTHROUGH program (Fig. 5).

FCE-Dillon, Inc., demonstrated a housing system that combines panels and utility modules of pre-cast concrete with poured-in-place concrete. The firm and its subcontractor made the pre-cast items—including deck, wall, and ceiling panels; kitchen-bathroom modules; elevator shaft modules; and stairways—in factories at Akron, Ohio. The panels were cast with hollow sections, which not only reduced the weight to be handled during erection, but also acted as forms for the site-placed concrete that bonds the walls and floors together in a monolithic five-story structure. The major innovative feature of the system is the factory-built utility module.

Home Building Corporation's (HBC) housing system consists of factory-built, wood-framed modules. Complete factory finishing included central air conditioning, heating, plumbing, carpeting, and appliances. Wall sections are a conventional type designed to provide thermal control; outside walls are insulated with glass fiber batts. Interior wall surfaces are gypsum board. The system makes extensive use of gluing to eliminate "nail popping" and achieve greater structural rigidity. HBC delivered the 12-foot-wide box modules by trailer from its Sedalia, Missouri, plant. At the site, the modules for each one-story SFD were placed 3 feet apart on the foundations, the gap then being closed with pre-cut components to create interior hallways.

National Homes Corporation used factory-built, steel-framed box modules with aluminum-clad siding and wood trim. Plumbing, electrical services, appliances, and carpeting were installed at the company's Lafayette, Indiana, plant. The main innovation was the use of steel floor joists and wall studs with nailers to facilitate intermodular connections. After delivery to the site by truck, the modules were joined in a conventional manner to form two-story townhouses.

The Scholz Homes, Inc., units are assembled from factory-built, wood-framed box modules, made at the Stiles-Hatton plant in Grand Rapids, Michigan, and shipped to the site by truck. Interiors were completely finished, except for rugs, in the factory. Exterior siding and trim were site-installed. The design permitted considerable flexibility in architectural treatment through the use of a variety of materials and finishes. On the apartments (MFLR), the steeply pitched roofs were "stick-built" at the site; these structures and some townhouses are of the colonial style, with louvered shutters and stone facing. Other townhouses have a contemporary appearance. All Scholz buildings are two stories high.

	FCE-DILLON				GENERAL ELECTRIC				HOME BUILDING				MATERIAL SYSTEMS				NATIONAL HOMES				PANTEK				PEMTOM				SCHOLZ			
	1BR	2BR				2BR	3BR	4BR			3BR	4BR		2BR	3BR	4BR		2BR	3BR	4BR			3BR	4BR		2BR	3BR			2BR	3BR	4BR
SFD (103)											28	17			11	7							26	14								
SFA (140)							32	16							12	16	4		4	8	2						6	14			8	9	9
MFLR (16)						8																									6	2
MFMR (36)	30	6																														
Totals (295)	36 UNITS				56 UNITS				45 UNITS				50 UNITS				14 UNITS				40 UNITS				20 UNITS				34 UNITS			

Fig. 5—Housing unit mix

Pemtom, Inc., designed a two-story, wood-framed housing concept called UNIMOD. During the Phase I design period, it became apparent that the original concept, which relied upon stressed-skin panels for walls, floors, and ceilings, would have to be abandoned because the long life qualities of the adhesive used could not be tested and proven within the BREAKTHROUGH program time period. In February 1971, Pemtom began work on UNIMOD 2, using a more conventional means of structural assembly. The company set up a factory about 30 miles away specifically to manufacture the BREAKTHROUGH units for Indianapolis and anticipated Phase III business.

The Pantek Corporation housing system is based on a structurally sound, load-bearing panel that can be erected with unskilled labor, by hand or with light equipment. The panel consists of two 4' x 8' sheets, one 5/16" plywood and the other cement asbestos board, with low-density polyurethane foam placed between for insulation. Exterior cement asbestos surfaces were coated at the factory with a mixture of epoxy and stone aggregate; interior plywood, with field-applied gypsum wallboard. Aluminum extrusions frame each panel and serve both as edging and as part of the panel locking system. Interior wall panels and Bucoa steel pans for ceiling and roof sections complete the basic package. Pantek's structural components were manufactured in the Ball Corporation plant at Muncie, Indiana, and shipped to the site by truck. Ground level floors are concrete slabs on grade. In two-story dwellings, steel joists and plywood subfloors make up the second level. Heating-ventilating-air conditioning ducts are under the floors. The HVAC unit itself is located in the master chase of the service area, along with the plumbing tree. Raceways within the wall panels carry electrical, telephone, and television circuits throughout the house.

The General Electric Company system consists of factory-built volumetric modules which contain all electrical, heating/air conditioning, and plumbing systems. The structure employs steel framing members and wood for exterior siding, floor panels, roof/ceiling sheathing, and stairways. All sheathing, siding, and paneling materials are attached to framing members, providing stressed-skin structural strength. A unique feature of the system is the use of cast plaster walls. The plaster is 5/8" thick and is fastened by punched loops on the steel studs. GE manufactured its modules in a plant at King of Prussia, Pennsylvania, and shipped them to Indianapolis by railroad (Fig. 6).

Material Systems Corporation (MSC) probably employed the most innovative materials and fabrication methods of any HSP on the site. The system uses a plastic composite material formulated from a blend of polyester resins, reinforcing fibers, and special additives. The basic construction element is a self-framing, full-load-bearing panel, made by chemically bonding thin skins of the composite material to structural corrugations of the same substance. Vertical cavities between corrugations are filled with insulation to provide the desired levels of fire resistance and thermal insulation. MSC set up a branch factory in Indianapolis to assemble box modules from the panels, which were fabricated in the company's home plant at Escondido, California. (The later SFA modules were assembled at Sacramento and shipped to Indianapolis by rail.) Conventional wood joists and plywood were used for the floor system. Wiring, plumbing, and appliances were added to complete the module, which was emplaced with others at the site in the usual manner to form a living unit.

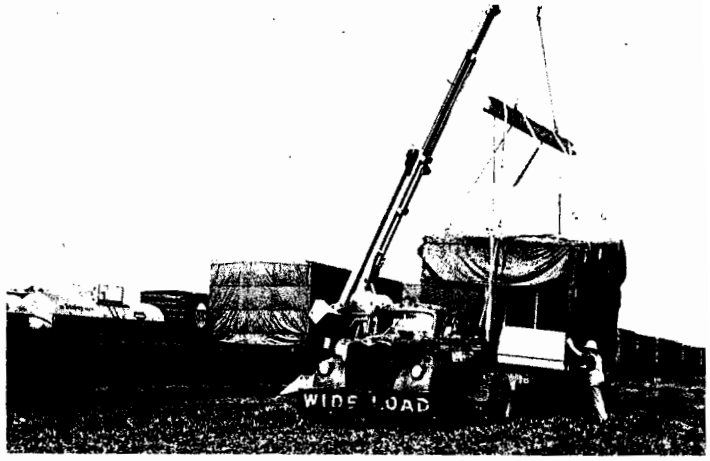


Fig. 6—Unloading General Electric modules from rail cars

Prototype Site Developer

For the developer's role at Indianapolis, HUD selected the Urban Systems Development Corporation (USDC), a subsidiary of Westinghouse Electric Company. USDC had an industrialized housing product line and experience as a general contractor on military housing projects.

A two-year Prototype Site Developer (PSD) contract, H-1383, was signed on July 10, 1970. USDC subcontracted with two local firms, College Park Corporation and a subsidiary, Manageers, Inc., for efforts such as site improvements, marketing, and security services.

USDC did the initial planning at its Arlington, Virginia, headquarters. On July 16, the developer moved the operation to Indianapolis and set it up

temporarily in an office of the parent company. The subsequent move into on-site trailers was delayed until January, 1971.

Program disruptions caused by land acquisition and site design changes placed a premium on flexible development planning. Financing arrangements, contract packages, and scheduling were particularly sensitive areas. USDC, based on extensive experience with PERT (Program Evaluation Review Technique) scheduling methods, prepared a very detailed computer-programmed PERT chart for use as a management tool.

Activity lines for all site development work, housing systems construction, and supporting functions were displayed. USDC maintained this chart along with others and, throughout most of the construction period, held weekly meetings for the purpose of coordinating site work. Key members of the developer's staff and representatives from all the contractors working on the site attended.

After extending the original PSD contract to April 1973, HUD replaced USDC with the Boeing Aerospace Company, functioning as Master Site Developer at all nine BREAKTHROUGH locations across the country.

Land Acquisition

Land acquisition was a long process at Indianapolis. The Marion County Commissioners, holding title to the land, steadfastly declined to release it to HUD, the city, or anyone else for use in the BREAKTHROUGH program. This problem did not become a critical issue until early July 1970, when the three county commissioners went on public record as opposing BREAKTHROUGH. The director of the UNIGOV Department of Metropolitan Development contended that he had received an earlier oral commitment from one of the commissioners to the effect that the county would give the city 40 acres of the 160-acre State farm tract for the project. The commissioner in question denied this and stated that no one had ever discussed BREAKTHROUGH with him and the only thing he knew about the project was what he read in the papers.

During the last week of August, the Greater Indianapolis Housing and Development Corporation, a quasi-governmental umbrella agency for nonprofit housing organizations, made a purchase offer of $197,450 to the county commissioners. The funds backing the offer came from the PSD, which in turn had obtained the funding from HUD. It was hoped the commissioners might be willing to accept money from private firms, where they would not deal directly with the federal government. However, the commissioners rejected the offer.

This stalled the project and nullified earlier predictions by the mayor that houses would be ready for public viewing in May 1971. During a meeting on September 29, the mayor appealed to Indiana Governor Whitcomb for assistance. The governor responded on October 21 by asking HUD Secretary Romney to intervene and use the federal power of eminent domain to acquire the land through condemnation proceedings. This was done by a "quick take" action, and on November 18, Federal Judge William Steckler signed an order giving HUD immediate possession of 42.9 acres of land for Operation BREAKTHROUGH. Title was transferred to HUD upon deposit with the county of a check for $213,000. (The total price ultimately paid was $313,000.) On December 7, 1970, HUD transferred the title to BREAKTHROUGH of Indianapolis, a special purpose organization (SPO) established by the developer solely for the purpose of building the Operation BREAKTHROUGH site in Indianapolis.

The county commissioners objected strongly to what they called a "land grab" by the federal government and filed a lawsuit contesting the action. Resolution of the case dragged on until February 1972, when the newly appointed successors to the protesting commissioners voted to drop the matter.

Financing

Financing for the Indianapolis BREAKTHROUGH site was obtained only after several sources had been investigated. HUD attempted to put together a national package for the entire BREAKTHROUGH program while the Indianapolis developer discussed local funding with a USDC subsidiary. These negotiations were not fruitful.

Late in 1971, HUD and USDC arranged for funding. National Homes Acceptance Corporation agreed to provide construction financing for the development, with FHA insuring the loan under Section 233 pursuant to Sections 213 and 234 of the National Housing Act. As a SPO, BREAKTHROUGH of Indianapolis was eligible for these FHA programs. Marketing plans had reached the point of determining that the project would be divided into a cooperative (covered by Section 213) and a condominium (Section 234). Thus, there were actually two mortgages, one for the cooperative and another for the condominium.

The developer initiated two other SPOs—Park Lafayette Cooperative and Park Lafayette Condominium—to supersede BREAKTHROUGH of Indianapolis upon mortgage closing. ("Park Lafayette" had been chosen as the name of the project.) Pending property litigation delayed that event until February 10, 1972, when both mortgages were endorsed with provisions for 7 percent interest, a 2-year construction period, and 40 years for amortization. The mortgages permitted take out loans on individual properties, with the result that home buyers could arrange their own financing through FHA, Veterans Administration, or conventional lending sources.

Site Preparation

The developer's schedule called for gaining clear title to the land and breaking ground in September 1970. This would have allowed substantial site work to be done and some demonstration units to be erected by May 1971, and let Mayor Lugar, as host of the International Conference of Mayors, show his guests some of the BREAKTHROUGH features during the convention that month.

However, the problems with land acquisition delayed groundbreaking until December 6, 1970. This may also have delayed construction as well, but another cause for the late start was modification of the housing mix:

(Date)	(Number of housing units)
December 1970	312
March 1971	242
April 1971	225
May 1971	271
June 1971	239
July 1971	295

These changes affected three critical procedures. First, the planner had to prepare a new site plan and amend drawings and specifications accordingly. Second, a recordable plat of the final site plan had to be submitted to the Department of Metropolitan Development before permits could be issued for construction to begin. Third, several aspects of the contracts that the developer had advertised for bids in the fall of 1970 were invalidated, and some contracts had to be renegotiated.

In addition to resolving these problems, the developer had to arrange a storm sewer easement to cross the properties of the city, the Penn Central Railroad, and the Indianapolis Motor Speedway. USDC later discovered that two buried gas pipelines on the west side of the railroad were in the way of the proposed storm sewer. Neither of the lines, owned by the Buckeye Pipeline Company and the Texas Eastern Transmission Corporation, could be removed. The storm sewer had to be redesigned to cross them. Final letters of agreement from all parties were not received until late June 1971.

In order to include the bulk of the site work under a single contract, the developer prepared and advertised a package that included grading, sewers, roads, water distribution, sidewalks, curbs, and gutters. Of the bids received in November 1970, only one was responsive to the total package, although several bid for various portions. OBW, unwilling to accept a single bidder, directed USDC to split the package and award work to the low bidders on separate jobs. The contracts were signed January 13, 1971, but notices to proceed were withheld until the site plan could be settled. OBW was also concerned about two pending lawsuits: the one filed by the Marion County Commissioners and another brought by Taylor Building Company and Duane Harrington. Plaintiffs in the latter case—a local builder and a resident in the neighborhood of the site—objected to BREAKTHROUGH on a number of issues related to code waivers. Both cases later were dropped, but until it was apparent that they would be resolved favorably, OBW could not approve going ahead on site construction.

Off-site sewer work (Fig. 7) began in late May 1971, and earthwork began on-site early in June. The goal was to get the site ready for the housing producers expected to begin construction in the fall. This goal was met, and by October, grading, sewers, water laterals, utility trenches, and road work had progressed to the stage where all the producers had access to their micro-sites. In fact, MSC, Home Building, and Scholz were already building foundations.

Only a base course was placed on the roads, to provide a wearing surface for access during the winter months. Roads were paved the following spring. Because the site was so flat, the plan called for some contouring to add interest. Figure 8 shows earth fill being stockpiled for later use for that purpose. Most utilities—water, gas, and electricity—shared a common utility trench.

Except for some weather hindrance—usually in the form of mud—site work was accomplished in a routine fashion during the winter of 1971-1972. Construction of community center facilities began in September 1971. Work on the swimming pool was suspended in November and resumed in the spring,

Construction Conditions

The site is nearly level, draining from the northeast to the southwest with a total fall of approximately 20 feet. Soil characteristics vary widely. The stratum just below the thin layer of topsoil is generally less than 10 feet thick and, with some exceptions, suitable for the support of relatively light one- or two-story structures on spread footings. For medium-rise structures with one basement level, it was necessary to place the footings on the denser materials or hardpan normally found about 10 feet below the surface. Frost conditions dictated placing all footings at least 3 feet below the final exterior grade. In some isolated cases, it was necessary to remove the unsuitable loose material and replace it with structural fill. The water table also is variable, being only about 4 feet below grade at the lowest portion of the site, the southwest corner. Elsewhere, it averages some 10 to 20 feet below the surface and, in general, posed no problems during construction.

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM July 1970:	Start site preparation	12-70
	Start housing construction	12-70
	Finish housing construction	5-71
	End demonstration/marketing	6-72
Interim CPM April 1971:	Start site preparation	4-71
	Start housing construction	4-71
	Finish housing construction	11-71
	End demonstration/marketing	6-72
Actual Performance:	*Start site preparation	12-71
	Start housing construction	12-71
	Finish housing construction	1-73
	End demonstration/marketing	5-73

*Groundbreaking took place 12-70.

HSP COSTS
(dollars in thousands)

Producer	Cost
Townland/Boeing	$2,281.0

HOUSING SYSTEM PRODUCER SCHEDULE

TOWNLAND MARKETING AND DEVELOPMENT CORP.

38 Single Family Attached
20 Multi-Family Low Rise
(created land considered equivalent to ground level)

Phase II Contract:	Start foundations	4-71
	Start erection	5-71
	Complete erection	10-71
	Finish units	11-71
Actual Performance:	Start foundations	12-71
	Start erection	3-72
	Complete erection	7-72
	Finish units	1-73

SITE IMPROVEMENT COSTS
(dollars in thousands)

Item	Cost
Site preparation	$122.3
Site amenities	2.9
Fencing and lighting	12.5
Landscaping	15.7
Miscellaneous	1.6
Total	$155.0

Fig. 22—Seattle site costs and schedules

1-31-75

Memphis, Tenn

Memphis

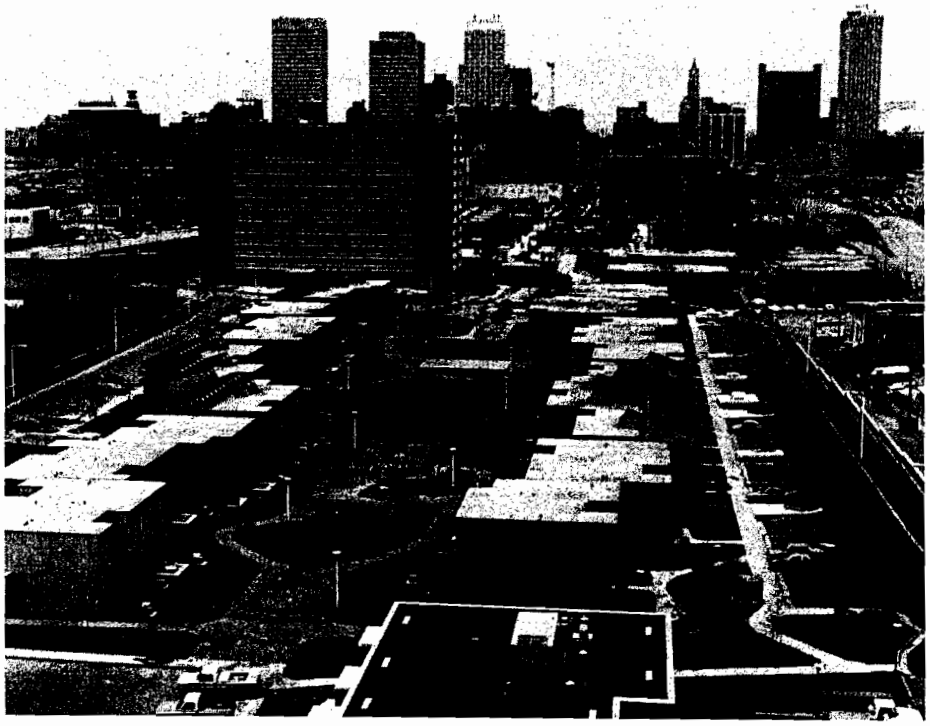
Site Location: Jefferson Ave. & Danny Thomas Blvd.
Prototype Site Developer: Alodex
Prototype Site Planner: Miller, Wihry and Brooks
Housing System Producers: Boise Cascade, FCE-Dillon, General Electric, Adult Student Housing
Total Housing Units: 518

Introduction

Edison Park, the Memphis Operation BREAKTHROUGH site, demonstrates industrialized housing in a diversified urban setting. The mixture of townhouses, high-rise and garden apartments accommodates 800 residents, including medical students, their families, and elderly people.

