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Cost-Effective Housing Systems for Disaster Relief

ORIGINAL

Evaluation of Applicable Housing Systems Technology

Volume 4

Department of Housing and Urban Development
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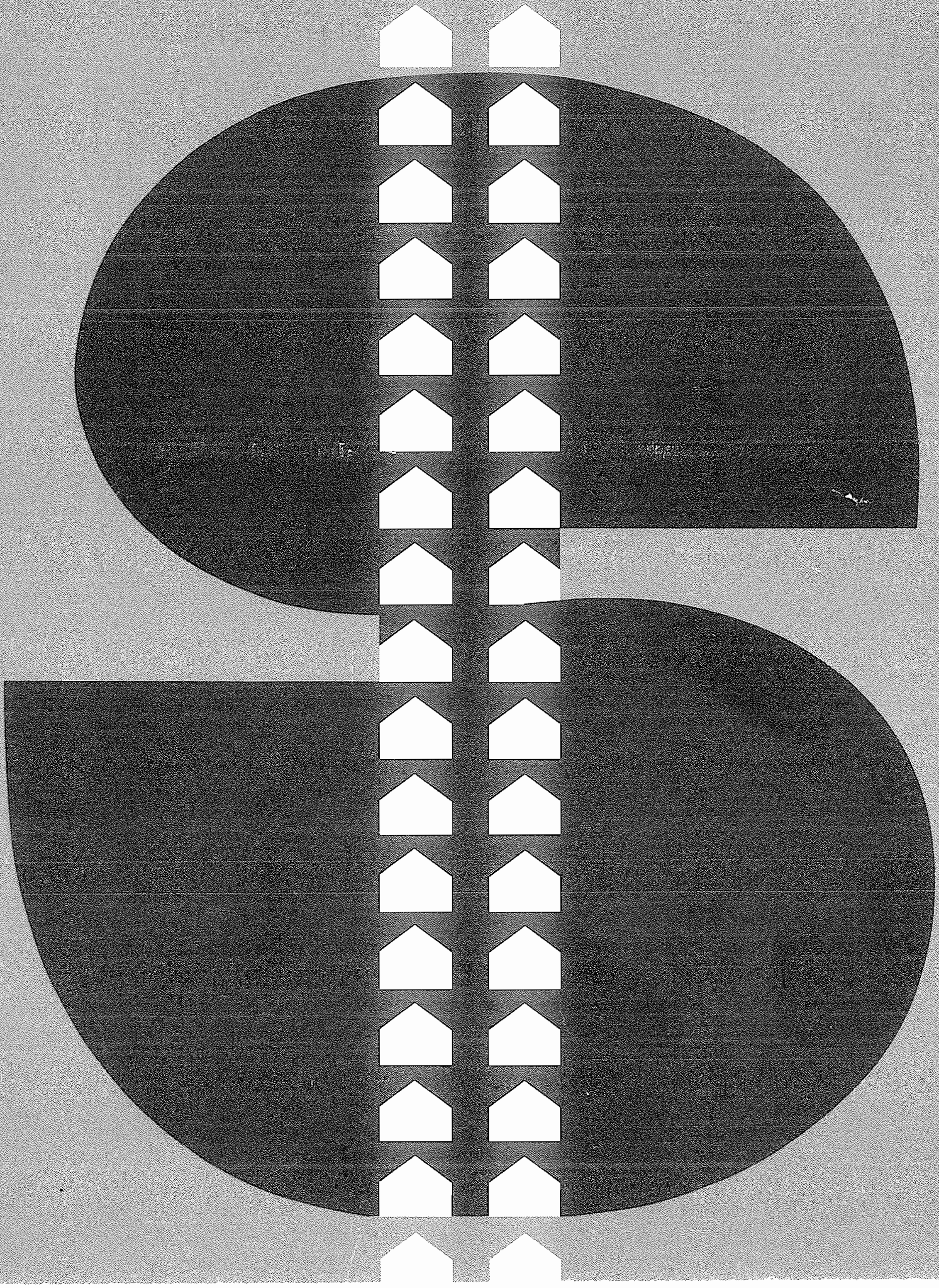

COST EFFECTIVE HOUSING SYSTEMS FOR DISASTER RELIEF

VOLUME 4

EVALUATION OF APPLICABLE HOUSING SYSTEMS TECHNOLOGY

Prepared for
Office of Policy Development and Research
ivision of Energy, Building Technology and Standards
U. S. Department of Housing and Urban Development

by
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Beyer-Blinder-Belle
A Joint Venture

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ABSTRACT

This report examines the entire spectrum of lightweight industrialized housing systems and selected subsystems and evaluates them as temporary accommodations for disaster relief. The purpose of the report is to isolate potentially applicable housing systems and, through a process of pre-selection, identify a limited number of systems that can be rigorously analyzed for cost-effectiveness in Task II.

Four main segments of the industrialized housing industry are identified: the mobile home segment, which produces mobile homes and travel trailers; the manufactured housing segment, which produces packaged or panelized housing as well as a variety of modular systems; manufacturers of special relocatable systems, such as those used by the military and oil companies for semi-permanent housing; and manufacturers of selected subsystems who produce mechanical cores and special foundation systems. Each segment is described in a separate report which traces the origin, development and nature of the industry; its current role in housing production, with emphasis upon its share of the market; and an evaluation of the applicability of its products to disaster relief.

The framework for evaluating housing systems emerged from the cooperation of interested manufacturers and the application of specific criteria proposed by HUD. Systems are classified by their usefulness for temporary housing or permanent housing. Although typical systems produced by the manufactured housing industry are not suitable for temporary shelter, they were analyzed for use in a new form of housing assistance: the Fast Delivery Permanent Home. This approach is proposed to offer displaced families, as an alternative to temporary housing assistance, the option of effective assistance for moving into a new, permanent home in the shortest possible time.

Temporary housing systems are classified according to their basic configuration: one box on wheels, the expandable box, two sectional boxes, the sectional box and knock-down, the core and panelized and the core and special packaged enclosure. Since these systems are

used temporarily, a set of minimum livability standards is applied to each system. The effect of these standards is to substantially reduce the size of the units, making them easier to transport and to maintain in relation to the standard single-wide mobile home which is currently being used for temporary disaster housing.

Twelve systems, falling within the basic configurations, are pre-selected for cost-effective evaluation. Each system is standardized to satisfy the minimum livability criteria. Mechanical subsystems are also analyzed and an all-electric system is applied to two of the pre-selected systems. Various methods for water supply and waste water treatment, such as portable systems or hauling to and from the site, are also evaluated for use at group sites.