Four housing systems—three of BREAKTHROUGH design and the fourth built conventionally by Adult Student Housing of Memphis, Inc. (ASH)—make up the 518 living units. The non-BREAKTHROUGH structure replaced one originally assigned to a Housing System Producer (HSP) that withdrew from the Memphis site before erection began. Several such assignment changes slowed the overall development schedules.

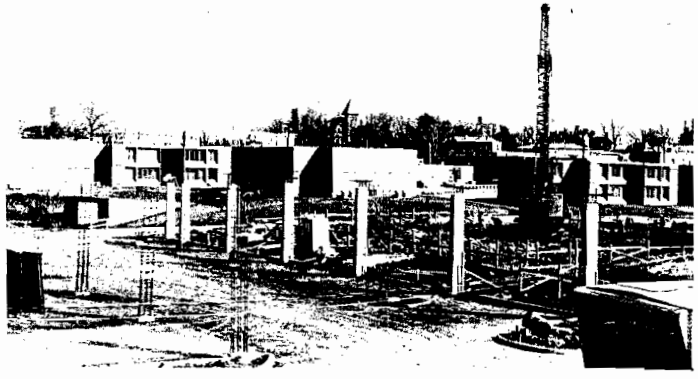
ASH and the Memphis Housing Authority (MHA), which were to become owners of the site, participated in obtaining funds for the later HSPs. MHA contracted with FCE-Dillon directly, as a test of BREAKTHROUGH Phase III, to build a high rise for the elderly. ASH financed its own high-rise building and the General Electric units through the College Housing Loan Program. A limited partnership, Memphis-Cascade, financed the Boise units under the provisions of FHA Section 236.



The site is located a quarter of a mile east of downtown Memphis and adjacent to the University of Tennessee Medical Center. This neighborhood, previously deficient in housing, was ideal for a BREAKTHROUGH demonstration.

Vacant since 1968, the 15.9-acre site was part of Court Avenue III Urban Renewal Area. Bordered by heavily traveled roadways, with noise expected to be a problem, the site was a challenge to the planner.

Site preparation started in December 1970. Poor soil conditions forced the use of piling for the major structures, causing delay and increased costs.



Cover:

Through intensive use of the land, the Memphis site features large amounts of open space for recreation and parking despite a density of 32.6 units per acre.

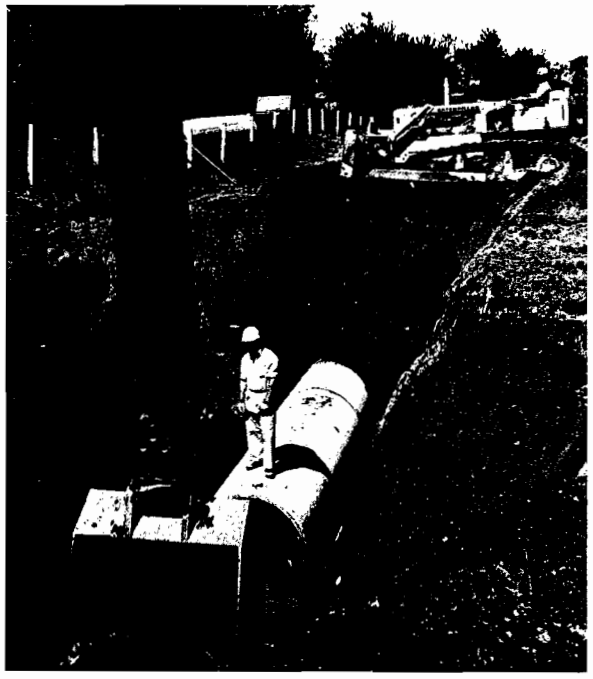


Fig. 7—Storm sewer installation

Fig. 8—Stockpiling for land sculpture

while the clubhouse work went right on through the winter. Both were ready for use by July 1972.

By mid-summer 1972, the site improvements were substantially complete except for the landscaping and some fencing, walks, and patios that had to be done in conjunction with it. The landscaping job extended well beyond the contract completion date and was not finished until October 15, 1973. With this exception, the site was about 95 percent complete by June 1972.

There were 22 contractors performing on-site work during this period. The total value of their contracts was $1.9 million. Additional work done on separate purchase orders brought the total cost of site work to approximately $2 million.

Housing Erection

Indiana has no State law for industrialized housing, so builders must meet a combination of State and local codes. The Indianapolis BREAKTHROUGH project, as a planned unit development, came under the jurisdiction of the Administrative Building Council (ABC), a State agency for structural inspection. In general, ABC requires compliance with the Uniform Building Code. The City of Indianapolis covered sewer, plumbing, and electrical inspection.

HUD and the city both found unsuitable clauses in the resolution of cooperation. Therefore they signed a second agreement on December 4, 1970, with the State concurring. From the standpoint of the HSPs, the most important part of this agreement granted variances to BREAKTHROUGH work.

Two of the eight Indianapolis HSPs (FCE-Dillon and Pantek) used panel systems. The other six (Home Building, Scholz, National Homes, Material Systems, General Electric, and Pemtom) used volumetric module concepts. With minor differences in technique, all the latter systems were erected in a similar fashion. Trucks brought the modules to the site, where large

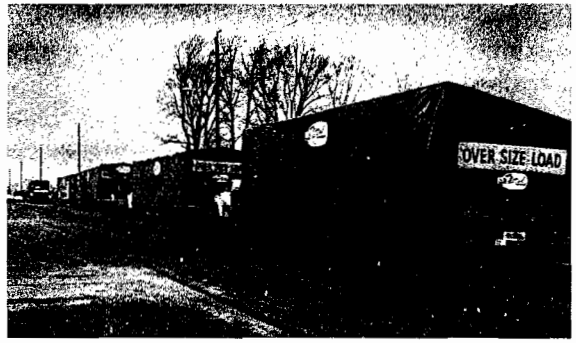


Fig. 9—National Homes modules in transit

cranes, usually of 45-ton capacity or more, unloaded them directly onto a waiting foundation. The rigging for the lift varied with the HSP, but in all cases it was designed specifically for this purpose. Each had straps, cables, or rods suspended from a frame or from a series of spreader bars. The straps in turn attached to the module. National Homes employed the simplest system, a spreader bar with cables connected to removable steel rods that were inserted through the steel rim joists at the ends of the module.

There was some variety in foundations. Scholz used concrete blocks. (Scholz townhouses were the only units in Indianapolis to have full basements, the others providing crawl spaces.) Home Building used concrete footings spanned by steel girders. Material Systems demonstrated pre-cast concrete grade beams, bolted together—a design intended for special site conditions.

Mechanical means, and glue on mating surfaces, fastened modules to the foundation and to each other, forming complete living units out of several boxes. In the case of townhouses and apartments, second-story modules were stacked on top of the first floor. Electrical and mechanical services and piping were connected between the modules and then to the site distribution systems.

The amount of finish work remaining to complete

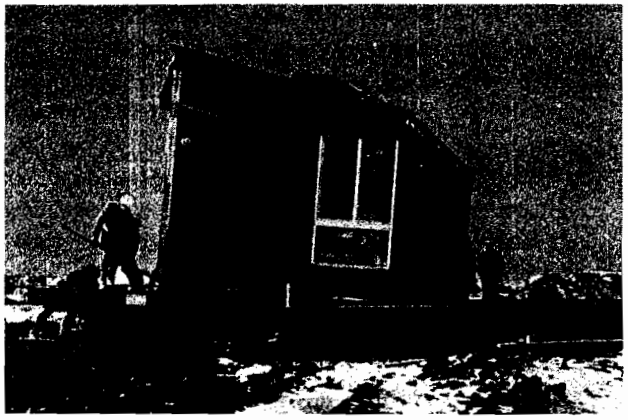
a unit also varied substantially with each HSP. On all systems, intermodular joints, inside and outside (including the roof), had to be covered to seal against weather. Although the erection phase, in general, proceeded rapidly and without incident, finishing frequently took much longer than had been anticipated. The construction schedule in Figure 14 shows the time span used by each producer. Only significant departures from standard erection practices will be discussed below.

Material Systems' contract was dated April 12, 1971; the notice to proceed was issued on July 22. Foundation work began on August 15. The first SFD modules arrived from the nearby assembly plant in March 1972.

MSC had the longest construction period of any Indianapolis HSP. Both field and factory operations contributed to the delays. The developer took final acceptance of the last SFA on June 16, 1973.

Home Building Corporation, with a Phase II contract dated March 12, 1971, received notice to proceed on May 20. Actual foundation work commenced September 13. The units, all SFDs, consisted of two modules joined longitudinally at the site. On the early units, Home Building experimented with a roll-off technique in order to avoid the high cost of crane service. This method of sliding the box off the trailer, down a track conveyor, and onto the foundation (Fig. 10) proved cumbersome and time consuming. Mud on the site also hampered the operation. Home Building therefore abandoned this system in favor of a crane. No unusual problems were encountered, and the modules fit together well. Finishing proceeded very slowly but without incident, and was completed September 30, 1972.

The Scholz Phase II contract was dated April 29, 1971. Notice to proceed was given on May 20 and construction of foundations started on October 6. Townhouse modules arrived at the site in November (the first to do so, and greeted with some public fanfare). Scholz experienced some delays because concurrent installation of water mains cut off access to the micro-site. Aside from this, erection proceeded in a routine manner. These units required more finish work than the other box systems, specifically stick-building the roofs on MFLRs and installing siding on all units. Plywood siding and stone and brick decorative fronts completed the exteriors.



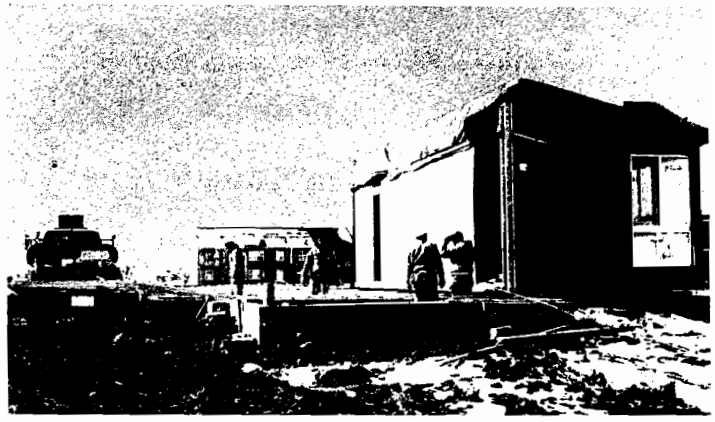


Fig. 10—Home Building's roll-off sequence

Scholz took a long time to get replacement parts shipped from the factory. After one of the slowest finishing operations of all HSPs, Scholz concluded its construction on February 15, 1973.

The National Homes Phase II contract for 14 townhouses was dated April 21, 1971, and notice to proceed was issued on June 28. Work on foundations did not begin until November 15, and erection started the next month. National came closest of all HSPs to meeting its original schedule. This performance most nearly approached the industrialized housing concept of minimum erection and "zip-up" time. National's modules were in the most complete condition upon arrival at the site, and required the least site labor to finish. All work proceeded smoothly and was completed by June 25, 1972.

Pemtom signed its Phase II contract on July 20,

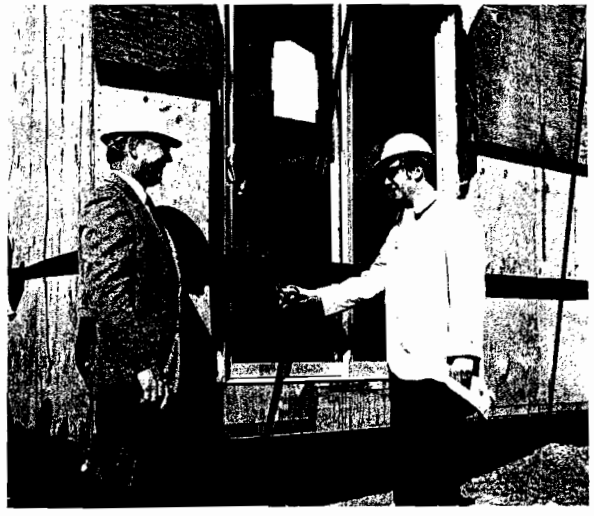


Fig. 11—Ceremonial welcome for first module to arrive

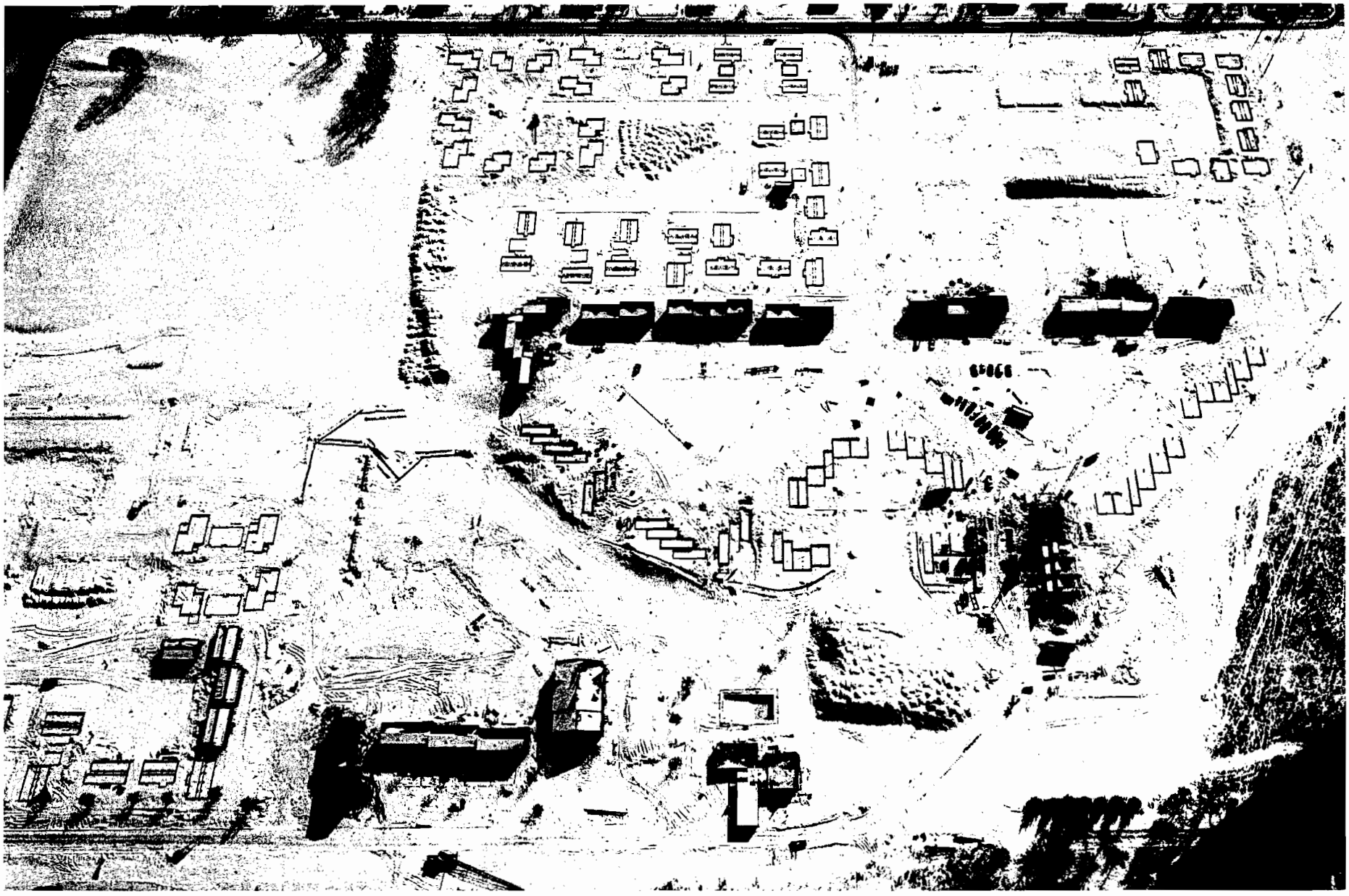


Fig. 12—Snow scene, February 1972, looking south

1971, and was given notice to proceed on September 27. Work at the site began on November 15. Pemtom's factory on the east side of Indianapolis delivered the first six modules during December. Erection began the following month, although the rather complex foundations were incomplete. An additional 2 feet of structural fill had to be added at one of the townhouse clusters to stabilize the soil. The lifting straps used in the erection process caused some exterior damage, so Pemtom replaced the straps with threaded rods that ran inside the wall cavity and connected to the base plate. Erection continued without further incident.

Pemtom responded slowly to inspection reports of discrepancies. The firm had found UNIMOD 2 to be economically infeasible, and closed the local plant after producing the 20 BREAKTHROUGH units. The record shows completion of site work on October 8, 1972.

Signing of the FCE-Dillon Phase II contract took place on April 21, 1971. The system at Indianapolis differs from that at the other BREAKTHROUGH sites only in the use of electric heat.

Given notice to proceed on December 1, FCE-Dillon began its foundations that same month. The first shipment of pre-cast panels arrived January 25, 1972, and kitchen-bathroom modules three days later. Erection proceeded rapidly, very nearly meeting the original schedule. The five-story building was topped out in March, which left elevator work and finishing. Next month, with almost everything done, a national elevator installers' strike slowed progress. USDC and HUD accepted the FCE-Dillon building on September 21, 1972. Dillon, experienced and well-organized, took somewhat more total construction time than did National Homes, but it built more units at about double the production rate.

General Electric was awarded a Phase II contract on June 30, 1971, and given notice to proceed on December 6. Site work started March 15, 1972, with foundations. The first trainload of modules arrived in Indianapolis on May 8. Early construction went

Fig. 13—Placing Pantek panel by hand

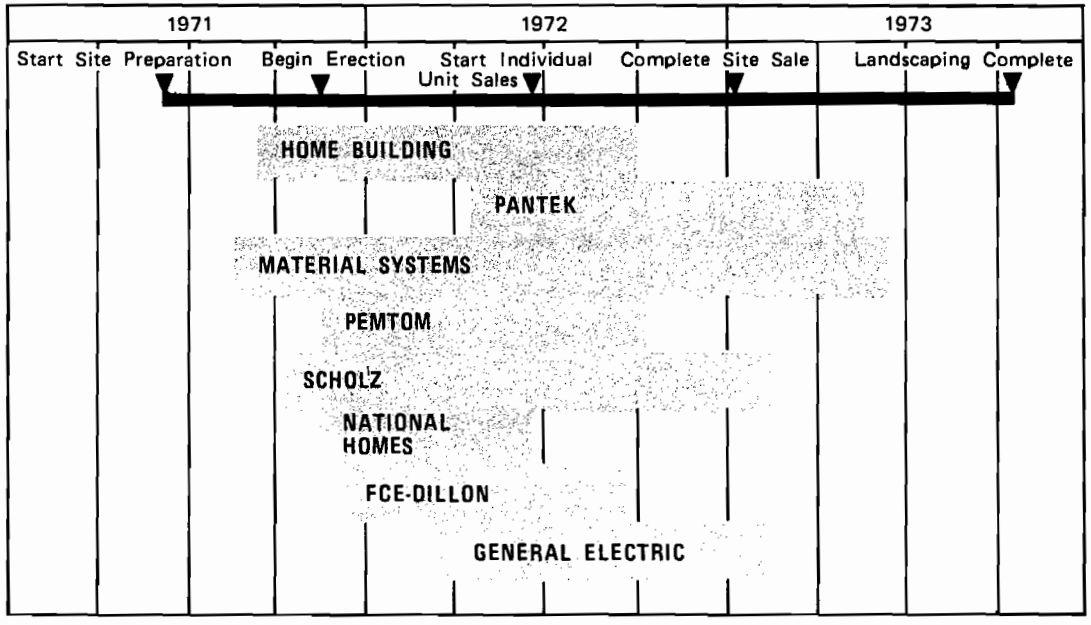


Fig. 14—Progress of housing construction

smoothly, two townhouse clusters and the low-rise apartment buildings being erected by the end of the month.

Two more unit trains—shipments of nothing but these GE modules—completed deliveries. During transit (and partially due to Hurricane Agnes) the modules suffered some severe wind and water damage, particularly to ceilings. GE encountered other problems when it became necessary to have some subcontracts re-bid delaying the schedule about two months.

The boxes fit together well, but the cast plaster walls appear no less vulnerable to handling damage than conventional drywall construction. GE's effective quality control system did ensure correction of discrepancies. Work was completed on February 15, 1973.

Pantek, with a Phase II contract dated July 6, 1971, got its notice to proceed on December 14. Construction began on April 17, 1972, and although off to a slow start, erection moved quickly. The Ball factory made the panels: those for the exterior (shown being placed in Figure 13) weighed about 6-1/2 pounds per square foot, while the interior ones weighed about 3-1/2 pounds per square foot. The balance of the house was built on the site.

After erecting the basic shell, Pantek proceeded much more slowly. Leaks and condensation caused trouble, which persisted into the warranty period. Although Pantek initially responded well to inspection discrepancies, it was one of the last HSPs to have its work finally accepted by the developer, on May 15, 1973.

Community Relations

USDC assigned an experienced employee to the community and public relations program. He conducted site tours, maintained media contacts, and prepared material for technical publications. Since the planner and UNIGOV handled briefings of citizen groups during the early days, the developer had little contact at the neighborhood level.

Important people, including the International Conference of Mayors and many foreign delegations, made frequent visits to the site during development. USDC gave briefings on BREAKTHROUGH and the Indianapolis project, and distributed general printed information and site maps. With completion of the clubhouse, the visitors program moved out of the construction trailers into the new quarters, which were shared with marketing. Resources included a national Operation BREAKTHROUGH movie and a slide show about the local site.

BREAKTHROUGH got a mixed reception from the news media. Whatever newspaper support it got came from informative articles on the project carried by *The Indianapolis Star.* The other metropolitan daily, *The Indianapolis News*, firmly opposed the program. Articles followed the theme that BREAKTHROUGH had too many strings tying it to government control. *The News* objected to BREAKTHROUGH at the start and never relaxed its criticism.

Operation and Maintenance

Neither of the developers faced major maintenance and operation responsibilities at Indianapolis. Adult Student Housing (ASH), which purchased the project, administers the affairs of the site, performs the maintenance, and generally functions as a rental manager would. USDC serviced a few finished units before the sale, and oversaw site security, provided by Manageers under subcontract. Boeing accomplished warranty administration.

Each HSP Phase II contract had a clause that required the builder to warrant all units against defects in materials and workmanship for one year following final PSD acceptance. When the site was sold late in 1972 all systems were still under warranty. Tenants, mostly students, tend toward relatively short terms of occupancy, therefore are not a fruitful source of comment upon operations and

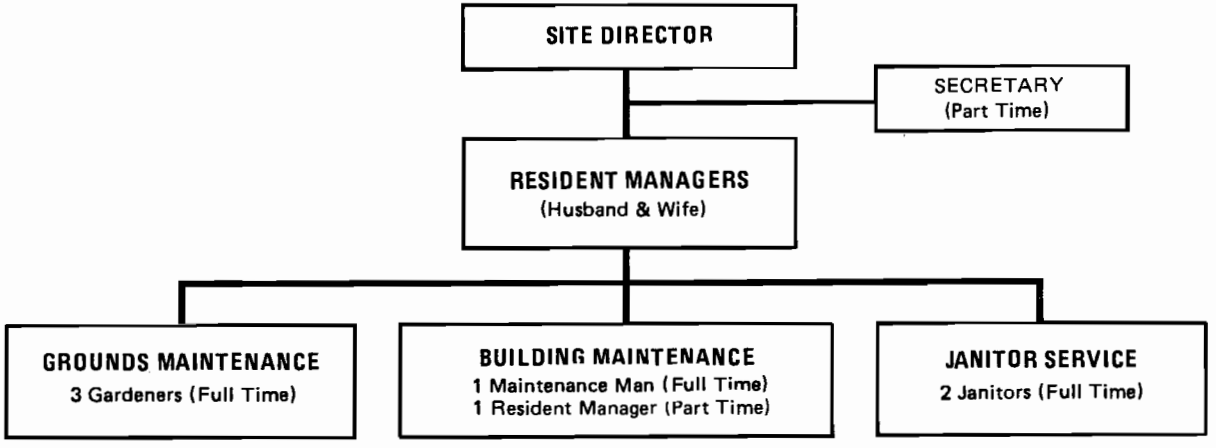


Fig. 15—Site owner's organization chart

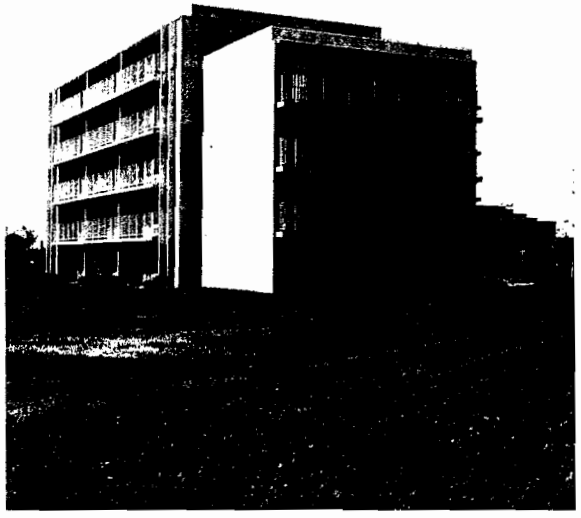


Fig. 16—FCE-Dillon medium-rise apartment

Fig. 18—Home Building single family detached unit

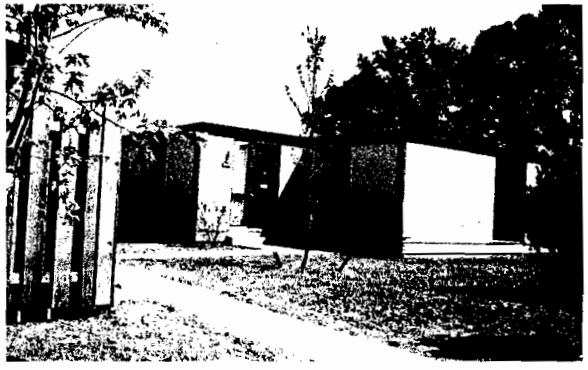


Fig. 19—MSC single family detached unit

Fig. 20—National Homes townhouses

Fig. 21—Pantek single family detached unit

Fig. 22—Pemtom townhouses

Fig. 23—Scholz colonial-style townhouses

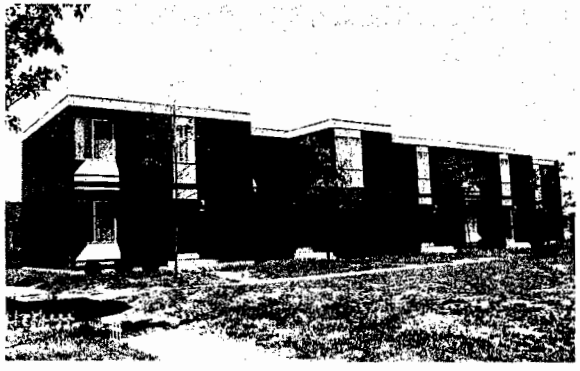


Fig. 17—General Electric townhouses

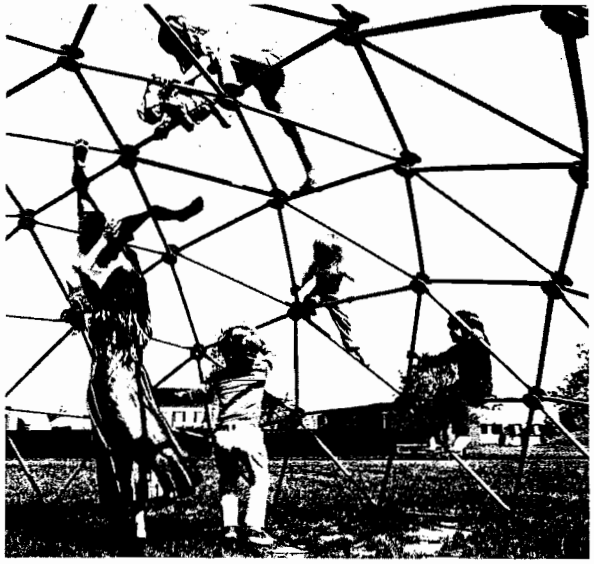


Fig. 24—Park Lafayette tot lot

Weather and Comfort

Prevailing Midwest climate patterns influence Indianapolis. It is one of the coldest BREAKTHROUGH sites, with mean low winter temperatures in the lower 20s. It is also the windiest location, having, on the average, five storms a year that are swept along by winds over 47 mph. Summers are hot and humid, with mean high temperatures in the high 80s, and relative humidity ranging between 55 and 89 percent. To cope with these conditions, all Park Lafayette houses are air-conditioned, well insulated, and fitted throughout with thermopane windows. National Homes units have storm doors.

maintenance. The following remarks are a composite of experiences by the developers and ASH.

The Material Systems units, under warranty until July 1974, have no current problems. Past corrections included replacement of warped doors and repairs of major leaks.

Home Building, one of the better systems demonstrated at Indianapolis, presented no serious difficulties. The producer responded in an adequate way to warranty matters, replacing a number of warped doors and some delaminated plywood siding panels.

Scholz experienced basement leaks, and the warping of plywood surfaces, which caused floor tile failures. Repairs were made under the warranty program, with adequate response.

From the standpoint of low maintenance, the National Homes units are considered the best on the site. Construction was of good quality, warranty response was excellent, and there are no outstanding problems.

Pemtom's only serious problem has been heating and cooling, caused by poor insulation of the suspended box module. Earlier, the builder replaced exterior plywood siding that had delaminated. Warranty response was adequate.

FCE-Dillon's warranty response was good; no significant problems were reported.

General Electric units encountered some small miscellaneous problems, but these were corrected. The plastic piping, which is more vulnerable to freezing than metal, suffered some damage due to improper insulation in the crawl space. Warranty response was good.

Pantek has more warranty problems than others demonstrated at Indianapolis, and the producer's response to complaints has been slow. Troublesome items include leaks, condensation around windows, faulty double-pane glazing, and heating and air conditioning systems.

Overall, the external appearance of Park Lafayette is good. There are no early signs of housing unit deterioration, and finishes are holding up well.

Marketing

The initial marketing plan prescribed selling all units to individuals. Subsidized housing was never seriously considered, although the FHA advised that Section 235 could apply to some units (mortgage-insurance financing of home ownership for lower income families).

Originally, the demonstration schedule called for some prototype units to be available for sale by May 1971. Manageers, Inc., under the marketing subcontract, staffed its organization and aimed its activities toward that early completion date. By October 1971, housing construction was just getting underway. Clearly, a detailed marketing program was premature. USDC, at OBW's direction, asked Manageers to curtail its activities until construction progress warranted a more aggressive effort.

Sales did begin on June 17, 1972. An early trend, where blacks bought 29 of the first 30 units sold, threatened the HUD/USDC goal of a representative community. The sales campaign remained unsatisfactory in that it did not attract sufficient prospects nor the desired racial mix. Several open house events failed to interest real estate agents. Television and newspaper advertising proved unproductive. With a plan for selling all 295 units in 16 months, the developer had commitments for only 10 percent after 5 months. OBW, finding no indication that sales would improve, asked USDC to suspend all advertising.

HUD received an offer, from Adult Student Housing, Inc., to buy the entire site. ASH, a nonprofit corporation serving the college housing market, identified an immediate need for 192 units, because student requirements at Indiana University and Purdue University at Indianapolis exceeded other available housing resources. School staff members found the

BREAKTHROUGH units appropriate in terms of distribution and amenities. Confirming the need, the Chancellor's Advisory Board recommended that the Board of Trustees of Indiana University sponsor for ownership the group best suited to make the units available to the students. The trustees selected ASH of Indianapolis, Inc. ASH then bought, under the College Housing Act of 1950, the 192 townhouses and low/medium-rise apartments. These units will revert to Indiana University when the permanent mortgage is paid off.

This left 103 single family detached units unsold. Park Lafayette, Ltd. (PLL), a private corporation, purchased them in December, bringing to a close the BREAKTHROUGH marketing program. On January 6, 1973, Park Lafayette, Inc. (PLI), bought the common areas, including the pool and clubhouse, which completed the transfer of the entire project to private ownership. PLI is a nonprofit corporation formed to own, maintain, and manage all of the community areas and services.

ASH and PLL found a ready market for the units. While ASH rented the 192 MFLRs and SFAs to students, PLL rented, with an option to buy, the 103 SFDs on the open market.

Park Lafayette

GTR for site development – J. Rothenberg
GTR for planner – M. Chateauneuf
STR – D. Bowman
ACO – J. Dilley
Director of OBR – J. Sabella

HSP COSTS
(dollars in thousands)

Producer	Cost
FCE-Dillon	$ 636.6
General Electric	1,150.0
Home Building	775.6
Material Systems	1,194.5
National Homes	270.9
Pantek	1,511.4
Pemtom	521.9
Scholz	678.6
Total	$6,739.5

SITE IMPROVEMENT COSTS
(dollars in thousands)

Item	Cost
Grading	$252.1
Storm & sanitary sewers	443.8
Water, electrical service	127.6
Clubhouse	180.2
Paving	239.3
Landscaping	257.3
Curbs, gutters, sidewalks	135.7
Carports, fences, & street furniture	172.1
City services	66.6
Other	134.6
Total	$2,009.3

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM July 1970:	Start site preparation	10-70
	Start housing construction	10-70
	Finish housing construction	12-71
	End demonstration/marketing	7-72
Interim CPM August 1971:	Start site preparation	5-71
	Start housing construction	8-71
	Finish housing construction	6-72
	End demonstration/marketing	12-72
Actual Performance:	Start site preparation	6-71
	Start housing construction	8-71
	Finish housing construction	6-73
	*End demonstration/marketing	10-73

*Date of completing last site construction contract; site sold 1-73

Fig. 25—Indianapolis site costs and schedules

FCE-DILLON, INC.	36 Multi-Family Medium Rise	
Phase II Contract:	Start foundations	10-71
	Start erection	11-71
	Complete erection	1-72
	Finish units	2-72
Actual Performance:	Start foundations	12-71
	Start erection	1-72
	Complete erection	3-72
	Finish units	9-72

GENERAL ELECTRIC COMPANY	48 Single Family Attached 8 Multi-Family Low Rise	
Phase II Contract:	Start foundations	11-71
	Start erection	1-72
	Complete erection	5-72
	Finish units	5-72
Actual Performance:	Start foundations	3-72
	Start erection	5-72
	Complete erection	7-72
	Finish units	2-73

HOME BUILDING CORPORATION	45 Single Family Detached	
Phase II Contract:	Start foundations	9-71
	Start erection	10-71
	Complete erection	12-71
	Finish units	4-72
Actual Performance:	Start foundations	9-71
	Start erection	1-72
	Complete erection	4-72
	Finish units	9-72

MATERIAL SYSTEMS CORPORATION	18 Single Family Detached 32 Single Family Attached	
Phase II Contract:	Start foundations	8-71
	Start erection	11-71
	Complete erection	2-72
	Finish units	2-72
Actual Performance:	Start foundations	8-71
	Start erection	3-72
	Complete erection	9-72
	Finish units	6-73

NATIONAL HOMES CORPORATION	14 Single Family Attached	
Phase II Contract:	Start foundations	11-71
	Start erection	12-71
	Complete erection	12-71
	Finish units	1-72
Actual Performance:	Start foundations	11-71
	Start erection	12-71
	Complete erection	4-72
	Finish units	6-72

PANTEK CORPORATION	40 Single Family Detached	
Phase II Contract:	Start foundations	10-71
	Start erection	1-72
	Complete erection	4-72
	Finish units	6-72
Actual Performance:	Start foundations	4-72
	Start erection	4-72
	Complete erection	8-72
	Finish units	5-73

PEMTOM, INC.	20 Single Family Attached	
Phase II Contract:	Start foundations	11-71
	Start erection	12-71
	Complete erection	3-72
	Finish units	4-72
Actual Performance:	Start foundations	11-71
	Start erection	1-72
	Complete erection	5-72
	Finish units	10-72

SCHOLZ HOMES, INC.	26 Single Family Attached 8 Multi-Family Low Rise	
Phase II Contract:	Start foundations	9-71
	Start erection	10-71
	Complete erection	1-72
	Finish units	1-72
Actual Performance:	Start foundations	10-71
	Start erection	11-71
	Complete erection	4-72
	Finish units	2-73

Jersey City, N.J.