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LIST OF ABBREVIATIONS

AASHTO - American Association of State Highway and Transportation Officials
ANSI - American National Standards Institute
ASA - American Standards Association
AWPI - American Wood Preservers Institute
BOCA - Building Officials Conference of America
BRAB - Building Research Advisory Board
DOD - Department of Defense, U.S.
EPA - Environmental Protection Administration
EPS - Emergency Preparedness Staff
FDA - Food and Drug Administration
FDAA - Federal Disaster Assistance Administration
FHA - Federal Housing Administration
FIA - Federal Insurance Administration
FmHA - Farmers Home Administration
HUD - Housing and Urban Development, U.S. Department of
ICBO - International Conference of Building Officials
INBEX - Industrialized Building Exhibit
ISO - International Standards Organization
MHMA - Mobile Home Manufacturers Association
MLS - Minimum Livability Standards
NABM - National Association of Building Manufacturers
NASA - National Aeronautics and Space Administration
NCBSC - National Conference of States on Building Codes and Standards
NFPA - National Fire Protection Association
RVI - Recreational Vehicle Institute
SBA - Small Business Administration
SBCC - Southern Building Code Conference
TCA - Trailer Coach Association
USPHS - U.S. Public Health Service
VA - Veterans Administration
WHO - World Health Organization

I INTRODUCTION AND SUMMARY

A. SCOPE

The contract for the present study defines the scope of this sub-task as follows:

> The contractor shall perform a literature search and investigation of types of temporary housing systems that have been utilized in past disasters and other types of temporary housing in use or being considered, for example, by the Department of Defense...
>
> The contractor shall investigate other forms of housing that could be utilized. Sub-system technologies which are not developed are not to be considered. Neither this project nor the subsequent demonstration project will fund any technology development. It is possible that the subsequent project will demonstrate new developed technology as a part of the housing system.
>
> The applicable codes for the selected system(s) and transportation standards in the disaster susceptible regions of the county are to be investigated and assessed. From this assessment HUD intends within a reasonable period of time to determine the applicable standards and codes to be utilized for disaster housing systems. Mobile water, waste treatment, and equipment is to be investigated, to determine its applicability.

The focus of the study is clearly on industrialized housing systems which "... should be immediately available for mass production." The difference between temporary and permanent industrialized housing is hard to define. Any light-weight system may qualify for either use. Therefore, this part of the study focused on the entire spectrum of complete, lightweight industrialized housing systems and selected components.

B. SUMMARY

1. INDUSTRIALIZED HOUSING SYSTEMS TECHNOLOGY AS A RESOURCE FOR DISASTER RELIEF MISSIONS

a. Context

During the past three decades industrialized housing systems have increasingly replaced conventional homebuilding in the United States. Industrialized technology has taken many forms, ranging from factory construction of complete houses to mass production of components like windows and mechanical cores. The market share of factory-built complete housing units has increased from 6% of total annual housing starts in 1950 to 18% in 1960 and 37% in 1970. It may reach 50% in 1974.

While industrialization is a major factor in the construction field, it emerged later and less dramatically than industrialization in such fields as transportation and communication. Resistance to industrialized construction appears to reflect an ambivalence characterized by fascination and fear. While the application of industrialized technology to such items as cars, telephones and airplanes has been readily accepted, industrialized technology has had to enter the field of housing under disguises. Thus, the full potential of industrial technology is far from fully realized in the construction field. Consequently, a realistic evaluation of the potential role of industrialized housing technology must focus on both technology and the factors affecting its development.

b. The Legal Framework

Key indicators of the ambivalence and resistance towards industrialized housing are the laws that regulate construction, shipment and use of factory-built housing. More than technology, these laws define the difference between the two main types of industrialized construction--mobile homes and manufactured housing.

Mobile homes were created largely to provide large amounts of mass-produced housing that sidestepped building codes, the laws traditionally governing housing construction. The mobile home's integral running gear has made it easier to transport the system and allowed it to qualify as a vehicle, thereby making building codes inapplicable. In place of building codes, the industry sponsored its own, more lenient construction standard for mobile homes--ANSI A 119.1--a performance code now adopted fully or partly by all but 11 states.

Manufactured housing, on the other hand, has been severely limited by having to comply with a multitude of prescriptive local building codes. Only recently, some statewide laws have been issued to replace local building codes for factory-built housing. In addition, the industry and some states are developing interstate agreements to simplify and unify inspection and evaluation procedures for manufactured housing. As a result, differences between some mobile homes and manufactured housing have become less significant.

Transportation standards have also played a major role in the development of industrialized housing systems. Until 1956, mobile homes and trailer coaches were practically identical, both being limited to a maximum width of eight feet. With the interstate highway system, manufacturers were gradually permitted to ship 10-, 12- and 14-foot-wide "oversized loads." However, provisions for oversized loads vary from state to state, causing a bewildering maze of conflicting rules.

c. The Framework for Evaluation

Industrialized housing systems for disaster relief were evaluated with three elements in mind:

--It was essential that manufacturers cooperate with HUD. Contacts with many manufacturers were established early in the study.

--HUD incorporated a set of evaluation criteria into the study. These criteria covered various aspects of a system, such as its intended use (temporary vs. permanent) and its livability. The criteria had to be used in a systematic, and organized way. As the first step, housing systems were classified according to their intended use for either temporary or permanent housing. Then each type of system was evaluated separately. As the second step, for temporary housing, a set of rough first-level evaluation criteria was applied to pre-select the most promising candidates for detailed cost-effectiveness analysis. An important criterion was compliance with the Minimum Livability Standards for Temporary Housing (MLS) developed for the purpose of the study. Floor plans of pre-selected systems were specially adapted to these standards. Only the single-wide standard mobile home--widely used for temporary disaster relief--was pre-selected as both currently marketed and specially adapted.

The third step for temporary housing was the detailed cost-effectiveness analysis performed in Task Report II. All quantifiable elements related to using the pre-selected systems in a relief mission were identified, estimated and weighed in a cost and value analysis. For permanent housing systems, the second and third steps were based on a proposed assistance program termed the "Fast Delivery Permanent Home" program. It is designed to offer logistical and financial assistance to families made homeless by a disaster so they can receive a new factory-built permanent house as quickly as possible. This program is proposed as an alternative to temporary assistance.

- -The segments of the industry and a list of nine basic configurations of systems were related to each other to form a matrix for classification, systematic evaluation and pre-selection of all potentially applicable products. This matrix was designed to shift the focus from industries and products to types of temporary housing systems. Figure 1 shows all identified temporary housing systems in relation to this matrix.

FIGURE 1
TEMPORARY HOUSING SYSTEMS BY INDUSTRY SEGMENT AND BASIC CONFIGURATION

BASIC CONFIGURATION / INDUSTRY SEGMENT	ONE BOX		EXPANDABLE BOX		TWO OR MORE SECTIONAL BOXES		SECTIONAL BOX(ES) AND KNOCK-DOWN(S)	CORE AND PANELIZED	CORE & SPECIAL PACKAGED ENCL.
	ON WHEELS	GENERAL	ON WHEELS	GENERAL	ON WHEELS	GENERAL			
									