Jersey City

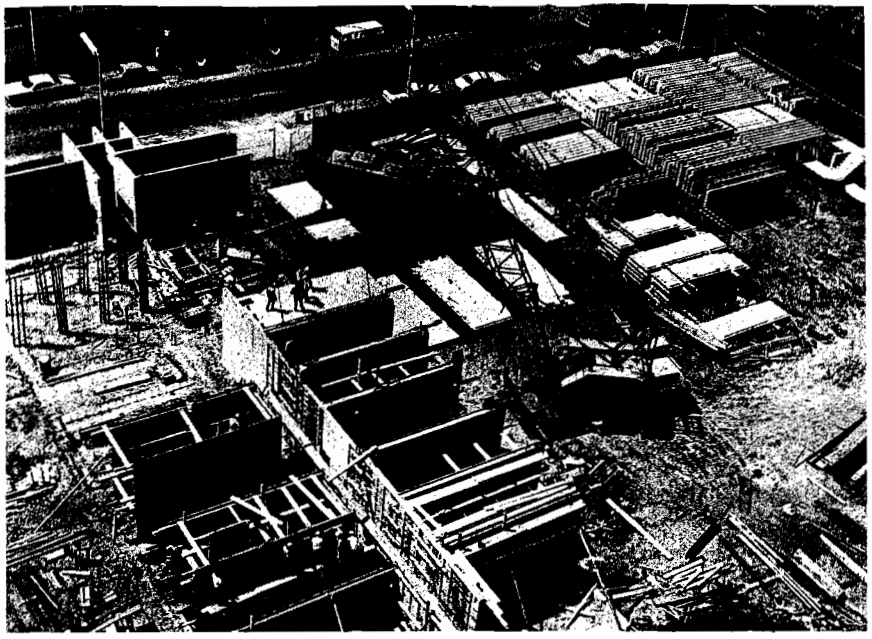
Site Location: Newark Ave. & Summit Ave.
Prototype Site Developer: Volt Information Sciences
Prototype Site Planner: David A. Crane
Housing System Producers: CAMCI, Descon, Shelley
Total Housing Units: 486

Introduction

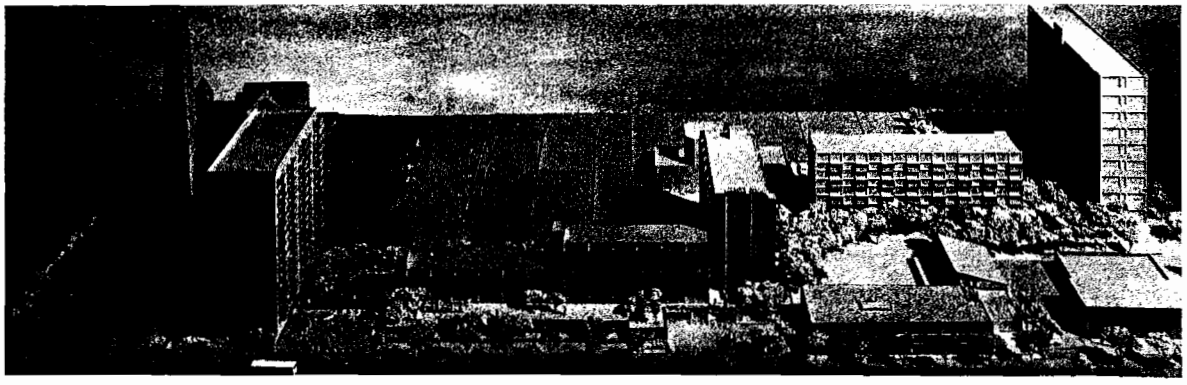
Summit Plaza, the Jersey City Operation BREAKTHROUGH site, is in an urban location and has a relatively high density of 77 living units per acre. Its community facilities feature an on-site "total energy" system and a pneumatic trash collector, and include a commercial building. Largely because of the complexity of housing system problems, the site design period was prolonged. Jersey City, subjected to numerous program changes and delays, was the last BREAKTHROUGH site built and occupied.

Considering local housing demand, proximity to rapid transit, and the overall redevelopment of the neighborhood, Summit Plaza has potential not only as a demonstration of industrialized housing, but also as a vital component in the rebuilding of an urban center.

Cover:
A dramatic view of the lower Manhattan skyline emphasizes Summit Plaza's key location: the heart of the country's largest city is only 20 minutes away.

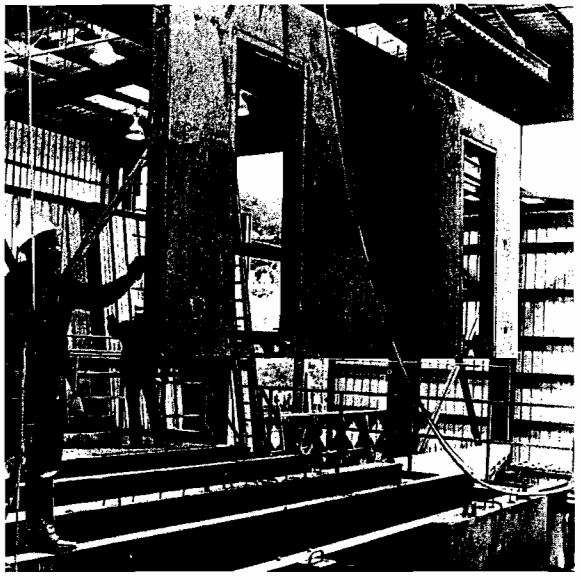


Work on the 6.35-acre site began in October 1971. The simultaneous need by many contractors for building sites, material staging areas, and equipment access, was one of the problems that prolonged housing construction. With the limited space available, some contractors had to wait.

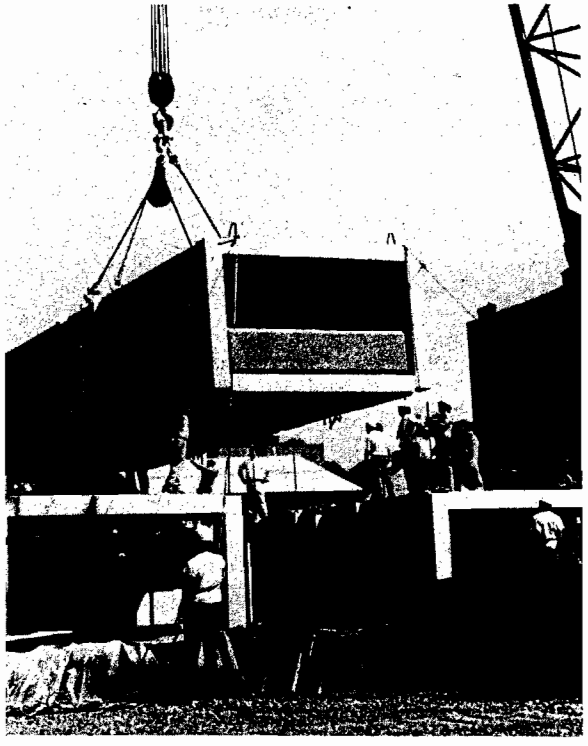


Site design responded to the objective of creating a viable, high-density, urban living environment. The basic plan has a linear structural development pattern, with carefully massed buildings linked by pedestrian concourses, plazas, and open spaces. The plan provides separation of pedestrian and vehicular traffic.

St. John's is a crowded, older neighborhood in transition, mingling commercial, residential, and other land uses. BREAKTHROUGH buildings, rising above the others, show what can be expected of Jersey City's current urban renewal program.



Two housing system producers used factory-cast concrete panels. CAMCI erected a 15-story, 153-unit building and Descon an 11-story, 141-unit building with three sections.



The only concrete box module system in the BREAK-THROUGH program is demonstrated at Jersey City. Shelley erected an 18-story, 152-dwelling-unit building and an 8-story, 40-unit building. The first occupants on the site moved into a Shelley apartment in March 1974.

Three blocks from the site, the major transportation center at Journal Square is served by buses and PATH commuter trains.

The Central Equipment Building (CEB) is at the heart of two innovative utilities systems demonstrated on the Jersey City site. The total energy system supplies electric power, hot water for heating and domestic use, and chilled water for cooling. A pneumatic trash collection system moves refuse by pipe to the CEB for compaction before pick-up.

Background

Jersey City is the only Operation BREAKTHROUGH demonstration site in the major northeast United States urban area of approximately 25 million people. It has been said that Jersey City, lying between Newark and New York City, is essentially a fringe of those two central cities. It suffers many of the social and economic ills now commonly recognized as characteristics of urban areas; the socioeconomic decline of the central city resulting from the exodus to the suburbs, the incipient loss of population and tax base, an aging housing stock, and inadequate public facilities. The strategy for survival of such areas includes recapturing some of the departed affluent, rebuilding the urban physical plant, and upgrading facilities and services. Journal Square redevelopment is pivotal in this strategy in Jersey City, as well as being an important part of urban redevelopment in the New York metropolitan area.

Responding to the June 1969 national announcement of Operation BREAKTHROUGH, the Jersey City Division of Planning, acting for the mayor, requested further information and requirements for participation. The task of preparing a proposal was given to the Jersey City Redevelopment Agency, a semi-autonomous public agency responsible for coordinating all urban renewal projects in Jersey City. During September, the redevelopment agency submitted a proposal for a BREAKTHROUGH demonstration in Jersey City at one of four alternative sites.

A HUD observer team visited Jersey City in November 1969 and viewed the alternative sites. In December, HUD notified the redevelopment agency that Jersey City was among the BREAKTHROUGH finalists, subject to further screening of tax policies, utilities, schools, population growth, housing demand, and other criteria.

Jersey City Council immediately passed a "resolution of cooperation with prototype housing," cited

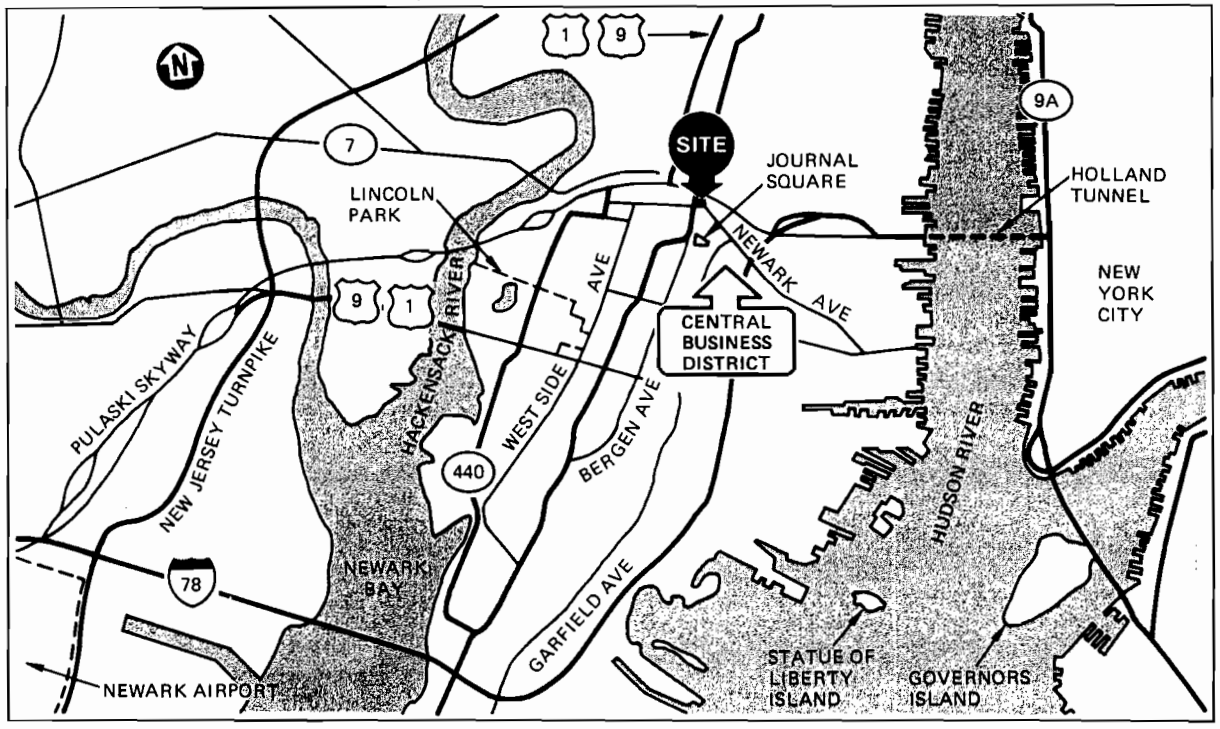


Fig. 1—Jersey City and surrounding area

such benefits as helping to provide needed housing, implementing planning programs, and providing a working partnership between federal, state, and local governments and private industry. Anticipating a need by BREAKTHROUGH for some relief from local codes and ordinances, the resolution stipulated that variances would be allowed if (a) validated by HUD's arrangement with "nationally recognized and professionally accepted scientific and engineering organizations" and (b) certified by HUD as to acceptability, based on "sound performance standards."

When word of Jersey City's selection for BREAKTHROUGH came, the press applauded it as both a valuable demonstration and an opportunity for new housing in the city. *The Jersey Journal* of December 16, 1969, carried the headline: "JERSEY CITY GETS A BREAK." The city planning director called the program "a real breakthrough for Jersey City, a program that will make the city a focal point of urban housing development."

The BREAKTHROUGH site, approximately 1,100 feet long and varying from approximately 150 feet to 350 feet in width, incorporates a dog-leg section to the east. Its position at the crest of a gently sloping hill gives many units a view of the local scene. The site, located within the city's St. John's urban renewal area, comprises 6.35 acres of nearly level, cleared land, in temporary use at that time as a park-

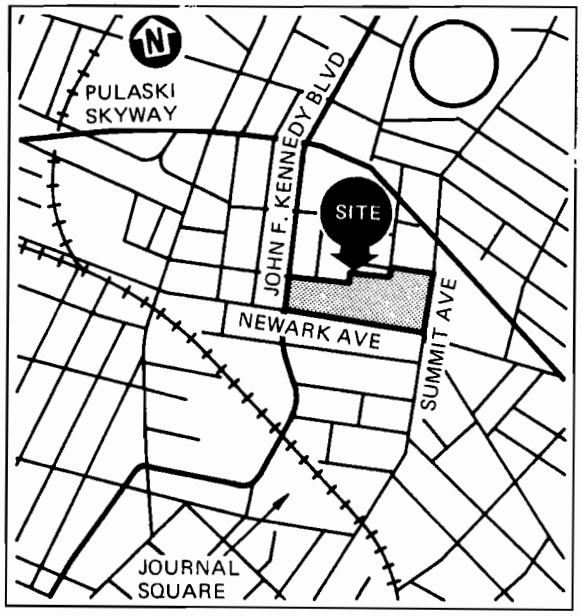


Fig. 2—Location of BREAKTHROUGH site

ing lot. On three sides it is bounded by major arterials—Kennedy Boulevard to the west, Newark Avenue to the south, and Summit Avenue to the east. A relatively new and popular library, the Five Corners branch of Jersey City Public Library, stands at the southeast corner of the site.

Nearby rapid transit affords exceptional regional accessibility. Three blocks to the south, Journal Square, Jersey City's business and shopping district and historically a major transportation hub, includes a modern transportation center for the growing Port Authority Trans-Hudson (PATH) and public transit systems. The Pulaski Skyway provides direct arterial access east to Manhattan by way of the Holland Tunnel, and west to the New Jersey Turnpike and Newark. Surface bus lines to many points converge at Journal Square, contributing to the excellent mobility available at the site.

The neighborhood surrounding the site includes a variety of building types and qualities. To the south across Newark Avenue are drab two- and three-story retail commercial buildings with apartments above ground-level stores. To the north are the three high-rise buildings composing St. John's Apartments. These nearly identical 16-story slab block structures contain approximately 830 total upper-middle income units. Still further north are the newer Grandview Apartments, some 300 dwelling units for low income elderly residents. To the west across Kennedy Boulevard and to the east across Summit are mixed uses ranging from three- and four-story loft buildings to a new drive-in restaurant.

Considerable development and redevelopment is planned for the area. The civic center, one block southwest of the site, will eventually include a new city hall, public safety complex, library, and museum. In and around Journal Square, expanded commercial and shopping facilities are under development.

Fig. 3—Across the street on Newark Avenue

Fig. 4—St. John's Apartments

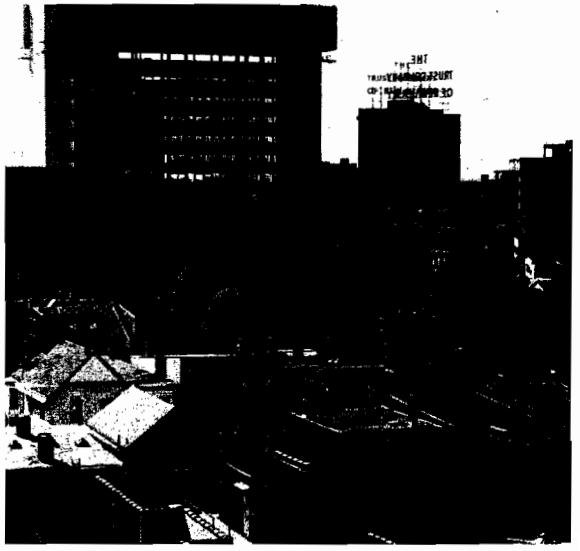


Fig. 5—Urban scene south of BREAKTHROUGH

All required utilities were convenient to the site. There was an adequate water supply for both temporary and permanent needs. Sewer service was easily accessible in the city's combined sanitary and storm system. Electrical and gas services adequate to project demands were conveniently available.

Schools in Jersey City were suffering general overcrowding, and Public School No. 6, serving the site, was no exception, having a shortage of eight classrooms. Obviously, any new development coming into this urban area faced the responsibility of helping provide adequate school facilities.

The median income in Jersey City is below both national and State figures. Housing stock is old, and the deterioration rate is high. Community facilities and services for this area are overcrowded and generally less than what is available in the rest of the city. Due largely to these adverse trends, the private sector has been reticent to respond to the great need for rebuilding. In Jersey City, there was virtually no new housing construction at the time of the BREAKTHROUGH program.

Fifteen percent of Jersey City's population is black, a comparatively low percentage for an eastern city. However, most of these black residents are concentrated in the central city area, a typical urban concentration. The population in the project area has a high percentage of one-person households (34 percent) and a median age that is 10 years older than the city-wide average. Fully 84 percent of all nearby housing is in the rental category. Less than half (47 percent) of the area's households include automobile owners.

Dwelling units are generally smaller, more frequently located in multiple family dwellings, and carry higher rents than housing elsewhere in the city; in fact, gross room rent is higher than anywhere else in Jersey City, averaging $35 to $40 per room. The vacancy rate of 4.4 percent is comparatively high for Jersey City, but this does not mean that there is an adequate amount of suitable housing. That vacancy rates are no higher, despite costly rents, shows a strong demand for housing. The BREAKTHROUGH experience later verified this fact.

In summary, it can be said that the site was very suitable for development. It represented a key parcel in a major redevelopment area that was experiencing absolute demand for new housing. At the start of BREAKTHROUGH, the local redevelopment agency owned the property.

Pre-Development Activity

Having selected the site, HUD then initiated other steps in the Jersey City BREAKTHROUGH program. In January 1970, following a national competition, Operation BREAKTHROUGH—Washington (OBW) signed David A. Crane & Associates to contract H-1199 as Prototype Site Planner (PSP). This firm, based in Philadelphia, was thoroughly familiar with Jersey City because of previous work there. Crane assembled a planning team that included subcontracted consultation from David Volkert & Associates, engineers; Cambridge Seven Associates, Inc., design and graphics; and Alan M. Voorhees & Associates, traffic engineers. The PSP team worked closely with the professional staffs of the Jersey City Redevelopment Agency and Division of Planning.

Site planning began immediately. While the potentially high demand for housing and the framework of redevelopment plans were attractive assets of the proposed development, the site's physical characteristics were difficult. Crane has referred to the site as "tight and awkward" but acknowledged its favorable attributes of regional location and view. The initial analysis resulted in the Task I report of March 20, 1970, which described physical aspects, area-wide planning, community social conditions, and BREAKTHROUGH program objectives. The study developed criteria for site design and made four principal recommendations, calling for OBW to: (1) establish the Housing System Producer (HSP) assignments and working relationship with the planner; (2) determine dwelling unit allocation by size, rental scale, and building type; (3) assign non-residential uses; and (4) select a site developer.

As part of a reiterative process leading to a site plan concept, Crane held a series of meetings with local government code agencies, utilities, and service institutions to assess alternative development schemes. This evaluation helped to establish a general profile for Jersey City BREAKTHROUGH. Density, mix of housing units and building types, and school facilities requirements emerged as design criteria of special concern.

The planner conceived the project as an urban residential development of approximately 480 housing units contained in high-rise and medium-rise structures at a density of 80 units per gross acre. The selected design concept massed tiered buildings and towers, ranging from 3 to 18 stories, in order to avoid structural regimentation while providing open space relief consistent with adjacent developments. It allocated space for convenience shopping, commercial use, parking, school, and park and recreation facilities. In addition, OBW decided to select Jersey City for the demonstration of an on-site, independent, total energy system and a pneumatic solid waste collection system.

Crane's analysis pointed out the need for community facilities to serve the site, particularly parks and schools. However budgeted capital improvement funds were inadequate. Therefore, the site design goal was "self-containment," which required a rich mix of amenities and, in turn, on-site revenue producers to assure adequate finances. The planner also determined the optimum housing mix; 40 percent of the units subsidized, 60 percent rented at market rate; with 26 percent of all units to be family size (three or more bedrooms).

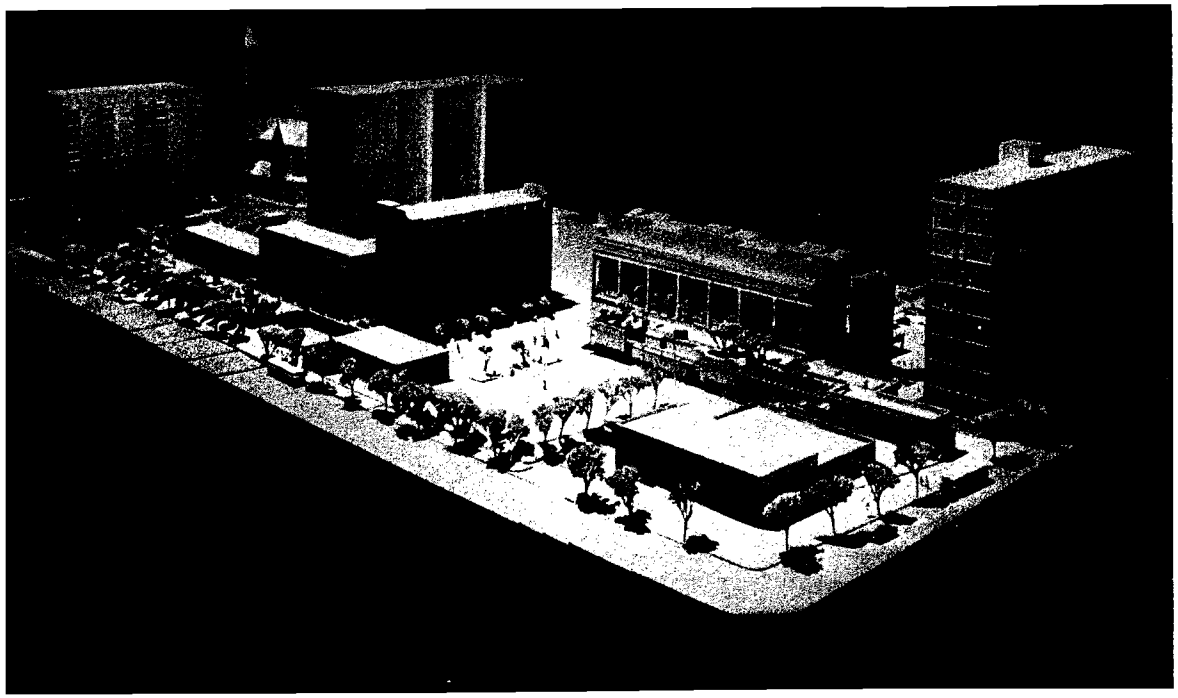


Fig. 6—Model of site as envisioned in mid-1971

During the spring of 1970, the planner worked from the Task I design requirements toward a final solution by assessing a multitude of alternative designs. Many combinations of unit mix and facility configuration were computer-analyzed, and, at an advanced state, three-dimensional scale model mock-ups permitted accurate study of various schemes, ranging from 300 to 700 units.

The planner chose a concept that David A. Crane described as:

> ". . . .a residential 'mega-structure,' but with enough articulation of some of the non-residential facilities to make some concession to a problem of which we were then only dimly aware—that very few of these high-density building systems would be capable of accepting parking, shopping, schools or other mixed uses at their bases. Nevertheless, we felt that in order to get the densities on the site that would achieve a total optimum relationship between costs and revenues, we had to have a rather high degree of connectivity and multi-level integration among functions."

With this concept, the planner gained tentative approval from local authorities and community groups. BREAKTHROUGH fit well with the city's planning and development programs. By proposing and sponsoring the project, the redevelopment agency gained a key element in the growth of St. John's and Journal Square, so Jersey City saw BREAKTHROUGH as more than an experiment.

Crane began to prepare a final site plan based on a particular massing of structures that included some low rise groups for relief, architectural continuity, and to provide pathways or routes between larger structures. These "route buildings" had to accommodate the planned ground floor family-size housing units as well. To fill this need, the planner wanted a high-density housing system with flexibility.

OBW announced the housing system assignments in May. The three original producers were CAMCI, Inc., the BREAKTHROUGH subsidiary of Module Communities, Inc.; Descon/Concordia Systems, Ltd., later renamed Descon Systems, Ltd.; and Townland Marketing and Development Corporation, a consortium formed by Keene Corporation. The planner quickly found that several assumptions now were questionable in the light of specific system characteristics. Generally, the systems were less flexible than had been desired. Although the Townland system was physically suitable, Townland was reluctant to play the part of "route builder," because that would jeopardize its own demonstration objectives. Descon had no such conflict and willingly accepted the role.

The planner made agreements with producers on guidelines for housing designs, allotted new living unit distributions, and revised the site plan. While the producers engaged in housing design, the PSP was free to move on to planning non-residential elements.

OBW named a prototype site developer in July 1970, but site work could not start until a new design problem was resolved. Specifically, the housing systems could not adapt to the ambitious multiple use configuration envisioned by the PSP. Changes were made, and delays mounted. Townland's allocation was severely cut (from 192 to 42 units), and Shelley Systems, Inc., was added to make up the difference. The four-HSP arrangement was short-lived; eventually, Townland withdrew from the Jersey City project, triggering another series of adjustments.

Site Plan

The final site plan has 486 multi-family high-rise, medium-rise, and low-rise structures ranging from 4 to 18 stories and arranged in tiered buildings and towers. Units designed for larger families are located on the lower floors of all buildings with ready access to the school, recreational areas, and open space. Space is allocated for convenience shops, professional offices, an elementary school, a park, courts, play areas, a swimming pool, and parking. Some of the non-residential uses are distributed in the lower floors of the housing structures, and others are located along the pedestrian routes and open spaces.

The overall site concept is basically a linear structural development linked by pedestrian concourses, terraces, plazas, and open spaces at various levels. Approximately half of the site total of 6.35 acres is open space, including a partially turfed playfield and park adjacent to the proposed school facilities and the existing library. Other open spaces on the site are designed for a variety of uses and users.

A substantial amount of site parking is located below buildings and decks. Service vehicles come and go with minimal visual impact. Automobile and pedestrian conflicts are minimized. The so-called "Descon deck," an elevated structure, satisfies several requirements for covered parking, access to first-level living units in Descon A-1 and A-2 (low-rise and medium-rise buildings), and a pedestrian mall.

Commercial Space	54,200 SF
School	18,240 SF
Indoor Swimming Pool and Pavilion	5,700 SF
Central Equipment Building	9,500 SF
Improved Open Areas (approx.)	160,000 SF
Parking	367 Spaces

Fig. 8—Non-residential areas

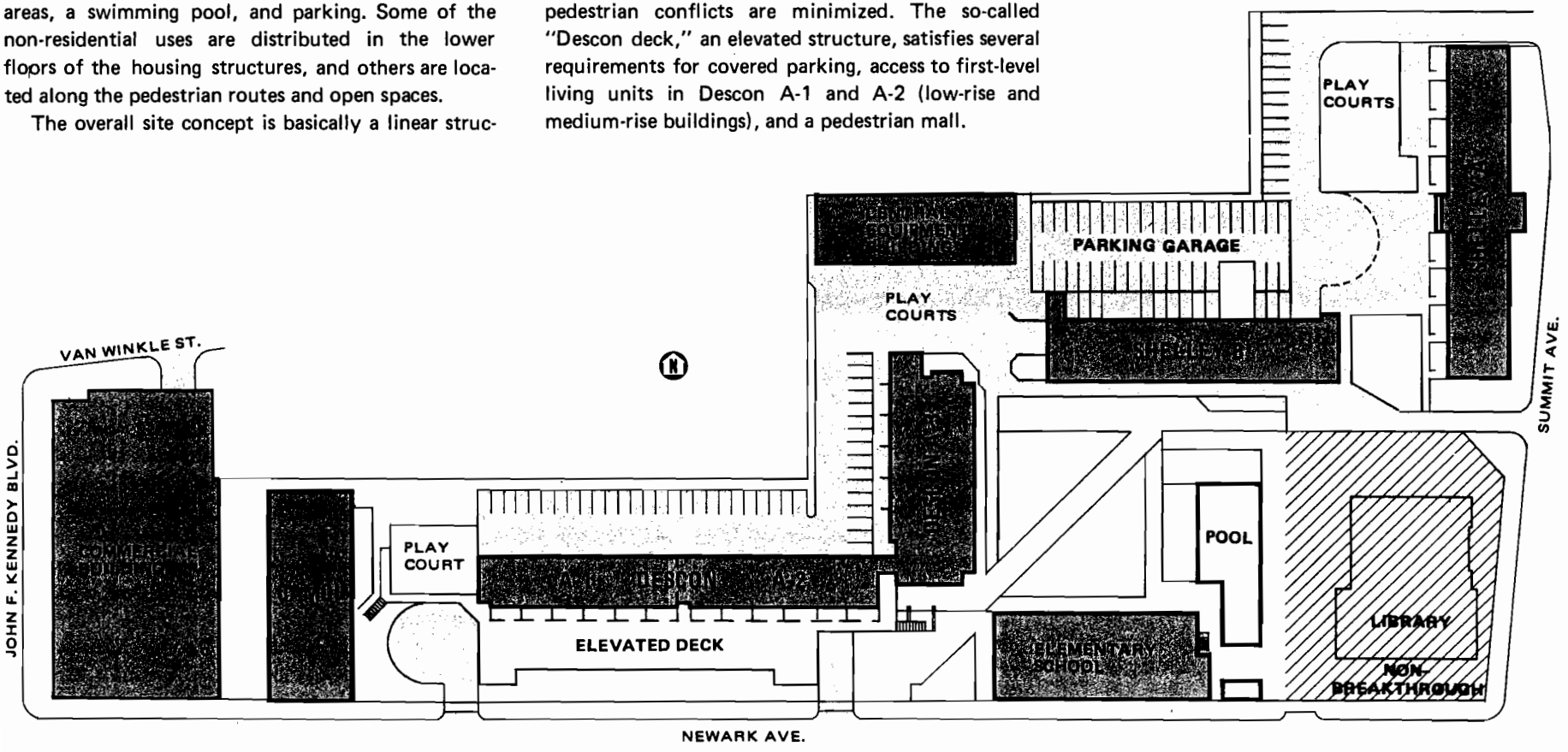


Fig. 7—Site plan as built

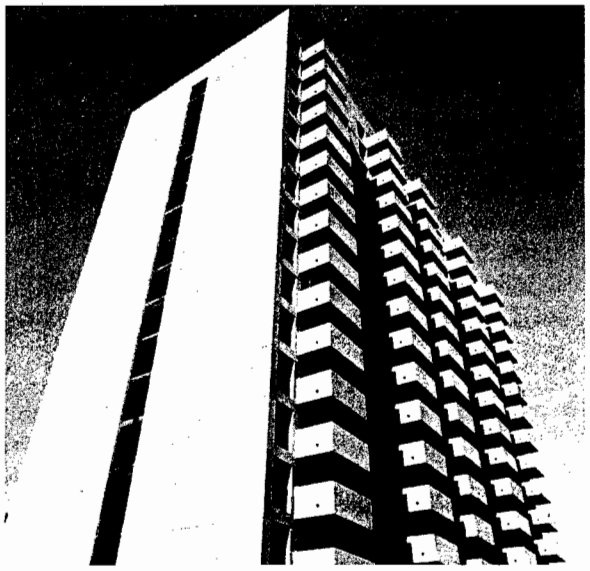


Fig. 9—Fifteen-story CAMCI building

Fig. 10—Two Shelley high rises

Fig. 11—Eleven-story Descon A-3

	CAMCI			*DESCON					SHELLEY				
	EFF	1 BR	2 BR	EFF	1 BR	2 BR	3 BR	4 BR	EFF	1 BR	2 BR	3 BR	4 BR
MFLR (12)						6	5	1					
MFMR (24)					2	16	6						
MFHR (450)	15	76	62	31	50	20	3	1	16	38	82	38	18
Totals (486)	153 UNITS			141 UNITS					192 UNITS				

*Descon is demonstrated in one building with three sections—11, 7, and 4 stories. These sections are commonly identified as separate buildings.

Fig. 12—Housing unit mix

The total energy facility, supplying electric power and hot and chilled water for heating and cooling, and the pneumatic solid waste collection system servicing both the residential and non-residential developments, are integrated into the site design. A Central Equipment Building (CEB) houses the machinery and control mechanisms associated with both of these utilities systems.

Housing Systems

The only BREAKTHROUGH demonstrations of the CAMCI and Shelley housing systems are at Jersey City. Descon is assigned to the St. Louis site as well as to Jersey City.

CAMCI, Inc., is a wholly owned subsidiary of Module Communities, Inc. (MCI), a division of Starrett Housing Corporation. In producing its 153 dwelling units in a 16-story tower structure, CAMCI employed a system based on the prefabrication of structural and architectural elements and the programmed coordination of factory production with on-site assembly. MCI tailored this industrialized system from the French Tracoba No. 1 prefabrication method that has been proven in Europe. The system provides wide architectural variety and is suitable for multi-family mid-rise and high-rise buildings. Main elements are load-bearing cross walls, shear walls, facade walls, gable walls, floor panels, roof panels, elevator shafts, and stairways. Even though most of the interior walls are load-bearing, there is considerable flexibility in material and configuration for walls that are non-load-bearing. Because the main facade walls are non-load-bearing, they can be designed to

nearly any configuration.

The MCI factory in Yonkers, N.Y., 50 miles away, accomplished prefabrication for the CAMCI system. On-site construction consisted mainly of the conventional cast-in-place foundation work, erection of pre-cast panels, cast-in-place concrete jointing of the structure, insertion of mechanical subsystems, and conventional finish work.

Shelley Systems, Inc., demonstrating 192 dwelling units in two high-rise buildings, one 18-story and one 8-story, features an interesting pre-cast concrete modular technique adaptable to a wide range of applications. Three-dimensional box-type units are stacked in a vertical checkerboard pattern. This arrangement creates alternating room spaces between adjacent modules, each complete with walls, floor, and ceiling. These modular units, in two sizes (44 feet long and 48 tons; 52 feet long and 53 tons), were almost totally prefinished on a factory assembly line. Architecturally, the Shelley system is applicable to most living environments, building configurations, exterior facade treatments, and facing materials.

A factory in East Paterson, N.J., produced the Jersey City modules of lightweight reinforced concrete, which were transported 20 miles to the site. Conventional construction on-site included foundations, elevators, basements and other ground floor spaces, and finish work. Mechanical and electrical work was done partially in the factory and partially on-site.

Descon Systems, Ltd., of Montreal, Quebec, constructed a combined 4-story low rise, 7-story medium rise, and 11-story high rise, making a total of 141 dwelling units. This system, principally software, was planned and organized to permit franchise operations by small entrepreneurs using existing fabrication facilities. It is intended for multi-family medium rise and high rise construction applicable to inner city development or urban redevelopment projects. Varied selection, design, and assembly of components allow flexibility in building configurations. Major elements of the building system are pre-cast concrete wall and floor/ceiling panels, non-structural curtain walls, plumbing, heating-ventilating-air conditioning (HVAC), kitchen, bathroom, storage, partitions, and doors. The panels are interconnected by mechanical joints, permanently bolted together on the site. Descon contracted with local firms to manufacture and assemble the primarily pre-cast concrete structures.

The Townland housing system was one of those originally assigned to Jersey City, and figured prominently in the planning phase. Townland designed a pre-cast concrete space frame—"land in the sky"—on which two- and three-story townhouses would be erected from box modules. However, the concept was never demonstrated at Jersey City, as the Townland assignment was cancelled in September 1971.

Utilities Demonstration Systems

HUD selected Jersey City for the demonstration, integral with BREAKTHROUGH, of an on-site total energy system as well as a pneumatic trash collection system. Each of these was a major program innovation contributing to the significance of the Jersey City project.

Prior to BREAKTHROUGH, HUD had devoted a number of research programs to more efficient use of energy and the control of environmental impact. One of the four key areas of research involved using small power plants in urban areas for such purposes as district heating systems or total energy systems (TES). Although convincing research and system design had been accomplished, and a number of varied systems were in operation, demonstrations providing detailed comparative cost and energy use figures were still lacking. Operation BREAKTHROUGH presented an opportunity for such a demonstration. HUD chose Jersey City as the best data source based on evaluations of the technical and institutional factors. These included fuel costs, the number and density of dwelling units, building configurations, and willingness of local planners and developers to cooperate. It was estimated that a successful performance at Jersey City should save between 20 and 30 percent of the site's energy and trash collection costs.

The total energy system was designed by Gamze, Korobkin, and Caloger, Inc., specifically for the Jersey City site, and features the following major pieces of equipment:

- Five 600-kilowatt diesel engine-generator units producing 480-volt, three-phase power for the entire complex (three units can carry the entire load, with one unit always in reserve when another is down for scheduled maintenance)
- One 790,000-BTU-per-hour waste heat boiler for each generator unit to recover waste heat from the diesel engine (60 to 70 percent of the energy in the diesel fuel)
- Two 400-hp boilers to supply additional hot water for the site if the demand exceeds the heat recovered from waste
- Two 550-ton absorption chillers for air conditioning

Four pipes are used for the distribution of hot and chilled water from the plant to the buildings being serviced. Two separate electrical feeders supply each building. One is termed an "essential load feeder." In the event that the total energy plant is out of service, power will be automatically supplied from the local utility company for this feeder to operate essential loads such as fire pumps, exit lamps, and elevators.