	1	2	3	4	5	6	7	8	9
A. MOBILE HOME INDUSTRY	*Single-Wide Standard M.H.^{2} Ruggedized Standard M.H.^{2} **Special Design Mobile Home^{2} Travel Trailer^{2}		Expando Mobile Home^{2} Expandable **Guerdon M.H.^{2}		Double-Wide Standard M.H.^{2}				
B. MANUFACTURED HOUSING INDUSTRY:	Evaluated for "fast delivery permanent home" program. Manufacturers of marketed relocatable housing systems included under C.b below.								
C. MANUFACTURERS OF SPECIAL RELOCATABLE SYSTEMS									
a. Military									
(1) Air Force			**USA Home^{2} Goodyear ES/C^{2}					**Goodyear MPASS^{1}	Goodyear Personnel Shelter EXP^{1}
(2) Army								AFCS^{1} Transportable Rec. Shelter^{1C}	MUST Air-Supported Shelter^{1}
(3) Navy			N. Am. Rockwell TACOSS^{2C}			N. Am. Rockwell Quick Camp^{2C}	Northrop USMC^{2C}		
b. Private Market Housing Systems									
(1) Camp Systems	(Atco Ind. Ltd.^{2}) (Atlantic Int'l.^{2}) (Elder Int'l.^{2}) (Porta-Kamp^{2})					(Atco Ind. Ltd.^{2}) (Atlantic Intl.^{2}) (Elder Int'l.^{2}) (Porta-Kamp^{2})	(Atco Ind. Ltd^{2}) **Atlantic Int'l^{2} (Elder Int'l.^{2}) Porta-Kamp^{2}	**Atco Ind. Ltd.^{2}	
(2) Honeycomb Panel Systems								Endure Prod.^{1} **Panelfab Intl.^{2}	
(3) Dome Systems									Circle^{1} Dome E.^{1} **Geodesic^{1} O'Dome^{1}
(4) Miscellaneous Systems		Atlas Portable^{2}	**Altair Ind.^{2} Interdesign Inc^{2}						Univ. Hsg. Syst.^{2} A.G. Windfield^{2}
c. Other Commercial Relocatable Shelter Systems									
(1) Air Structures									Air-O-Struct.^{1} Birdair Struct.^{1}
(2) Metal Structures									**Armco^{1} **Concor^{1} Stransteel^{1}
(3) Container Vans						**Fruehauf or similar^{1C}			

C - Containerized System

1 - Existing technology without integral mechanical core.
2 - Existing technology with potential integral mechanical core.
* - Included in cost-effectiveness analysis as marketed (meeting HUD/EPS Level I retention criteria).
**- Included in cost-effectiveness analysis with a floor plan specially adapted to meet the Minimum Livability Standards for Temporary Housing established for this study.
( ) The systems produced by the manufacturer in this category ("Basic Configuration) are not specifically evaluated in the report.

2. INDUSTRY REPORTS

Industrialized housing systems were evaluated and preselected in reports on the mobile home industry, manufactured housing industry, manufacterers of special relocatable systems and manufacturers of selected components. Each report consists of an industry profile and an evaluation of products the industry provides for disaster relief missions.

a. The Mobile Home Industry

The mobile home industry is currently the strongest and fastest growing segment of the construction industry. Today's mobile home still qualifies as a vehicle but it is a complete housing system primarily intended for quasi-permanent use in one location.

Mobile homes do not have to conform to building codes. Instead, most mobile home construction must conform to a national industry-sponsored standard. Exemption from building codes has been a major reason for the industry's spectacular growth during the past 15 years. So far, only mobile homes, along with travel trailers, have been used by the government to provide imported temporary housing assistance to disaster victims.

From its humble beginnings before World War II, the mobile home industry has expanded to a 1973 production level of nearly 600,000 units--22% of total housing starts. Because of its low purchase price, the mobile home has captured an increasing share of the low-cost housing market. Today almost two-thirds of all new housing units selling for under $25,000 are mobile homes. Low costs are achieved through exemption from building codes, mass-production on assembly lines and extensive use of semi-skilled labor.

Mobile homes are especially attractive to young and retired families. These groups compose over 70% of all mobile home households.

Of the 3.4 million mobile homes in use today, half are located on private lots and nearly all the rest are in mobile home parks.

The top 50 companies--15% of all mobile home manufacturers--account for 80% of total annual production. They have a median annual output of nearly 5,000 units, compared to an average of less than 500 units for each of the remaining 280 companies. This high degree of market concentration sharply differs from the fragmentation typical of the rest of the construction industry. Mobile home manufacturing and living is concentrated in California, Texas, Alabama, Georgia, Florida, North Carolina, South Carolina, Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York.

If structurally upgraded, the single-wide standard mobile home would have great potential as a reusable temporary housing system. Upgrading might involve using better components and redesigning the unit. The resulting "special design mobile home," which would be smaller and stronger, should be more suitable for disaster housing than the standard mobile home.

Along with the single-wide standard mobile home and the special design mobile, an expandable model was pre-selected for cost-effectiveness analysis.

b. The Manufactured Housing Industry

The manufactured housing industry produces factory-built permanent housing meeting the same construction, health and safety requirements as conventional housing.

Since World War II the role of manufactured housing has dramatically increased. In 1973, 23% of total housing starts (excluding mobile homes) were factory-built. The amount of factory-built housing is expected to increase even faster in the future. Factory-built housing starts may exceed 30% of total permanent housing starts this year and 50% by 1980.

There are two major categories of manufactured housing, distinguished primarily by degree of factory completion. The older and larger category produces packaged housing, also known as panelized or prefabricated housing. Approximately 80% of all manufactured housing is produced this way. The 1,100 plants producing packaged housing in the United States are operated by 700 companies. The younger and smaller segment of the industry manufactures modular housing --the system with the highest degree of factory completion. The modular housing industry, which emerged within the last five years, is expected to enter a period of sustained growth and become a major factor of the construction industry. Modular systems can be light-weight (predominately wood-framed) or heavyweight (concrete) and come in single and multifamily units. The predominant type of modular construction is the wood-framed, two-piece modular/sectional home. Designed for single-family use in subdivisions or on scattered sites, it is available from many manufacturers. Though the system is fairly standardized, a wide variety of different models are on the market. One manufacturer, Continental Homes, offers 24 different models with 30 different floor plans.

So far HUD has not used significant amounts of manufactured housing for disaster relief because HUD is authorized to provide only temporary assistance. Permanent housing assistance can be made available only through low-interest loans from other federal agencies. Emphasis on temporary housing would have to be modified so disaster victims can benefit from this important and growing resource.

The Fast Delivery Permanent Home approach would make it possible to offer such alternative assistance to displaced families. HUD should use and augment existing efforts such as the Flood Disaster Protection Act of 1973 to provide the pre-disaster planning required for this approach. HUD should also develop a new, complementary program offering logistical and financial assistance for purchasing fast delivery permanent homes.

The government now pays an average of $8,000 to accommodate one displaced family rent-free for one year in a mobile home. If the same money were available for purchase of a manufactured single-family home, many families could resolve their long-term housing problem without further government assistance. Provision of manufactured townhouses and garden apartments would require more sophisticated planning and coordination but could increase the number of families benefiting from a fast delivery permanent home program.

Use of manufactured housing systems as fast delivery permanent homes can result in much higher benefits than the present emphasis on temporary housing assistance.

c. Manufacturers of Special Relocatable Systems

The mobile home and the manufactured housing industries are the two main segments of the housing industry providing complete industrialized housing systems. A third industry segment--manufacturers of special relocatable systems--includes manufacturers whose systems are fairly marginal phenomena. But some of the companies have grown dramatically during recent years and seem less affected by the current slump in construction than producers of predominant systems.