The pipe network includes numerous flow and temperature sensors. Their purpose is the thorough analysis of thermal efficiency of the plant under various conditions throughout the year. The demonstration allows monitoring of reliability, maintenance,

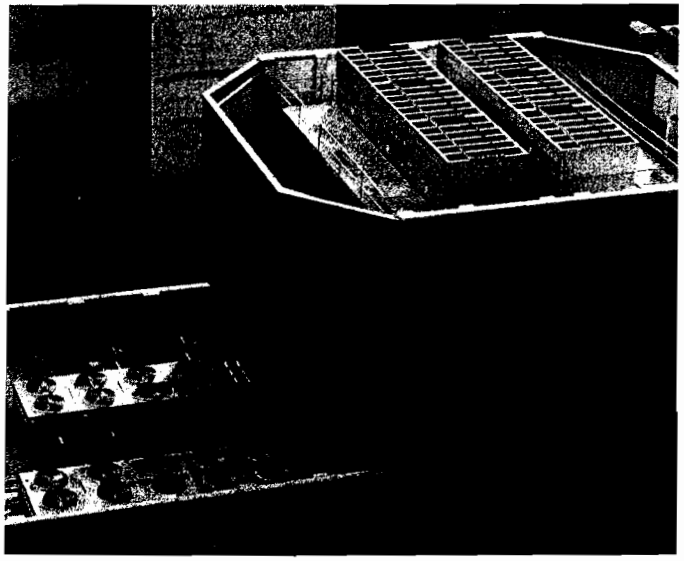


Fig. 13—Central plant for utilities demonstration systems

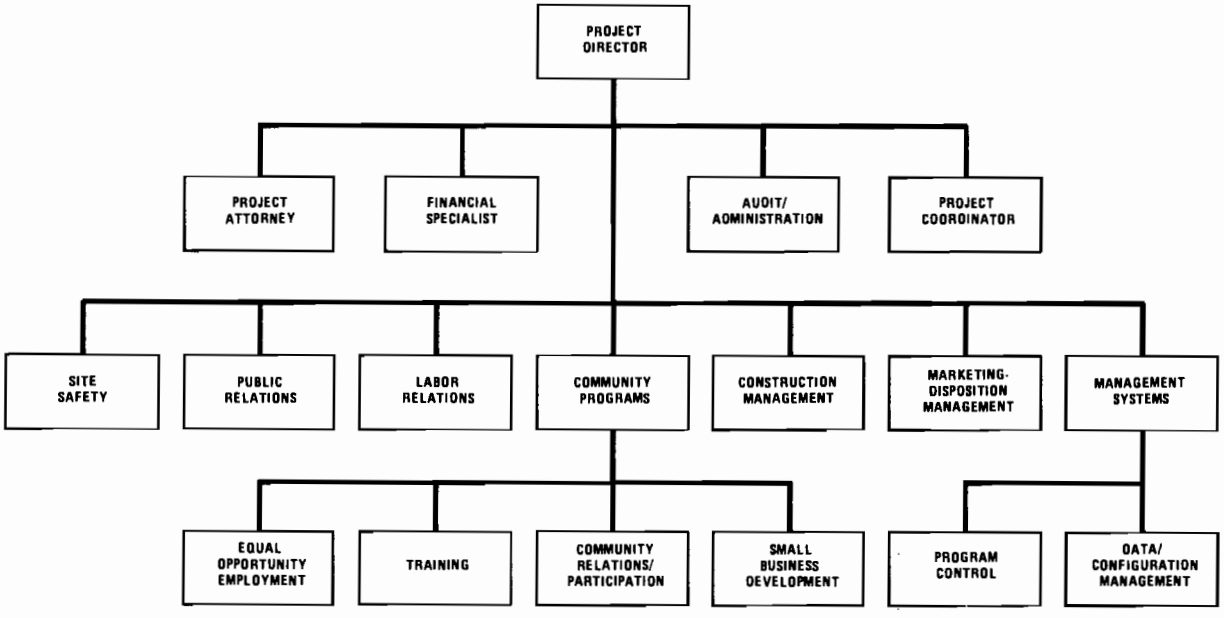


Fig. 14—PSD organization chart

stability of the electrical power delivered, and especially, the actual cost savings of a total energy plant in residential use over a long period of time. Also checked will be the plant's ability to control noise levels, air pollution, vibration, heat, and odors. Very simply, the tests will determine whether total energy plants are good neighbors.

The pneumatic trash collection (PTC) system was installed by Envirogenics Company, an affiliate of Aerojet-General Corporation. Aerojet-General is the licensee of AB Centralsug Company of Stockholm, Sweden, developer of the basic system. The PTC has been used successfully in Europe. In general, it has been found that automated waste collection systems may be more economical than conventional systems in high-rise residential complexes where labor costs are high. Although this technology has been available in the United States for several years, few systems have been installed, and comparative testing and evaluation are needed. Jersey City BREAKTHROUGH provided an opportunity to demonstrate and evaluate such a facility—the first residential system in the U.S.

Prototype Site Developer

From a nationwide group of 68 proposals, HUD selected Volt Information Sciences, Inc., as one of eight BREAKTHROUGH Prototype Site Developers (PSDs) and assigned the firm to the Jersey City project. HUD announced this selection on July 17, 1970, after completing negotiations with Volt. The news release described the PSD role as a critical effort "responsible for nearly every phase of activity on the site, from groundbreaking to eventual disposal."

Volt Information Sciences, of New York City, is a diversified management, engineering, training, and education organization with experience in technical and executive disciplines such as data management, configuration control, and integrated logistics support. Volt also has been involved with various software programs including vocational counseling, remedial education, social science research, housing program development, and business systems for a number of federal agencies and private companies.

Volt established under its Housing and Development Division an extensive BREAKTHROUGH organization (Fig. 14), and formed Summit Apartments, Inc., a special purpose organization (SPO), to act as a legal entity for the Phase II contracts and to hold title to the property. Lasker-Goldman, an accomplished construction manager under subcontract to Volt, provided the critical day-to-day presence on the construction site.

The developer awarded site construction contracts

and made purchases on the basis of sealed bids subject to HUD-approved procedures setting guidelines for bidding, cost reimbursements, fees, and listing and soliciting of minority subcontractors. HSPs contracted with the developer for housing construction (Phase II), although OBW directed the negotiations.

Volt proposed several Equal Opportunity and manpower training programs for funding by HUD or the U.S. Department of Labor. One proposal, submitted in October 1971 on behalf of the Jersey BREAKTHROUGH Construction Consortium (organized by Volt for project efforts in equal employment), was for an extensive training program under the Department of Labor's "Jobs '70" program. Volt and the three housing producers requested participation by the Joint Apprenticeship Program of the Workers Defense League (acting as training subcontractor to the consortium) and the various construction trade unions in Jersey City. However, funds were not provided for this training and Volt actually located trained minority construction workers through the existing New Jersey State Outreach Program.

The developer had signed an agreement with the Hudson County Building Trades Authority stipulating that trainees and apprentices used on the project must be acceptable to unions and employees already assigned. Volt's Equal Opportunity officer kept detailed progress records, and these were reviewed and approved by the consortium. Volt followed through with affirmative action when deficiencies arose. In some instances, employers were notified that corrective actions were required to achieve Equal Opportunity standards.

Volt's original two-year PSD contract (H-1382) was eventually extended to a 32-month period. At the expiration of the amended contract in January 1973, with the project still under development, HUD transferred the PSD effort to Boeing Aerospace Company, which had been selected as HUD's Master Site Developer for the completion of all BREAKTHROUGH sites.

Boeing continued to perform all PSD tasks until the site was sold to Summit Plaza Associates in June 1973. Under terms of the sales agreement, the new owner then assumed part of the developer's role, including some construction management, design/construction of non-residential facilities, coordination and support of the HSPs, completion of the utilities demonstration system, maintenance and operation, and rental marketing.

Through the agency of the SPO, Summit Apartments, Inc., Boeing remained active on the site, taking responsibility for construction management of the Descon buildings.

Land Acquisition

The Jersey City Redevelopment Agency owned the two contiguous parcels of land, cleared and vacant since 1955, that jointly were to become the BREAKTHROUGH demonstration site. This property represented a vital segment of the total St. John's redevelopment project. Despite friendly ownership, acquisition of this tract for BREAKTHROUGH was not easy. One obstacle was a stipulation by the owner of St. John's Apartments in his contract with the redevelopment agency reserving approval sanction over proposed St. John's redevelopment projects. The official urban renewal plan designated vacant land "for public use." For a tract so designated to be developed for residential purposes required a revision of the same urban renewal plan, with concurrence in such revision by the owner of St. John's Apartments being a prerequisite to commencement of work. This provision had been invoked once, before, in 1966, when the apartment manager successfully opposed construction of a senior citizens' housing project.

The redevelopment agency perservered in its negotiations with the St. John's Apartments owner and reached an agreement with him to execute a "Consent to Change a Redevelopment Plan." This agreement seemed to remove the final hurdle and prompted the HUD selection, in December 1969, of Jersey City for a prototype site demonstration. However, the obstacle reappeared unexpectedly. Before signing the consent agreement, the St. John's Apartments owner sold a controlling interest to a new corporation, which invalidated the consent agreement. The new owner said he did not want "subsidized housing" adjacent to his property and filed suit to enjoin the redevelopment agency and HUD from proceeding with BREAKTHROUGH.

At this point, HUD acted forthrightly, bringing condemnation action against the "6 acres of land, more or less, situated in the City of Jersey City, State of New Jersey and the Jersey City Redevelopment Agency, et. al., defendents." In December 1970, the property was awarded to HUD with a compensation to the redevelopment agency set by the court at $250,000. HUD then transferred title to the property to Summit Apartments, Inc., allowing BREAKTHROUGH to proceed. These legal complications were not resolved until October 1971 when final condemnation payment was made.

Financing

Problems of tax abatement and financing for BREAKTHROUGH required special attention, and Volt therefore retained an experienced consulting firm. The consultant prepared a plan calling for the developer to establish a sponsoring nonprofit corporation which would qualify for loans from the New Jersey Housing Finance Agency (NJHFA). Volt had its existing special purpose organization, Summit Apartments, Inc., certified as a limited dividend corporation eligible for long-term mortgage financing from the NJHFA.

NJHFA is a quasi-public, State agency established

by statute in 1967 to assist in the development of housing for moderate income families through low interest mortgage loans to qualified developers. Agency funds are raised principally from the sale of revenue bonds to private investors and institutions. Because the interest from these bonds is not subject to federal income taxes, NJHFA can lend mortgage money at interest rates ranging from 2 to 2.5 percent below prevailing market rates. Loans made by the agency can cover construction and permanent financing of housing developments and related facilities and are available to eligible limited dividend and nonprofit sponsors.

In September 1971, after a protracted period of negotiation, Summit Apartments finally obtained a long-term $17,200,000 mortgage for 40 years at 7 percent interest. This mortgage constituted the largest loan the NJHFA had made to that date. Mortgage insurance was issued under FHA Section 233 pursuant to Section 236. Marketing forecasts accompanying the mortgage insurance application indicated that approximately 70 percent of the housing units would be for moderate income families, 10 to 15 percent for low income families, and 10 to 20 percent for nonsubsidy market rentals.

An important part of the financial package is the agreement over tax abatement. In lieu of property taxes, Summit Apartments contracted to pay the city 15 percent of the annual "gross shelter rents paid by tenants," which would serve as "an annual service charge for municipal services supplied to the housing development." This charge was expected to total about $225,000 annually—dependent, of course, upon the number of units rented at true market rate.

The developer worked out procedures for drawing mortgage funds from NJHFA. This was the first time in its history that the agency provided construction financing in conjunction with FHA-insured advances. In so contracting, Summit Apartments agreed that there could be no mortgage drawdowns for construction until 100 percent drawings were submitted to FHA. For this reason, HUD funds were required until the National Bureau of Standards and OBW approved the HSP drawings.

On June 20, 1973, Boeing, acting for HUD, sold the Jersey City BREAKTHROUGH development to Summit Plaza Associates, a limited dividend corporation affiliated with Starrett Housing Corporation. Effective that date, the new owner took over all right, title, interest, and responsibility for site management and administration.

Site Preparation

Site planning was well under way when the official groundbreaking ceremony was held on December 30, 1970. Representatives from HUD, the redevelopment agency, the city, and Hudson County attended the event, which featured addresses by the developer and Jersey City Mayor Whelan. There were glowing praises for the Operation BREAKTHROUGH program, and high hopes were expressed for its anticipated results. The news media covered the event in considerable depth. It was publicly announced that site work would begin the first week in January and that the project would be completed within a year, possibly as early as the following fall. This forecast was to prove over-optimistic.

Almost all of the site improvements were intimately linked with the housing systems. Thus, very little work could be done as long as housing design problems persisted, and this, in turn, delayed completion of detailed site planning. The Townland situation was at the heart of the matter. OBW found, during Phase II negotiations, that Townland costs would exceed significantly the funds available for the Townland Phase II contract. Therefore, Townland's assignment was sharply reduced in February 1971, and a fourth producer, Shelley Systems, was assigned to the Jersey City site.

As a result, the HSP assignments and the site plan were modified. CAMCI remained as before with 153 housing units in a 16-story high rise. Descon was also unchanged, with 141 units in three buildings of 4, 7, and 11 stories. Shelley was designated for 152 units in an 18-story high rise, while Townland's new allocation was 42 units (reduced from 192) in a 6-story medium rise. Site redesign became a major effort between planner, developer, the HSPs, and OBW. Design teams located in New York, Philadelphia, and Montreal interacted dynamically by means of a telecopier network. Once more, alternative plans were assessed against the new alignment and revised cost criteria. There was a temptation to choose the simplistic solution, high-rise towers, because it was least expensive from a total cost standpoint. OBW, however, did not consider this scheme sufficiently chal-

Construction Conditions

Prior to BREAKTHROUGH, the site was vacant, having been closed for several years as a part of the St. John's urban renewal project. The remains of some foundations and utilities existed. Although it lies within a larger area of gently sloping land, the site is nearly level, broken only by a slight rise near its center. Overburden varied from 7.5 feet to 17 feet deep, with soil and foundation conditions that were generally favorable for BREAKTHROUGH construction. Beneath the debris, bedrock lies at 8 to 40 feet, covered by clay deposits and a high groundwater table.

lenging to merit BREAKTHROUGH demonstration. The favored design represented a further compromise of the idealistic concept, but it remained comparatively attractive in the urban setting.

Lasker-Goldman moved its construction trailer onto the property in May 1971, and built a site perimeter fence. Meanwhile a flurry of activity was still under way on utility plans and design for non-residential improvements, along with the continuing housing system design work. In June, Volt reviewed utility plans to determine an optimum construction sequence. A master schedule was established, but no work was started. Since the property was cleared and vacant, very little site preparation had to be done prior to arrival of the housing producers, although some utility installation would have been useful.

The familiar pattern of housing system problems continued to delay the commencement of significant on-site activity. Crane had reached a detailed level of design on the latest site configuration by September, when another major change occurred to the program. Townland, again having difficulty staying under OBW cost limits, withdrew from the Jersey City project, stating that it would be unable to meet imminent schedule requirements.

Following Townland's departure, OBW expanded Shelley's assignment to embrace another 40 dwelling units in an eight-story structure. Although this important move (see Figure 12 for the resulting final unit mix) can be described simply as a substitution, it forced more modifications to be made in the design of the site and its systems.

Crane, proceeding with non-residential designs, including the commercial space, school, and swimming pool, had to reconsider these facilities, too. Hard questions were raised: Who would operate the school? How much and what kind of commercial space was appropriate? Should the site include a swimming pool? A community building? Volt bore the major responsibility for these issues which it addressed through study and negotiations with Crane, OBW, the redevelopment agency, the school district, and affected housing producers (Shelley and CAMCI, whose structures were considered for the assignment of commercial space).

These vexations were further complicated by the emerging design requirements of the energy and trash collector systems and magnified the confusion caused by the lack of discrete stages of site development. A more orderly progression would have first established a final design, followed by site preparation, then by housing erection. But each modification to the site design would approach completion only to be invalidated by abrupt and unmanageable new changes to the program. Some design drawings were not finished, nor the related site improvements begun, until well into the erection phase. Utilities service coordination also continued long after the housing producers began construction, although part of the air vacuum piping for the PTC was laid in October 1971, just as the HSPs started.

Several problems developed concerning building regulations early in the site preparation phase. Volt failed to budget for city building fees, amounting to $80,000. This seemingly minor impasse went without a solution for a number of months until the redevelopment agency succeeded in obtaining a temporary building permit and fee waiver in August 1971. This was one of several occasions when the redevelopment agency assisted the progress of BREAKTHROUGH. Another problem arose over building code review. In the resolution of cooperation, the city had affirmed its intent to provide variances where necessary to the project. However, the Jersey City Division of Building Permits balked at issuing a blanket code waiver, taking the position that code review could be waived only if the State would certify the standard of building. The State had already deferred to the agreement between HUD and the National Bureau of Standards for testing and validation. When the city became aware of the State's position, the building permits division again asserted its inspection prerogative. The code variance question largely was unresolved during project development.

The most significant site preparation subcontract was for underground utilities distribution. Volt let this contract in February 1972. However, a labor union jurisdictional dispute shut the job down with less than 10 percent of the work done. After much negotiation, Volt terminated the subcontract. The job did not resume until Boeing took over the PSD role months later. In February 1973, Boeing awarded a new contract for this work to the lowest of seven bidders. Utility installation finally was completed in November 1973.

Housing Erection

Preparing for the anticipated start of housing construction, Volt met with the city building inspector in April 1971. At that time, the inspector, fearing new construction techniques and the danger of failures, declared that no codes would be waived. Asking to see all pre-cast elements and documentation of fabrication, he announced his intention to apply the closest possible scrutiny to the project.

The design interface requirements for site utilities, the multiplicity of housing systems, and the problems relating to non-residential facilities imposed further delay on the commencement of construction. For example, OBW and the designer of the pneumatic trash collection system devoted extensive coordination to the problem of determining the portion of the system that would be the responsibility of each housing producer for construction. Furthermore, the producers were far from finished with their 100 percent drawings. Consequently, critical fixed details of foundations, floor plans, and utility alignments were not available to the PTC designer. The designer, in turn, could not provide the producers with vital PTC sys-

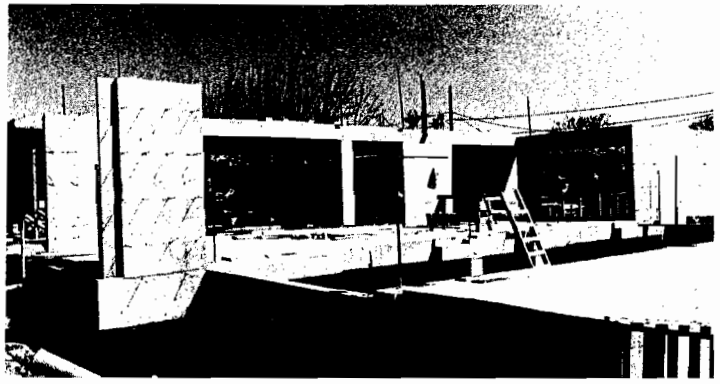


Fig. 15—First Shelley building before modules arrived

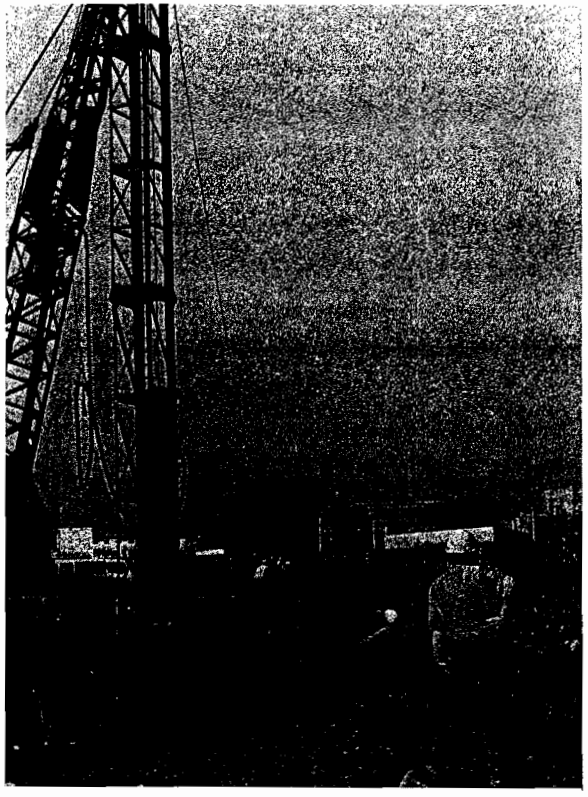


Fig. 16—Descon drives piles

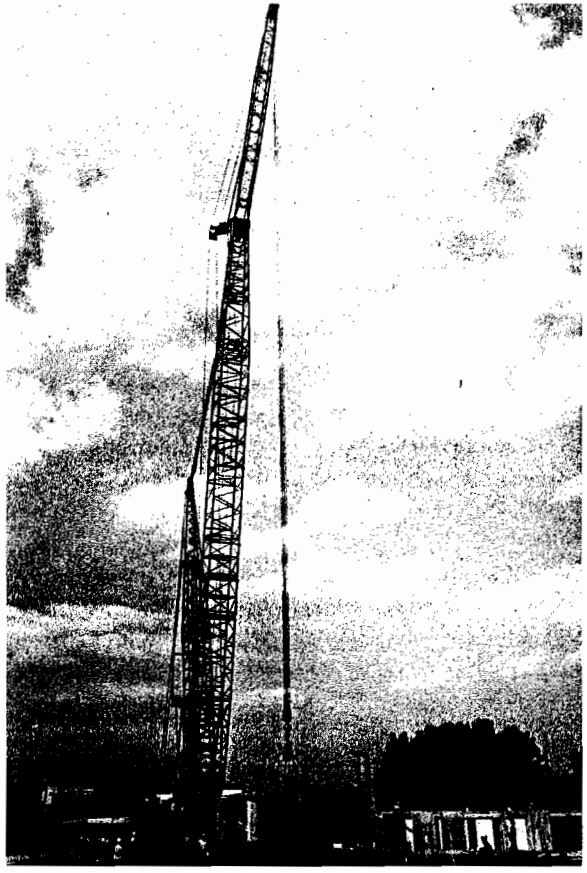


Fig. 17—Skyhorse crane lifting Shelley module

Fig. 18—Piling for CAMCI high rise

tem interface details. Thus, the interdependency of these events and the difficulty of establishing firm plans in a fluid situation contributed significantly to the initial delays.

By early fall of 1971, Shelley and Descon acquired building permits and initiated on-site work. Both prepared for erection with cast-in-place foundations. Volt and the HUD Site Technical Representative (STR) met to develop a site staging plan to accommodate housing erection on the crowded site. Shelley anticipated receiving four or five modules per day by truck from the fabrication plant 20 miles away in East Paterson. The modules, which could be delivered at night, were transported on conventional low-bed trailers reinforced for load distribution. Descon expected upwards of 40 to 50 trailer loads a day of pre-cast panels and service modules. These components would be trucked to the site, unloaded, and positioned by tractor for a crane to hoist and install.

By November 1971, Shelley was continuing foundation work and setting up for the basement. Its Skyhorse crane arrived on November 18, brightening prospects for meeting schedule requirements, which called for completion of module erection shortly after Thanksgiving. The work was progressing on the basis of 95 percent drawings; meanwhile, OBW's intense review of 100 percent drawings resulted in a need for many changes by Shelley. The foundation contractor complained that working with the 95 percent drawings was difficult, that housing producer supervision was needed, and that both of these items slowed the construction pace.

Shortly thereafter, Shelley established its project supervisor on-site to expedite matters. By December, foundations were complete and work progressed on cast-in-place slabs. At that time, Descon was progressing well with foundations, and preparing for panel erection with receipt of OBW notice to proceed. CAMCI set site coordinates in preparation for starting

site construction.

In late 1971, with the final assignment of Shelley B to replace Townland, the HSP assignments were fixed, in turn making completion of the site utility plans a high priority. The contractor for the CEB (central equipment building) began exploratory excavations for caisson drilling. At this point, well into the construction phase, design and location of several of the non-residential structures were still unresolved.

By February 1972, it became clear that none of the producers could meet the current schedule calling for start of erection in April. CAMCI had just begun preparatory work, driving piles. Shelley progressed slowly with cast-in-place concrete and some mechanical activities. Shelley's crane was not yet assembled; pre-cast work was stalled at the factory because a needed form was tied up in the dock strike; and there were as yet no approved 100 percent design drawings. Descon, also lacking its 100 percent drawings, proceeded slowly.

In April, a 16-day plumbers' strike delayed all HSP work. Plumbers' Union Local No. 69 picketed the site in a jurisdictional dispute over laying underground pipes. Shelley assembled its Skyhorse crane and began placing the runway. All producers and contractors were cautioned by the developer about non-compliance with several items in the site safety program. With the failure to meet the scheduled April erection start date, Volt asked the producers to provide updated construction schedule data.

Throughout the 1972 summer construction period, delays continued to beset the project, and the producers achieved little progress. Shelley did assemble its crane and track to be used for hoisting its modules into place. The seats for ground floor modules were also poured, and spandrels were stacked and ready for erection. Unfortunately, the modules were substantially behind the fabrication schedule. Tours of the East Paterson plant disclosed little activity. The accumulation of troubles faced by Shelley was taking its toll; previously rescheduled, the summer erection start had to be revised again. On-site, the iron workers' union demanded that Shelley have full crews on hand for the unloading of prefabricated modules; however, a compromise was reached in time to avert a strike.

Visits to Descon's Shockebeton, N.J., plant also verified a system production lag. Having not yet started prefabricating, and unable to establish an erection start date, Descon completed form work, grading, and some mechanical installation, but little other site work.

CAMCI, too, progressed slowly. Footings were poured, foundation work was accomplished, cast-in-place walls were completed, and panels stored on-site. CAMCI required an elevation set for the PTC line in order to proceed further.

Fig. 20—Shelley A topping out, April 1973

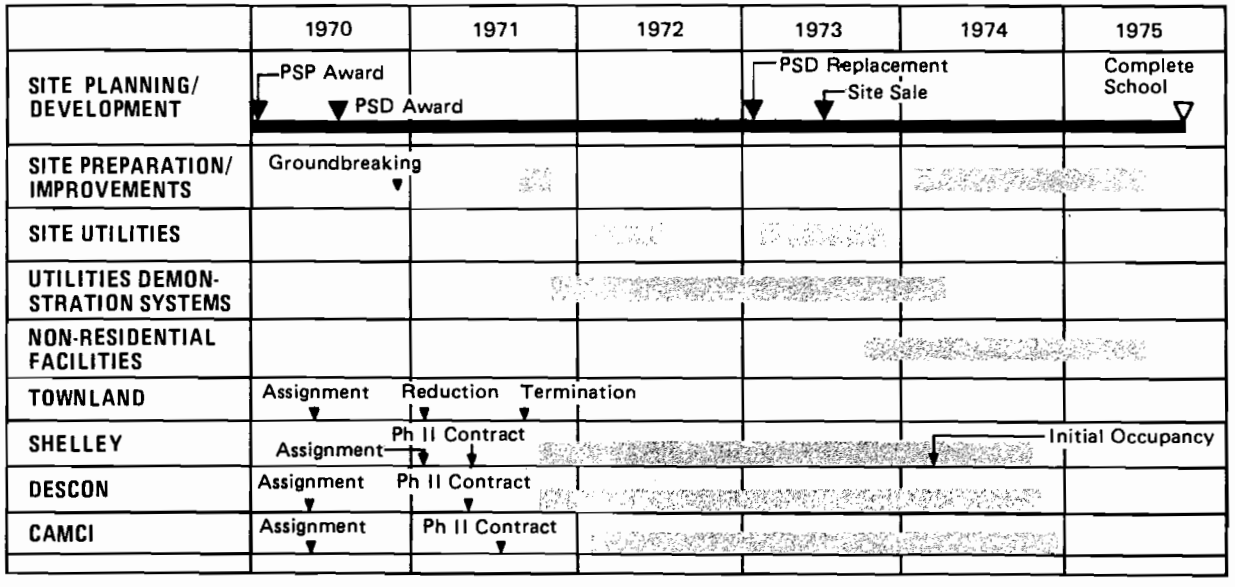


Fig. 19—Scheduled completion prolonged for three years

Fig. 21—From left: CAMCI, Descon A-1 and A-2, A-3

Fig. 22—Shelley finishing work, October 1973

In June 1972, a further complication was presented by local labor organizations. Volt met with the Hudson County Board of Business Representatives to respond to several complaints about BREAK-THROUGH. Volt's labor coordinator requested a one-week cooling-off period in which to resolve areas of conflict. Fortunately, the major issue, that of labor assignments on-site, was settled during this period, and the project continued.

In August, components of the Shelley and Descon systems started to arrive from the pre-cast plants for on-site erection. Shelley placed three modules, then quality non-conformance problems at the pre-cast plant again caused delays. Descon set its crane and began erection, showing considerable promise in this phase, placing, in the remainder of the month, 59 wall panels, 19 stairs, and 142 slabs. Only slow production and delivery of components prevented an even faster pace. CAMCI neared completion of its cast-in-place work and began erection. During this month, the elevator installers' national strike delayed preliminary elevator work.

During the fall and early winter of 1972, Descon displayed good progress in erection, CAMCI managed steady progress, and Shelley proceeded slowly, experiencing continuing quality non-conformance problems in pre-cast production and erection. Descon building A-1 was topped out in September 1972.

By the end of the year, Shelley had erected 78 modules on building A and was making mechanical installations. Shelley building B was ready for the start of pre-cast erection. Descon was well along, setting curtain wall spandrels and infill panels, pouring stairs, and continuing plumbing and electrical work on buildings A-1 and A-2 while erecting pre-cast wall and slab panels and setting service modules in building A-3. CAMCI completed all pre-cast wall and slab panel erection to the 13th floor and was progressing well with mechanical work. Over this period, problems continued to confront site construction. The elevator installers' strike still hampered the erection progress. Weather damaged some finished Shelley modules on the site. The Descon plant again lagged in supplying pre-cast components, and the quality of work from Shelley's pre-cast production plant continued to be a problem. In a number of cases, the lack of adequate shop drawings made site work coordination and inspection difficult for the developer.

The pace of housing erection was slow through the winter and into the spring of 1973. It became evident that the new completion date of summer of 1973, already reset several times, would not be met. A host of delay-causing problems still attended the project.

In April, Shelley had completed all module erection on building A and was prepared for modules on B. Shelley experienced a number of continuing problems and delays, including change order negotiations and correction of weather damage to finished modules awaiting erection. The weather damage caused Shelley to change its production method to finish the units after erection. Descon had topped off A-1 and A-2 and was finishing those buildings. A-3 was well along in panel and service module erection. Descon experienced some quality control problems, especially with its fire alarm system. CAMCI had completed pre-cast erection and was well along with its plumbing, electrical, and finish work. All producers suffered delays in the harsh winter and had been slowed by the elevator installers' strike, which was not settled until January 30, 1973. Based on the continuing problems besetting several of the producers and the slow pace of construction, schedule estimates for project completion were revised and extended to the end of 1973.

In July, Descon advised that its financial status precluded completing construction without a substantial increase in the Phase II contract price. The site had been sold in June to Summit Plaza Associates, and the sales agreement protected the new site owner against such eventualities. Under the terms of the

contract, HUD intervened and became manager of Descon's site interests. HUD designated as its agent Summit Apartments, Inc., the developer's special purpose organization (SPO). HUD then proceeded to: (1) instruct Summit Plaza to reassign its Phase II Descon contract to the SPO; (2) assign Descon's subcontracts to the SPO; (3) direct the SPO to terminate Descon; and (4) contract with the SPO to complete construction. Before the crisis, Descon had "topped out" its buildings and was engaged in finishing operations. The job was inactive for four months, but by November Summit Apartments, Inc., had work under way again.

During the first half of 1974, the major effort on the CAMCI and Shelley A buildings involved punch-list work prior to FHA inspection. The city granted partial permission to occupy Shelley A in March. By mid-year, the producers completed all construction except Shelley B, the last residential building to be started. It was accepted by the owner in July 1974, and minor punch-list items were corrected in the next few weeks.

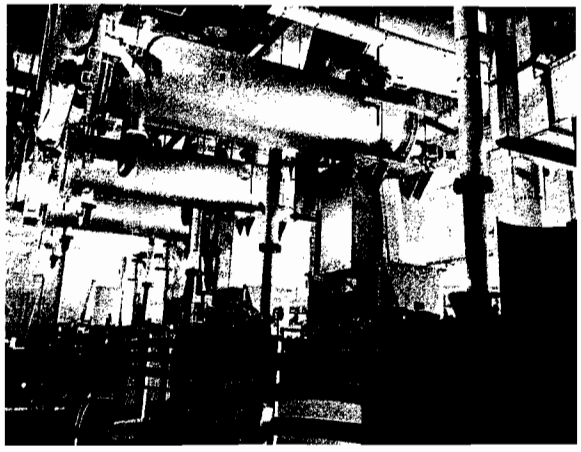


Fig. 23—Inside the Central Equipment Building

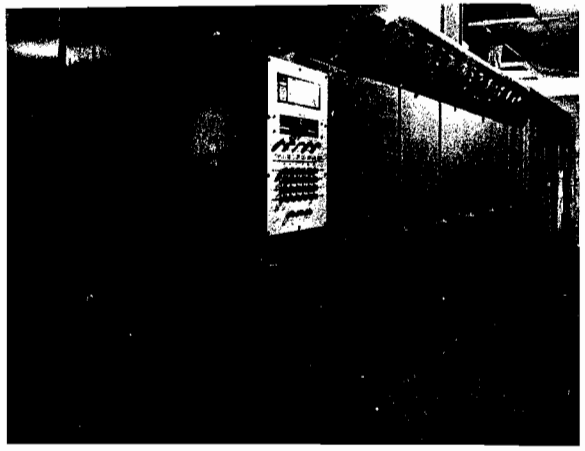


Fig. 24—Control panel for utilities demonstration

Non-Residential Development

Jersey City BREAKTHROUGH includes an extensive non-residential component, of which the energy system and trash collection system are important demonstrations in their own right. Several of the elements were closely integrated with the housing systems and other site facilities, from design through to construction. These elements contributed to and suffered from the same delays and changes.

The TES (total energy system) and PTC brought a number of additional participants onto the site and increased the demand on the developer for site management in the areas of coordination, scheduling, and interface control. Volt and OBW exerted a major effort in mid-1971 to schedule completely the development of the innovative utilities, the CEB, and supporting items such as fuel source, emergency power, maintenance, and control. Crane designed the CEB, while OBW assigned the TES design to Gamze. Volt let several construction subcontracts in late summer, and the building contractor started on the CEB in December.

Volt released bid packages in February 1972 for installation of the TES. Even the lowest of seven bids was for twice the budgeted funds available. Several bidders agreed to negotiations. C. W. Johnson was selected in March and had a full-time supervisor on the site in April. TES and PTC contractors generally stayed closed to schedule despite several changes required as a result of checking by Volt and NBS. The PTC designer, Envirogenics, experienced an interface problem where the pipelines and chutes were to run within the non-residential structures. Because HSP reassignments disturbed the site plan, non-residential building design trailed. Envirogenics solved its own problem by setting the alignments and elevations in the PTC design; other subsequent designs were obliged to conform.

Crane proceeded with design until May, when OBW determined that more economies were needed. Volt and OBW decided that a separate design-construct package for the commercial building, school, Descon deck, and swimming pool would be a cost-effective approach. The pre-school was deleted from the project. Volt requested proposals from design-construction contractors and, in the summer, awarded the contract to a joint venture for $2,400,000. The joint venture not only experienced administrative difficulties but also found that construction costs would be higher than expected. Volt terminated that contract and, in November 1972, selected the Austin Company to make a preliminary design, with a design-construct option based on cost estimates.

In July 1972, Volt and C. W. Johnson met with

the city and gained the necessary code waivers for the TES, but the pace of work was slow through 1972. Development of the TES required occasional component testing; otherwise, there were the now-typical inconveniences resulting from belated release of final drawings and interface problems between TES and housing erection.

Austin completed its work in February 1973 and submitted a lump sum proposal to build the non-residential facilities for $2,910,000. This amount again substantially exceeded previous estimates and available funds. OBW rejected the proposal. Several months later, under terms of the sale to Summit Plaza Associates, the new site owner accepted responsibility for providing facilities equivalent to those proposed by Austin. Work proceeded at the characteristically slow pace evident elsewhere on the site. Construction finally began on the Descon deck in October 1973; and was substantially completed prior to Descon's first occupancy in June 1974. The commercial building was completed (except for glazing) in the spring of 1975 and the school is scheduled to be completed in the fall of 1975.

When Boeing, as Master Site Developer, took over from Volt, the TES effort was expedited because it was expected to pace the overall project. Boeing therefore augmented the vital construction management task, establishing particularly close supervision of the contractors. Although outside factors continued to delay the TES schedule, progress improved enough to permit completion before the system was actually needed. In December 1973, the TES became operational. Testing and modification of components of both TES and PTC continued until final installation and full system demonstration early in 1974. The TES supplied power for on-site construction activities during this period. On April 1, 1974, Gamze, under contract to HUD, became operator of the TES, which began supporting daily living requirements. The PTC began partial operations in early 1974 with service extended to other site facilities upon their completion.

In retrospect, the interface problems common to these complex and closely related facilities proved perplexing. The development of the non-residential facilities unquestionably complicated the overall BREAKTHROUGH project, but it seems clear that the advanced utility systems, in particular, will provide a valuable demonstration.

Community Relations

As was the case at other BREAKTHROUGH sites, community relations were more strained at the inception of the project than at any time thereafter. However, after the land had been successfully acquired and initial opposition from some St. John's residents had been expressed, there were few other problems.

The site planner took pains to explain the project to the public through news releases, special site tours, and general media coverage. Crane identified a number of organizations expected to be interested in BREAKTHROUGH, foremost of which was the mayor's citizens' advisory committee. This large group of some 80 people, working through various subcommittees, constituted a powerful forum for active citizen involvement in Jersey City. The planner recommended making early contact so that community relations and public involvement might most effectively flow through this committee. Other interested organizations identified included area development groups, merchants' associations, real estate boards, labor unions, the board of education, and citizens' groups.

Residents of nearby St. John's Apartments initially opposed BREAKTHROUGH, based on little more than fear of a "low cost housing project" that would cause "depreciation of property values." Prior to development, Crane, Volt, HUD officials, and representatives of local government held a series of community meetings at City Hall, before the citizens' advisory committee, and in the immediate St. John's area. Although moderately strong anti-BREAKTHROUGH sentiment was expressed during the planning stage, today there is little evidence of opposition.