The discussion is organized in three main sections: systems developed for the military, systems developed for the private market and other commercial systems.

(1) Relocatable Systems Developed for the Military

The military has traditionally a strong interest in relocatable shelters. Through history, tents has served this purpose. Today, additional, more rigid shelters are required for special equipment and semi-permanent installations.

During the past decade the three services have tried to use the technology and research resources of the aerospace industry to develop new, easily relocatable shelter systems. Several prominent aerospace manufacturers have participated in ambitious programs for this purpose. As a result, several new and extremely rugged systems have been developed, though usually not beyond the prototype phase. These systems can be transported by air, sea and land; the more recent ones are "containerized"--built to be shipped in 8'x8'x5'-40' container form. Since October, 1972, the Department of Defense has required that all relocatable systems meet the container standards of the International Standards Organization (ISO).

Especially interesting is the military's recent reassessment of its previous preference for new technology. Partly because of cost problems, partly because of greater awareness of commercially available systems, the military is now more interested in adaptation of marketed technology for military purposes.

(2) Relocatable Housing Systems Developed for the Private Market

Although most manufactured housing is not designed to be relocatable, the commercial sector produces a variety of relocatable housing systems.

The most easily identified industry segment are the manufacturers of camp systems--structures specifically developed for temporary use in construction camps, oil fields and the like. A second small group of manufacturers produces honeycomb panel systems, a technology originally developed for airplanes. Dome systems were included because the geodesic principle is said to provide superior structural efficiency. Finally, a group of odd but innovative housing systems were combined under the label miscellaneous systems.

(3) Other Commercial Relocatable Shelter Systems

Another group of relocatable systems is designed not for housing but for general shelter. They were included in the study because two of these categories--air structures and metal structures--have frequently been considered for disaster relief. The third category--container vans--was included because containers are designed for frequent and rugged shipment and because of their importance to the military.

Since these shelter systems are incomplete for housing purposes, they are evaluated in combination with separate mechanical core subsystems. The discussion of separate mechanical cores is included in the report on "Selected Subsystems."

Based on the first level criteria for pre-selection, 11 of the 30 special relocatable systems were pre-selected for cost-effectiveness analysis in Task Report II.

Figure 1 presents an overview of the 30 systems evaluated and the 11 pre-selected systems.

d. Manufacturers of Selected Subsystems

According to one report, more than 90% of all light construction uses one or more manufactured components.

The wide spectrum of the components industry includes manufacturers of specialty components such as mechanical cores and complete-line manufacturers who produce complete building packages.

Two types of components appear of particular interest: mechanical cores and special foundation systems.

(1) Mechanical Cores

There are two types of mechanical cores: mechanical core modules and "plug-in" mechanical cores. Modules are produced by manufactured housing companies as part of complete housing systems and are not available as separate subsystems. The plug-ins are subsystems which can complement certain shelter types lacking integral mechanical services.

Two basic configurations of temporary housing systems need complementary mechanical cores: core and packaged, and core and special packaged enclosure.

Five mechanical core systems were evaluated. An Alcoa "service module" satisfying the Minimum Livability Standards was pre-selected for cost-effectiveness analysis in conjunction with incomplete shelter systems.

(2) Special Foundation Systems

Special foundation systems for temporary housing range from concrete blocks to sophisticated jack systems. Certain requirements such as tie-downs must be part of any foundation system for temporary housing. As the cheapest and most useful system, the concrete block pier foundation with tie-downs was included in the cost-effectiveness analysis for all pre-selected temporary housing systems. The study also investigated some foundation systems designed for permanent housing, including stilt and pole foundations and an all-weather wood foundation. These systems may be of interest for the proposed fast delivery permanent home program.

3. PRE-SELECTED SYSTEMS

Based on evaluation of existing technology in the four industry reports, 12 specially adapted products were pre-selected for detailed cost-effectiveness analysis in Task Report II and for comparison with the single-wide standard mobile home. These products are:

- Single-Wide Special Design Mobile Home (one box on wheels)
- Expandable Guerdon Mobile Home (expandable box)
- USA Home (expandable box)
- Altair Industries (expandable box)
- Fruehauf Container or similar (two sectional boxes -- containerized)
- Atlantic International (sectional box and knock-down)
- Goodyear MPASS (core and panelized)
- Atco Industries Limited (core and panelized)
- Panelfab International (core and panelized)
- Geodesic (core and dome)
- Armco (core and metal structure)
- Concor (core and metal structure)

As a basis for cost estimates in Task Report II, information on these systems is provided in a standardized format.

In addition, alternative mechanical subsystems were evaluated. An all-electric system was selected as common basis for all systems analyzed in Task Report II.

4. PORTABLE WATER AND WASTE TREATMENT TECHNOLOGY

This part of the investigation was limited to temporary housing group sites. A 100-unit site was chosen as the basis for the analysis.

a. Water Supply Systems

- If possible, the housing complex is best supplied from an existing potable water system. This will avoid problems and costs associated with an independent treatment and supply system.
- The mobilization time available in an emergency precludes using groundwater as a supply source, unless specific investigations are made before the disaster.
- For this study, it was assumed that surface water will be used, since this source can be developed better and faster than groundwater.
- It is also assumed that the surface water will require only coagulation, settling, filtration and disinfection to provide a safe, clean water supply. Thus, saline or highly polluted waters are not considered as suitable supplies. Few surface waters require softening, and such treatment is not provided for.
- Housing units are to be provided with normal plumbing fixtures, including a washing machine for each unit. Using a conservative average water consumption of 70 gallons per capita per day, and figuring four persons per unit, an average of 28,000 gpd (gallons per day) would be required. Peak hourly flow is 7.5 times the average daily flow, or 150 gpm (gallons per minute).
- Major components of the water supply, treatment and distribution system were identified, with a summary of pertinent design criteria. This system is standard for small water supply systems,

except that certain items are specified for portability and rapid installation. The water treatment plant and pressurizing system should be housed in a semi-trailer van for rapid deployment and protection from the weather. This van can also carry pumps and piping and possibly the wood stave tank materials. Major pieces of equipment should be pre-purchased and staged for deployment.

- Capital costs for the system cover purchase and installation of equipment. No storage or transportation costs are included, since these cannot be estimated.

- Operating costs of this system cover power, chemicals, and operating and maintenance labor. Administration costs cannot be estimated.

- Capital and operating costs can be expressed on on a unit basis for comparison with an alternative method of supply. Two assumptions have been made for the amortization of capital costs:

  - -- All capital costs are amortized over one year at no interest.

  - -- Only non-recoverable capital costs, such as pipe and installation costs, are amortized over one year at no interest, with no net cost assigned to recoverable items such as the treatment plant. These costs per 1,000 gallons are high compared to those for public supplies, which are rarely greater than $1 per 1,000 gallons. The difference is due to the rapid capital amortization and the poor economy of scale for the 100-unit system.

- As an alternative, housing units could be supplied by tank truck, if an operating public water utility were near the disaster housing site. Each housing unit could be provided with a storage tank and pressurizing system and water could be hauled in FDA-approved tank trucks. With this method:

  - -- Given normal water consumption and a one-year amortization of all capital costs, total cost is $45 per 1,000 gallons or 3.6 times that for the first alternative.

-- A 50% reduction in water usage, possible with water-saving plumbing fixtures, will reduce the cost of this system by 45% or 2.3 times that of the first alternative.

-- With a two-month deployment, if only non-recoverable capital costs are amortized, the trucked supply is only 15% more expensive than the primary alternative, given normal water consumption. At 50% of normal consumption, the trucked supply costs only 60% of the primary alternative system.

-- For less than 100 units, the trucked supply will gain in cost effectiveness, since its unit cost is not affected by the number of dwellings supplied.

If the disaster indicates a need for advance equipment staging for brief periods, particularly where under 100 units would be provided, housing units with individual water systems and water-saving plumbing features might be advisable.

b. Waste Collection and Treatment

The following are findings on the disaster housing waste handling system:

- An existing waste collection and treatment system should be used, either by gravity flow or pumping. Logistical problems and costs associated with an independent system would be avoided with either method.

- The system should be designed to handle an average of 25,000 gpd.

- The basic treatment system should provide secondary treatment by means of extended aeration to meet national requirements for secondary treatment of domestic wastes. To meet more stringent requirements, a filtration step should be added to the extended aeration plant. Sludge should be digested aerobically and digested sludge should be hauled to a local treatment plant for final disposal.

- Packaged treatment plants are available for each of these processes. They must be pre-purchased, since delivery times are too long to permit post-disaster purchase. These units are normally designed for out-door installation, so no special provision is needed to house the plant. However, the size of the extended aeration units (38'x12'x 11.5') and the weight (23,000 lbs.) make them harder to transport than the water treatment plant. Therefore, the units might be staged close to possible disaster areas.

- The collection system for the primary alternative is designed as a conventional gravity sewer system, with 8" diameter asbestos cement pipe. Under certain conditions, raw waste might be discharged into the treatment plant by gravity. However, pumping will probably be required and a packaged pump station should be used.

- Capital costs for the system include material and installation costs. Staging or transportation costs have not been estimated. The total cost is twice that of the water supply system, due primarily to the higher cost of installing sewer pipe.

- Operating costs cover power, chemicals and operating and maintenance labor. Administrative costs cannot be estimated.

- Capital and operating costs are combined on a unit basis by providing for amortization of the capital costs. As with the water supply system, no-interest amortization over one-year is assumed: either the entire capital cost or the non-recoverable capital costs can be amortized. Costs for sewage handling are more than double water supply costs when all capital is amortized, and more than triple when only non-recoverable capital is amortized. The difference is due to the high capital costs and the high percentage of non-recoverable capital costs for the sewage system.

- As an alternative, septic tanks and tile fields could be used for waste-water disposal. These would require a more site-specific design, but the costs are competitive with the centralized system:

Soil Condition	Total Capital Cost, $/Unit
Good	930
Fair	1,300
Poor	2,000

None of this cost would be recoverable, but considerable money could be saved under this sytem, particularly in favorable soil condition. Land requirements for this system for two dwelling units connected to a common septic tank and tile field are:

Soil Condition	Land Area, Square Feet
Good	1,100
Fair	2,100
Poor	4,100

With poor soil, this requirement could control the housing layout, but septic tank system should be considered in the disaster housing planning.

- Another alternative is wastewater hauling, similar in concept to the trucked water supply. The following conclusions can be made about this system:

  -- With normal water consumption and one-year amortization of non-recoverable capital costs, total cost of this system in $8.70 per unit per day, or 70% more than the primary alternative.

  -- With normal water consumption, the trucked disposal system cost is equal to the primary alternative cost at a six-month deployment and amortization period.

  -- With a 50% reduction in water consumption and one-year amortization of non-recoverable costs, the trucked system is competitive with the central system--$4.95 per unit per day versus $5.00 per unit per day.

  The concept of sewage disposal by hauling shows definite cost-effectiveness possibilities, particularly where deployment time is six months or less. The analysis also indicates that water conservation measures can dramatically reduce hauling disposal costs, and indicate the need to consider water-saving devices in the dwelling unit design.

- As an alternative to the gravity sewers assumed in the primary alternative, pressure sewers could be used. There is no information available on the long-term use of these systems, but some have been operated for more than a year. This system with a central treatment plant would cost the same as the primary alternative. However, a larger portion of the cost is recoverable. Since recoverable items have less impact on cost than non-recoverable ones, the pressure sewer system can be less costly than the gravity system. Such systems are worthy of consideration in the detailed phases of planning for disaster housing.

- A modular sewer and water utility system, using pressure sewers, could be designed for disaster housing. This system consists of water and sewer pipes housed in corrugated metal pipe and insulated. It would have the following advantages in comparison to the primary alternative systems:

    -- Pipe could be installed more cheaply and excavations would not be as deep.

    -- Only one trench would be required for water and sewer pipe.

    -- The pipe could be recovered for future use.

  The major disadvantage is the possibility of water supply contamination, but proper design and demonstration testing could minimize this danger.

II INDUSTRIALIZED HOUSING SYSTEMS AS A RESOURCE FOR DISASTER RELIEF MISSIONS

A. INTRODUCTION

Industrialized technology is the systematic application of science to human labor, enabling mass production of goods. Its dramatic impact on the world began with the invention of the steam engine.

There is a contradiction in the typical attitude towards industrialization. While items like cars, electric appliances and telephones have become accepted as indispensable parts of life, people have deep reservations about the use of technology for traditional necessities of life. Factory-produced food sells best if advertised as homemade. Synthetic clothing is often made to resemble handmade models. Houses are expected to have familiar attributes, borrowed from traditional styles.

Clearly, our attitude toward technology is schizophrenic. We depend on technology for our survival, but we do not want to be confronted with that fact. To obscure our dependence on industrialization, we borrow symbols of the pre-industrial past.

An evaluation of industrialized building systems must be based on a clear set of assumptions about the nature, potential and social and psychological limitations of industrialized technology. This study is based on the following assumptions:

Industrialized technology cannot be selectively employed by a society. If it is used to produce more effective machines, weapons and means of communication, it will also bring changes in other areas where it is less welcome. In these areas it tends to manifest itself under disguises. The disguises, in turn, may reduce the possible benefits, yet these disguises represent a nostalgic clinging to symbols of the past.

Industrialized technology has met great opposition in the field of housing and it has had limited success when it was openly promoted. Operation Breakthrough is a clear example. On the other hand, industrialization continues to penetrate the entire housing industry "through the back door."

This indirect approach has led to the emergence of commercially successful but technologically ambiguous phenomena like the mobile home. Such phenomena are compromise efforts and do not reflect the full potential of technology.

Clearly, the evolution of technology in an area depends not only on the ingenuity of scientists but also on popular attitudes. An invention is hypothetical until it is built and tested. Often large-scale production is the only way to prove the viability of a technological product. But large-scale production usually requires broad public acceptance. Thus, someone might develop a novel building system which could produce cheaper, better housing. But if the system does not gain widespread acceptance, it is not a real option. Even the military has been unable to offset the lack of a market demand for advanced relocatable housing systems.