HUD's funding of the Jersey City BREAKTHROUGH project did not provide for a visitors center program. Site tours for a number of interested people and groups were arranged by the redevelopment agency, the developer, and other officials; and interested visitors were accommodated as well as possible. A great number of inquiries was received regarding the project, with more than 4,000 expressions of interest in tenancy. These queries found their way to the developer, the redevelopment agency, city departments, and others.

Operation and Maintenance

In Jersey City, project operations were limited to management of the demonstration by the developer and making provisions for site safety, security, and maintenance. Due to the extensive delays in site development and housing erection, rental management and project maintenance efforts could be, and were, assumed directly by Summit Plaza Associates upon purchase of the project.

Lasker-Goldman managed site safety to HUD standards, with the site superintendent acting as safety officer. Each housing producer was responsible for enforcing safety within its own building envelope through a system safety officer who also regulated subcontract activity. Periodic meetings were held to discuss site safety procedures.

A minority-owned industrial security service, organized for the project with the help of the Jersey City Urban League, provided site security under subcontract. This approach, conceived by Volt, brought minority presence on-site and gave an opportunity for minority training. The security force operated from

an office located in a construction trailer. Trespass, vandalism, and theft during the project development resulted in some monetary loss and minor impacts on the schedule.

Marketing

Initial sponsorship of the project by the Jersey City Redevelopment Agency assumed a commitment to low and moderate income housing as well as to market rate rentals that would accommodate middle income urban dwellers. Such a mix was highly desirable in order to realize the full potential of the prime urban residential property. The mortgage was insured under FHA Section 233, pursuant to Section 236, providing for subsidized housing. Various recommendations were made during site development for ultimate occupancy, but no marketing plan had been approved. Then in June 1973 HUD sold the site to Summit Plaza Associates. The new owner accepted all responsibilities for marketing from that time forward.

It is worth repeating that, during development of the project, over 4,000 people inquired about rentals. Obviously, the marketing task was not to fill the units; the real challenge was to assure an optimum mix of tenants.

On March 11, 1974, the first residents moved into Shelley A at Summit Plaza. Demand was high, and almost 300 units were leased in the first two months. Of these renters, 35 percent are elderly or retired, 20 percent minorities, and 20 percent Manhattan commuters. (Obviously, these are not mutually exclusive categories.) When all the units became available, full occupancy was achieved rapidly with the final tenant mix distinctly multinational and ethnically mixed. Most of the units are under FHA Section 236 with the remainder rented at market rate or under HUD's rent supplement program.

Weather and Comfort

Jersey City's climate is that of the New York metropolitan area, with yearly temperature averages ranging between 77° and 31° and extremes between 95° and 10°. Despite relatively mild temperatures, the prevailing high summer humidity dictated the installation of air conditioning in all dwelling units. Annual precipitation is 42 inches. Winds, averaging 10 miles per hour, blow mostly from the northwest and the southwest, but occasional onshore winds carry Atlantic storms and heavy precipitation into the area.

GRT for site development — W. Wilcox, R. Jones
GTR for planner — M. Chateauneuf, C. Gueli
STR — S. Nagel, A. Reed
ACO — M. Senchak
Director of OBR — A. Marcks, J. Sweeney

HOUSING SYSTEM PRODUCER SCHEDULES

CAMCI, INC. — 153 Multi-Family High Rise

Phase II Contract:	Start foundations	1-72
	Start erection	3-72
	Complete erection	10-72
	Finish units	12-72
Actual Performance:	Start foundations	2-72
	Start erection	8-72
	Complete erection	2-73
	Finish units	12-74

DESCON SYSTEMS, LTD.
12 Multi-Family Low Rise
24 Multi-Family Medium Rise
105 Multi-Family High Rise

Phase II Contract:	Start foundations	10-71
	Start erection	8-72
	Complete erection	12-72
	Finish units	3-73
Actual Performance:	Start foundations	10-71
	Start erection	8-72
	Complete erection	4-73
	Finish units	10-74

SHELLEY SYSTEMS, INC. — 192 Multi-Family High Rise

Phase II Contract:	Start foundations	8-71
	Start erection	5-72
	Complete erection	1-73
	Finish units	2-73
Actual Performance:	Start foundations	10-71
	Start erection	8-72
	Complete erection	9-73
	Finish units	9-74

HSP COSTS
(dollars in thousands)

Producer	Cost
CAMCI	$3,562.1
Descon	5,753.0
Shelley	8,097.6
Total	$17,412.7

PROTOTYPE SITE DEVELOPMENT SCHEDULE

Preliminary CPM December 1970:	Start site preparation	1-71
	Start housing construction	1-71
	Finish housing construction	7-71
	End demonstration/marketing	7-72
Interim CPM July 1971:	Start site preparation	5-71
	Start housing construction	8-71
	Finish housing construction	3-73
	End demonstration/marketing	3-74
Actual Performance:	*Start site preparation	10-71
	Start housing construction	10-71
	Finish housing construction	12-74
	End demonstration/marketing	6-75

*Site fence constructed 5-71

SITE IMPROVEMENT COSTS
(dollars in thousands)

Item	Cost
Landscaping, paving, site amenities	$1,269.0
Site utilities	1,071.4
Non-residential facilities	3,499.0
Total Energy System	3,392.6
Total	$9,232.0

Fig. 25—Jersey City site costs and schedules

2-28-75

Appendix

Appendix

Glossary

Three separate lists are provided here for the reader's convenience: generally used abbreviations and acronyms, standard definitions of housing types, and brief descriptions of pertinent FHA programs.

General Terms

ACO .... Administrative Contracting Officer

ACSI .... Alcoa Construction Systems, Inc.

ASH .... Adult Student Housing, Inc.

BCHD .... Boise Cascade Housing Development

BSI .... Building Systems International, Inc.

CAMCI .... CAMCI, Inc., a subsidiary of Module Communities, Inc. (name derived from "Celanese American-Module Communities, Inc.")

CPM .... Critical Path Method

CTC .... Community Technology Corporation

CWS .... Christiana Western Structures

FCH .... Foundation for Cooperative Housing

FHA .... Federal Housing Administration

FHLB .... Federal Home Loan Bank

FNMA .... Federal National Mortgage Association ("Fannie May")

GE .... General Electric Company

GNMA .... Government National Mortgage Association ("Ginnie May")

GTR .... Government Technical Representative

HBC .... Home Building Corporation

HSP .... Housing System Producer

HUD .... U.S. Department of Housing and Urban Development

HVAC .... Heating-Ventilating-Air Conditioning

MCI .... Module Communities, Inc.

MFHR .... Multi-Family High Rise

MFLR .... Multi-Family Low Rise

MFMR .... Multi-Family Medium Rise

MSC .... Material Systems Corporation

MSD .... Master Site Developer

N/A .... Not Applicable

NAACP .... National Association for the Advancement of Colored People

NASA .... National Aeronautics and Space Administration

NBS .... National Bureau of Standards

NCHP .... National Corporation for Housing Partnerships

OBR .... Operation BREAKTHROUGH—Regional (HUD regional program office)

OBW .... Operation BREAKTHROUGH—Washington (HUD Washington, D.C. program headquarters)

PD&R .... Office of Policy Development and Research, HUD

PERT .... Program Evaluation Review Technique

PSD .... Prototype Site Developer

PSP .... Prototype Site Planner

PVC .... Polyvinyl Chloride (plastic pipe)

R&T .... Office of Research and Technology, HUD (now PD&R)

SFA .... Single Family Attached

SFD .... Single Family Detached

SLS .... Supported Land System (Townland)

SPO .... Special Purpose Organization

STR .... Site Technical Representative

TRW .... TRW Systems Group

Housing Type Definitions

SFD .... Single family detached. A single dwelling on an individual lot, self-contained and physically separated from other buildings by open area. May be one or more stories high.

SFA .... Single family attached. A single dwelling on an individual lot, self-contained but with at least one wall commonly shared and subdividing a larger building complex. May be one or more stories high; the dwelling unit occupies the space from the lowest level to the roof. Popularly called a townhouse or row house.

MFLR .... Multi-family low rise. A multiple dwelling on a common lot, composed of two or more single living units (apartments or flats) in a building that is one to three stories high. The units typically share the use or ownership of some facilities; the building may or may not have elevator service. A "garden apartment," in Operation BREAKTHROUGH usage, is an MFLR unit accessible to outside landscaping on at least one side, in a walk-up (no elevator) building, but not necessarily occupying all space from lowest level to roof. "Duplex," "four-plex," etc., usually are MFLR terms, with the prefix indicating the number of dwelling units in a single structure.

MFMR .... Multi-family medium rise. A multiple dwelling on a common lot, composed of a number of single living units (apartments or flats) in a building more than three stories high but less than eight. The units typically share the use or ownership of some facilities; the building has elevator service. This category resulted from the practical limits of various elevator types in apartment buildings.

MFHR .... Multi-family high rise. A multiple dwelling on a common lot, composed of a number of single living units (apartments or flats) in a building more than seven stories high. The units typically share the use, or ownership, of some facilities; the building has elevator service. Strictly speaking, MFHR originally covered all multiple dwellings over three stories high, but MFMR as an intermediate category has since gained currency.

Sections of National Housing Act Used to Insure Operation BREAKTHROUGH Mortgages

Section 203 (b) .... Insures construction or purchase of one- to four-family homes. Market rate of interest.

Section 207 Insures construction or purchase of multi-family rental housing projects. Market rate of interest.

Section 213 Insures construction or purchase of cooperative housing projects. Market rate of interest.

Section 221 (d)(2).... Insures construction, rehabilitation, or purchase of homes for low and moderate income families and families displaced by governmental action. Market rate of interest.

Section 221 (d)(4).... Insures construction or rehabilitation of housing projects for moderate income families and families displaced by governmental action. Market rate of interest.

Section 233 Insures construction of experimental housing which involves the utilization and testing of advanced technology in housing design, material, or construction, and which meets the insuring requirements of other sections of the National Housing Act.

Section 234 Insures construction, rehabilitation, or purchase of condominium projects. Market rate of interest.

Section 236 Insures construction or rehabilitation of multi-family housing projects for lower income families. Interest-assistance payments by HUD to the mortgagee on behalf of the mortgagor.

Sources of Information for This Report

General

The histories of the Operation BREAKTHROUGH prototype sites were prepared basically from two sources: interviews with people involved and monthly PSD status reports. Correspondence, press releases, newspaper clippings, and magazine articles were used wherever available and appropriate. HUD made the final determination of the material to be presented. Primary references for specific sections of this report are given below, followed by a partial list of important general publications. An earlier, but thorough, list is in *Operation BREAKTHROUGH: Mass Produced and Industrialized Housing: A Bibliography*, prepared by the HUD Library in May 1970 and sold by the Superintendent of Documents, U.S. Government Printing Office.

Introduction

Secretary Lynn's remarks appeared first in "Portrait," *Automation in Housing*, December 1973/January 1974. The "Final Report of the Operation BREAKTHROUGH Prototype Site Evaluation Board" fully describes the site selection process. Transmitted to Secretary Romney by memorandum from John H. Betz, chairman of the evaluation board, the report is not in general circulation. The definitive article on the subject, "Evaluation of Proposals for Operation BREAKTHROUGH," by Ralph Warburton, *Industrialization Forum*, July 1970, includes brief sketches of the selections of producers and planners.

Prototype Site Developer Role

The chronology is from HUD news releases. HUD Procedure OB-1, in draft, and a PSD contract were referred to as well. An article by Andrew R. Mandala in the October 1970 *House & Home*, "Operation Breakthrough Struggles to Avoid Becoming Operation Breakdown," describes the funding cutback.

Prototype Sites

Kalamazoo

Bert L. Smokler & Company prepared a comprehensive final report that includes personal judgments and assessments of the various housing systems. The final report from Perkins & Will, September 1972, is another source. Photos came from Schiavone Studio, Kalamazoo, and the Perkins & Will Partnership.

St. Louis

Millstone submitted to HUD a final report that covers basic data such as dates and events. Perspective on LaClede Town can be obtained from "LaClede Town: The Most Vital Town in Town," *Architectural Forum*, November 1968. A history of the development of the site is in the St. Louis Plan Commission's "Saint Louis Progress Report" series. "Breakthrough Update," *Professional Builder*, June 1971, gives an HSP point of view. The final report by Hellmuth, Obata & Kassabaum, Inc., is informative on site investigations and conceptual planning. *The Management Manual: St. Louis Operation BREAKTHROUGH*, prepared by the LaClede Town Company, is a guide to physical, fiscal, and social management. Dorrill Photocolor, St. Louis, provided several photographs.

Macon

The PSP's Task I report, April 1970, provides input for the Pre-Development Activity and Site Plan subjects; also, the final PSP report of April 1972 has comments on the site adaptability of various housing systems. Dr. Alfred W. Hoadley, School of Civil Engineering, Georgia Institute of Technology, and Professor James O. Harrison, Biology Department, Mercer University, made the environmental studies (water quality and ecology, respectively) cited in the text. These appear in quarterly reports to HUD from the Macon-Bibb County Planning and Zoning Commission. "Operation Breakthrough," by Marley Cole, *Today's Homes*, Winter 1972 edition, is a popular description of the program that uses Crystal Lake as the example. A different aspect appears in "Operation Breakthrough—Progress Report from Macon," *Mobile-Modular Housing Dealer*, August 5, 1972. Information about the cooperative method is given in a brochure prepared (1971) by FCH Services, Inc., for Kenilworth Manor, Inc. An interview with Craig E. Lindelow, former executive director of the Macon-Bibb County Planning and Zoning Commission, enlarged our knowledge of planning considerations early in the program. Mr. Lindelow also furnished a picture of the balloon test. John Bell (once with the planning and zoning commission) prepared a paper, "Operation Breakthrough in Macon, Ga.—A Case Study," while at Georgia State University. It discusses community involvement. "Three Years Change Crystal Lake's Image" in the *Macon Telegraph and News*, April 8, 1973, is a historical view. The *Congressional Record*, May 29, 1974, lists the design awards.

Sacramento

An article in *The Christian Science Monitor*, "Pioneering Builders Find Pioneering Buyers," by Merelice Kundratis (September 25, 1970) covers early community reaction. The University of California study by Richard Bender, et al. *Industrialization of the Building Site*, includes narrative accounts of the development at Greenfair. Working papers prepared for that study by John Parman supplied not only facts but a different point of view. Marketing factors that influenced development plans were obtained from *Residential Housing Analysis and Recommendations* by Larry Smith & Co., April 13, 1970. Construction conditions were given in the October 1970, *Soils and Geological Engineering Report*, by Dames & Moore. The site criteria (October 1970) established by Wurster, Bernardi and Emmons/Lawrence Halprin and Associates, and the planner's final report (January 1973) support the Pre-Development Activity and Site Plan topics. The specific responsibilities of the advertising and marketing agents and the PSD role are described in the "Greenfair Marketing and Operations Manual" dated January 11, 1972. One comment about the Oak Park neighborhood appeared in the July 1973 *HUD Challenge*. General background material is in *Symposium '72: Factory Housing Forum* (a transcript), Industrialized Housing Council, Berkeley, Calif. Various photographs came from Pope Studios, David A. Kahl, John S. Baldwin, and *The Sacramento Union* (all of Sacramento), and from Jeremiah O. Brogstad of San Francisco.

King County

Boeing Company appraisals covered some parts of the King County story. Specifically: Business Acquisition; Organization and Staffing; Program Planning, Scheduling, and Control; Community Relations; and Equal Opportunity were topics of monographs with limited distribution because of proprietary implications. Scrapbooks kept at the site from the start of the program preserve the media's views on most important events. Copies of the site planner's report, written in April 1973, are available. Eckbo, Dean, Austin & Williams/George S. Nolte wrote the Task I report, March 1970. Parman's coverage of the site development (*Industrialization of the Building Site*, as mentioned under Sacramento sources) gives an insight to King County government attitudes.

Seattle

The internal sources noted for King County also apply to the other site that Boeing developed fully. Building Systems Development wrote the PSP final report in June 1973. That firm also produced the Task I report (March 1970) and a supplement (June 1970). Because Townland was the only HSP at Seattle, the Townland section in Feedback's *Phase I Design and Development of Housing Systems* is an important reference. Parman's view of the site development (*Industrialization of the Building Site*, as mentioned under Sacramento sources) is helpful.

Memphis

The Alodex Corporation maintained comprehensive files during its involvement in BREAKTHROUGH that were used as source material, along with interviews of Alodex personnel. Memphis Housing Authority and Adult Student Housing provided both historical and operational data. A *Business Week* article, "The Swift Decline of Stirling Homex," October 28, 1972, amplifies the withdrawal of that HSP. The PSP report by Miller, Wihry & Brooks describes the site plan and its design process. Rod Phillips, Memphis, took several of the photographs shown herein. The Memphis Public Library located the old picture of the railroad depot and arranged for a copy by Nadia of Memphis.

Indianapolis

Information and photographs in the files of Urban Systems Development Corporation document much of the Indianapolis site history. The monthly narrative reports were helpful. A series of interviews with key PSD personnel, covering a wide range of experiences, supplemented the written material. The planner's reports, by Skidmore, Owings and Merrill (Phase I—March 1970; Final—November 1970), contributed to the Pre-Development and Site Plan topics. Aerial photos are by Robert Lavelle, Indianapolis. Some other pictures came from Craig Kuhner, Muncie, Ind., and Uwe Kohler of Ball State University.

Jersey City

The major part of the Jersey City Operation BREAKTHROUGH story was derived from the monthly narratives and daily logs prepared by the Lasker-Goldman Corporation, the PSD subcontractor for construction management, and from discussions with Lasker-Goldman personnel. "Jersey City's Operation Breakthrough—A Case Study," by Jack Raphael Stokvis (Jersey City Redevelopment Agency, January 1972), gives input for the background and progress through 1971. Facts about the pre-development activity and the site planning/design effort that contin-

ued well into the construction phase come from the PSP Task I report of March 1970 and from David A. Cranes's "Operation Breakthrough Experience," *International Systems Building Round Table Conference* (Synopsis and Proceedings), published by the Boston Architectural Center, January 1973. The PSP final report (August 1973) makes good use of illustrations to explain the planning process. Technical aspects of housing construction are described in "Industrialized Housing Comes on Strong in Jersey City," *Constructioneer*, January 8, 1973. Another progress report, with emphasis on Shelley, is in *Engineering News-Record*, June 14, 1974. The description of the utilities systems is based on "Total Energy and Pneumatic Waste Collection Demonstrations," published by HUD in May 1972. "Pneumatic Waste Collection on the Rise" by Gene Dallaire, *Civil Engineering*, August 1973, is the source for the "first" claimed by the PTC. Later information appears in "Total Energy Plants Utilize 'Waste' Heat," by Tom Bergeron, *Contractors' Electrical Equipment*, September 1973, and in "Recycled Trash Will Heat and Cool," by Richard Rescigno, *Bergen County Record*, September 20, 1974. Clippings from *The Jersey Journal*, a daily newspaper, provide history and information about public and local government acceptance of the BREAKTHROUGH program. Louis Checkman, Jersey City, took the photograph of the site model used in the Introduction.

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