Consequently, this report does not focus on systems which are developed in theory or prototype but not available on the market. Instead, it identifies existing examples of light-weight building technology that have been tested and marketed. This report evaluates building systems with a focus on markets and manufacturers. Reports on the mobile home and manufactured housing industries and manufacturers of special relocatable systems and selected components represent the bulk of Part III. Part II presents a brief overview of industrialized housing, discusses relevant laws and presents the methodology used for evaluation.

B. OVERVIEW OF INDUSTRIALIZED HOUSING

1. DEFINITIONS OF INDUSTRY SEGMENTS

a. Glossary

To ensure a consistent use of language in this report, a glossary of terms is contained in Appendix I. This glossary is based on existing definitions which were amplified and adapted for this study.

b. Industry Organization

This section outlines the organization of existing lightweight industrialized housing and shelter industries. It also defines certain key terms.

A housing system is defined as all parts of a structure organized for expeditious erection, if the structure is designed for living. The system usually includes all required utilities and mechanical subsystems. To be erected on a site, a housing system may require a foundation system.

A shelter system is defined as all parts of a structure organized for expeditious erection, if the structure is not designed for living. To be erected on a site a shelter system may need a floor system, a mechanical subsystem or other subsystems.

Figure 2 illustrates the organization of industries providing housing and shelter systems. Two major industries produce housing systems: the mobile home industry and the manufactured housing industry.

The mobile home industry produces housing systems with integral running gear designed for quasi-permanent use.*

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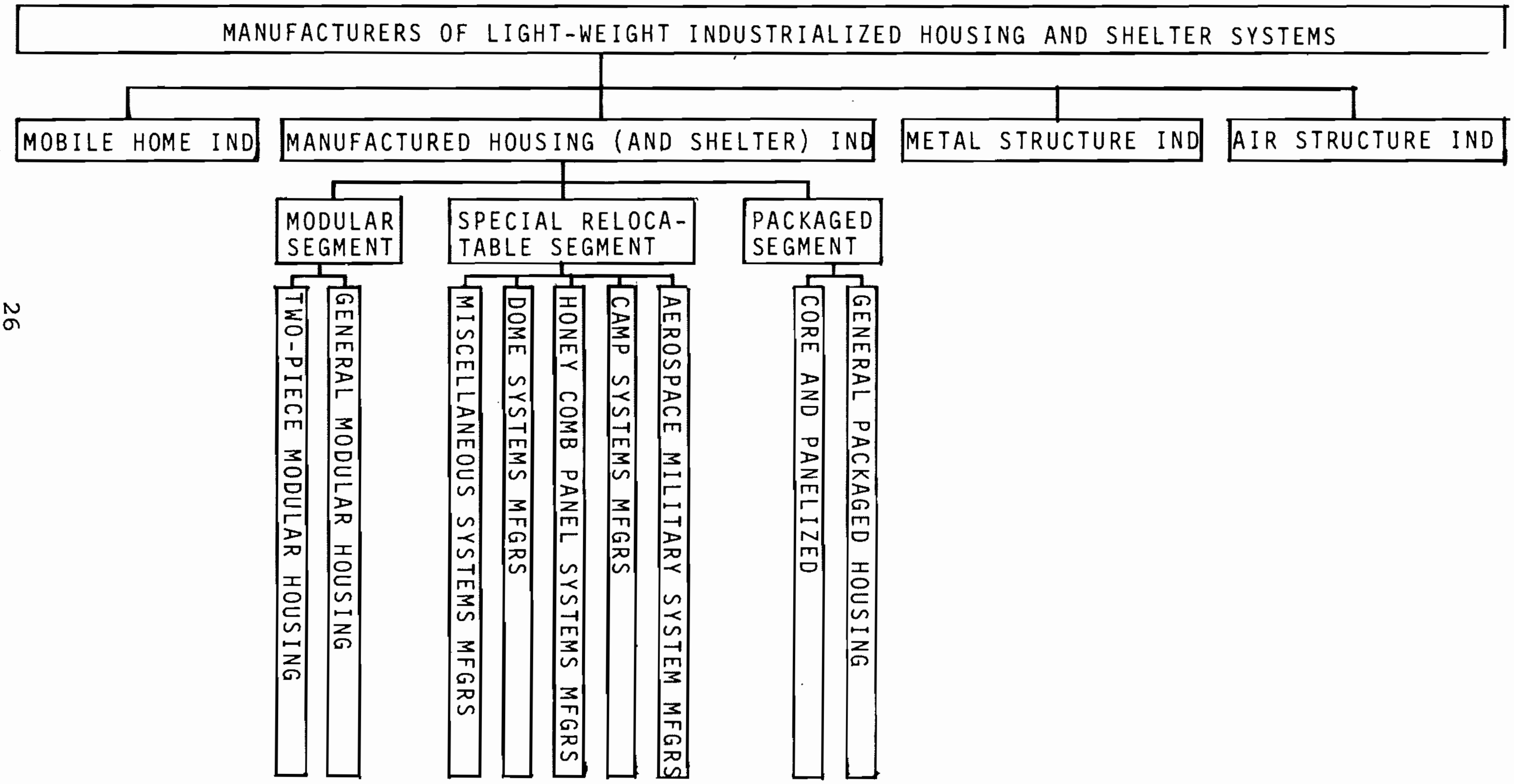
* For a complete definition of mobile home, see Appendix I.

F I G U R E 2

SCHEMATIC ORGANIZATION OF LIGHT-WEIGHT INDUSTRIALIZED HOUSING AND SHELTER INDUSTRIES



The manufactured housing industry produces housing systems which qualify for permanent use and meet the same construction, health and safety requirements as conventional on-site construction. The manufactured housing industry consists of two main segments: modular housing and packaged housing.

The modular segment produces a housing system by which two or more modules are assembled on permanent foundations to form a house.

A module is defined as

> a factory-assembled, three-dimensional section of a building to be shipped to site and joined with one or more sections "or other systems" to form a building or house to meet the same construction health and life safety requirements as for conventional on-site building.*

The heating system, plumbing and wiring are installed in the factory. As a permanent housing system, modular housing is eligible for long-term mortgage financing and taxed as real property.

Two-piece modular/sectional housing, a special sub-category of modular housing, is defined as a system of constructing permanent single-family houses by assemblage of two modules.

Packaged housing is defined as a system of constructing permanent code-complying buildings by assembling packages of factory-produced panels or components including a mechanical core module on permanent foundations.

> The factory assembles all the basic structural materials of the structure, such as walls, roof trusses, interior partitions, windows, doors, cabinets, shingles, flooring, insulation, etc. and loads them on a truck so they can be used as the truck is unloaded. Unless a manufacturer includes a mechanical core with his unit, the packaged house does not include mechanical com-

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* National Associaltion of Building Manufacturers.

ponents such as heating, plumbing and electrical work. Prefabricated and panelized are synonyms for packaged housing. Pre-cut housing in which materials are pre-cut and labeled, but little or no assembly work is done in the factory, are also packaged houses.*

Core and panelized housing, a special sub-category of packaged housing, is constructed by combining a package of panels with a special module containing a mechanical core. A mechanical core is defined as

> a factory-assembled, three-dimensional section of a building, which includes installed mechanical elements containing all mechanical, electrical, plumbing, heating and cooling elements and related systems. Mechanical cores may contain the kitchen, with its range, cabinets, counters and sinks, and the bath and associated fixtures. Ranging in size from 8 by 10 feet to 12 by 20 feet, cores are shipped to the site and erected on a previously prepared foundation, or stacked for multi-story structures. The remainder of the structure surrounding them may be of component, panel or conventional type. Use of mechanical cores substantially reduces the need for the scarce, expensive skilled trades on the erection site. (Also called Utility Core or Wet Core.)**

The modular and packaged segments are generally recognized as sub-industries. An additional group of manufactured housing firms produces a variety of housing systems designed for special purposes or using innovative technology. Since these manufacturers emphasize the relocatability of their products, this group was termed the "special relocatable" segment. The various systems included in this group are identified in report III-D.

Finally, two industries producing light-weight shelter systems can be identified: the metal structure industry and the air-structure industry.

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* Directory/Census of Manufactured Housing, Section I, 1974.

** National Association of Building Manufacturers.

2. SOURCES OF INFORMATION

While the industrialized housing industry is a significant element in the economy, production of industrialized housing is fragmented among many manufacturers. As a result, observers have trouble keeping up with the development of the field. Due to the lack of a clearinghouse of information, constant turnover of companies entering and leaving the field and biased reporting, it is virtually impossible to present a complete, up-to-date and objective portrait of the industrialized construction industry.

a. Manufacturer Associations

(1) Mobile Home Industry

The mobile home industry is represented by the Mobile Home Manufacturers Association (MHMA) and the Trailer Coach Association (TCA). The MHMA monitors industry production and maintains a directory of member companies. It is the most important source of information on the industry. The MHMA's role is discussed in detail in chapter III-A-2.

(2) Manufactured Housing Industry

The National Association of Building Manufacturers (NABM) serves as spokesman for this industry. NABM has conducted surveys on the annual production of manufactured housing. However, the statistics published must be used with caution since they include double-wide mobile homes which do not qualify as manufactured housing in NABM's own definition. Statistics on manufactured units shipped also include mechanical cores -- a component rather than full housing system -- which further complicates an accurate determination of market penetration.

(3) Shelter Industries

The Metal Building Manufacturers Association and the Canvas Products Association represent the metal and air structures industries. Both associations maintain directories of member companies and serve various other functions. However, these associations do not provide statistical information on annual production of the two industries.

b. Directories of Manufacturers

Manufacturers associations and trade magazines publish directories on manufacturers. Most directories are updated annually, but there are significant contradictions among directories. The most thorough and complete directory is the Directory/Census of Manufactured Housing. However, its accuracy is limited because it depends on the voluntary cooperation of manufacturers. It is impossible to determine the number of companies owning plants or total annual production per industry segment, since many manufacturers do not disclose production information.

c. Periodicals

Professional Builder (PB), Automation in Housing (AH) and Manufactured Housing Newsletter were the most important periodicals used as sources of information for this report. However, statistical information published by these sources may show significant discrepancies and must be carefully examined.

d. Books and Published Reports

Due to the rapid change in the industrialized housing field, books and reports may be out of date when they are published. Nevertheless, books and reports represent an important source of information on the development of industrialized construction. An interesting example of how books are periodically updated is provided by J.A. Reidelbach Jr.'s three books on modular housing (1970, 1971, 1972). For detailed references, see the bibliography at the end of this volume.

e. Direct Contacts with the Industry

This has been the most important source of information. More than 400 manufacturers were contacted initially and several marginal but interesting systems were identified through personal contacts. The 1973 Industrialized Building Exhibit (INBEX) in Chicago also offered an opportunity to meet interested industry representatives.

f. The Military

Reports on various housing and shelter systems developed for the military were provided for the study. While information disclosed by the military is inevitably incomplete, it appears to provide a representative cross-section of recent work done in the field of temporary housing and shelter systems.

C. OVERVIEW OF CODES, STANDARDS AND REGULATIONS AFFECTING INDUSTRIALIZED HOUSING SYSTEMS

INDUSTRIALIZED HOUSING TRANSPORTATION REGULATIONS

A major constraint in the evolution of industrialized housing systems has been transportation regulations.

Table 1 shows the historical development of today's 12- and 14-foot-wide mobile homes from eight-foot-wide trailer coaches. The data show how production adjusted quickly to a wider unit as soon as such units appeared on the market. The first appearance of new units, however, has always been connected with new transportation regulations.

Permission to ship units more than eight feet wide and 32 feet long* greatly contributed to the rise of the mobile and modular housing industries. But it created a bewildering maze of conflicting state highway regulations. Different states have different rules covering such items as time and day of shipment, permitted weight and dimensions, required signs and lights and necessary permits.

In the beginning of HUD's temporary housing assistance program, variations in state highway regulations seriously hampered the government's ability to deliver mobile homes to disaster victims. Masses of mobile homes destined for disaster relief were sometimes detained at state borders awaiting clearance. Fortunately, most of these problems have been resolved by the national policy statement of the American Association of State Highway and Transportation Officials (AASHTO). This statement, "Movement of Mobile Homes in the Event of National Emergency,"

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* The 1973 limits for travel trailers -- that is, units to be shipped without special permits.

TABLE 1

MOBILE HOME WIDTHS AS A PERCENTAGE OF MOBILE HOME PRODUCTION

	Width				Expandables, Double-Wides, and Triple-Wides
	8 Feet	10 Feet	12 Feet	14 Feet	
1955	100.0%	--%	--%	--%	--%
1956	91.0	9.0	--	--	--
1957	75.0	25.0	--	--	--
1958	31.0	69.0	--	--	--
1959	20.9	79.1	--	--	--
1960	9.5	90.5	--	--	--
1961	1.9	98.1	--	--	--
1962	2.0	72.7	5.0	--	20.3
1963	1.5	73.3	6.4	--	18.8
1964	0.9	59.8	21.1	--	18.2
1965	0.9	41.4	45.1	--	12.6
1966	0.5	24.6	65.3	--	9.6
1967	0.3	7.3	84.1	--	8.3
1968	0.1	2.2	85.9	--	11.8
1969	0.5	1.1	84.2	2.3	11.9
1970	0.3	0.5	78.6	8.1	12.5
1971	0.4	0.7	69.6	16.2	13.1

Source: Mobile Home Manufacturers Association.

was issued on July 5, 1973. It states:

> Mobile homes destined for relief mission, and under HUD contract and bearing the HUD sticker, will be permitted to move on all Interstate system routes.
>
> Individual state departments of highways or transportation will assign additional routes for emergency moves.
>
> Travel will be restricted during inclement weather based on state police judgment (e.g., no travel during periods of heavy rains, fog or snow).
>
> A speed limit of 45 mph, or a limit specified by the state through which the unit is traveling.
>
> Units can travel 7 days a week, 24 hours a day.
>
> Due to heavy traffic volumes, travel on federal holidays will only be allowed during extraordinary emergency periods.
>
> The maximum dimensions allowed are a width of 12 feet and a total length, including the towing unit, of 80 feet.
>
> Red flags are to be displayed on the four upper corners of the mobile home and "wide load" signs on both the front and rear.
>
> Clearance lights will be required on each upper corner of the mobile home during hours of darkness.
>
> Emergency moves on other than emergency designated routes and all other non-emergency travel in each state (e.g., travel back to the storage area after the disaster relief mission is completed) require a regular hauling permit from each state.

In essence the Government Bill of Lading becomes the official permit for moving HUD mobile homes during a relief mission. All requirements except those covering escorts have been standardized; when the mobile home travels on two-lane roads, escort requirements are still determined by the state. However, recent experience has shown that escort requirements can also be waived.

This agreement between the federal government and the states has helped HUD expedite delivery of temporary housing when the disaster declaration is in effect. But transportation standards still are key factors for evaluating housing systems since they affect industries potentially supplying temporary housing and HUD's shipments of units before and after a disaster declaration.

The following discussion of principal regulations affecting transportation of oversize loads (mobiles and modulars) is based on a study conducted for the Department of Transportation.*

Almost all the regulations apply to both mobiles and modulars. The main differences relate to requirements covering the maximum number of axles and the towing vehicle, since mobile homes have an integral running gear.

1. <u>Dimension Restrictions</u> (Table 2)

   These restrictions limit the length, width and height of the coach and the coach and tractor. The industry is seeking relaxation of restrictions on 14-foot-wides which are in effect in 13 states. A height limitation of 13'6" is most common. Although 31 states do not control coach length, restrictions on combination lengths (coach plus tractor) vary from 75 to 95 feet.

2. <u>Speed Limits</u> (Table 3)

   Speed limits are usually based on highway type and speed zone.

3. <u>Time of Operations</u> (Table 4)

   Tuesday through Thursday are the only days during which 12-foot-wides can be transported in all states. Three

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* Glanz, William D., <u>et al</u>.

states forbid shipments on Monday and Friday. Weekend and holiday shipments are almost totally prohibited, but different states vary considerably as to specific holidays observed.

4. Sign Regulations (Table 5)

There currently are four variations on sign location and 14 variations on sign configuration.

5. Warning Lights (Table 6)

Only 11 states require lights on 12-foot-wides but no two requirements are identical.

6. Towing Vehicle (Table 7)

Most states require a towing vehicle (tractor) of a specific tonnage.

7. Escorts (Table 8)

Escort requirements are usually determined by highway type, lane width, length of combination vehicles, area of travel or miscellaneous provisions. Escort requirements do not apply to interstate highways.

8. Axles

Three axles are required by some states for units longer than 60 feet. Some states require brakes on all axles.

TABLE 2

DIMENSION RESTRICTIONS

	Maximum Dimension Limits Allowed Under Permit			
	Width	Height	Coach Length	Combination Length
Alabama	14 ft.	--	--	85 ft.
Arizona	14 ft (a)	--	65 ft.	--
Arkansas	14 ft.	--	--	--
California	12 ft.	13 ft. 6 in.	70 ft.	85 ft.
Colorado	14 ft.	13 ft. 6 in.	--	--
Connecticut	12 ft.	13 ft. 6 in.	60 ft.	75 ft.
Delaware	14 ft.	--	--	--
Florida	12 ft.	13 ft. 6 in.	70 ft.	85 ft.
Georgia	12 ft.(b)	13 ft. 6 in.	--	83 ft.
Idaho	14 ft. 6 in.	14 ft.	--	85 ft.
Illinois	14 ft.	--	--	70 ft.
Indiana	14 ft.	13 ft. 6 in.	--	80 ft.
Iowa	14 ft.	13 ft. 10 in.	68 ft.	80 ft.
Kansas	14 ft.	--	--	85 ft.
Kentucky	14 ft.	--	70 ft.(c)	80 ft.
Louisiana	14 ft.	13 ft. 6 in.	--	85 ft.
Maine	--	--	--	--
Maryland	14 ft.(a)	14 ft.	--	--
Massachusetts	14 ft.(a)	--	--	--
Michigan	14 ft.	15 ft.	70 ft.	85 ft.
Minnesota	14 ft. 6 in.	13 ft. 6 in.	70 ft.	85 ft.
Mississippi	12 ft.	--	--	80 ft.
Missouri	14 ft.	14 ft.	70 ft.	85 ft.
Montana	15 ft.	--	70 ft.	--
Nebraska	14 ft.	13 ft. 6 in.	65 ft.	85 ft.
Nevada	14 ft.	--	--	85 ft.
New Hampshire	14 ft.	--	--	--
New Jersey	12 ft.	--	--	--
New Mexico	14 ft.	13 ft. 6 in.	80 ft.	95 ft.
New York	14 ft.	13 ft. 6 in.	--	--
North Carolina	12 ft.	13 ft. 6 in.	--	80 ft.
North Dakota	14 ft.	13 ft. 6 in.	--	--
Ohio	14 ft.	13 ft. 6 in.	70 ft.	85 ft.
Oklahoma	14 ft.	--	--	--
Oregon	14 ft.	--	--	85 ft.
Pennsylvania	14 ft.	--	--	85 ft.
Rhode Island	14 ft.	13 ft. 6 in.	--	79 ft.
South Carolina	12 ft.	--	70 ft.	80 ft.
South Dakota	14 ft.	--	--	--
Tennessee	12 ft.	13 ft. 10 in.	--	85 ft.
Texas	--	--	--	--
Utah	14 ft.	--	--	85 ft.
Vermont	14 ft.	--	--	--
Virginia	12 ft.	--	70 ft.	80 ft.
Washington	14 ft.	--	--	85 ft.
West Virginia	14 ft.	12 ft. 6 in.	--	75 ft.
Wisconsin	16 ft.	14 ft.	70 ft.	85 ft.
Wyoming	--	--	--	--

Notes: (a) 14-foot-wides allowed only on lowboy trailer.
(b) 12'4" width permitted for modules.
(c) 65' coach length limit for 14-foot-wides.

Source: Glanz *et al*.

TABLE 3
SPEED LIMITS FOR 12-FOOT-WIDES

	Upper and Lower Speed Limits Under Various Conditions							
	2-Lane Highways				4-Lane, Divided, Interstate			
	60 MPH Zone		70 MPH Zone		60 MPH Zone		70 MPH Zone	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Alabama	50	--	50	--	50	--	50	--
Arizona	45	--	45	--	45	--	45	--
Arkansas	35	--	35	--	35	--	35	--
California	55	--	55	--	55	--	55	--
Colorado	--	--	--	--	--	--	--	--
Connecticut	--	40	--	40	--	40	--	40
Delaware	45	--	45	--	45	--	45	--
Florida	35	--	35	--	35	--	35	--
Georgia	50	--	50	--	50	--	50	--
Idaho	--	--	--	--	--	--	--	--
Illinois	35	--	35	--	Min+5	--	Min+5	--
Indiana	--	--	--	--	--	--	--	--
Iowa	35(a)	--	35(a)	--	35(a)	--	35(a)	--
Kansas	50	35	50	35	50	35	50	35
Kentucky	--	--	--	--	--	--	--	--
Louisiana	45	--	45	--	45	--	45	--
Maine	45	--	45	--	45	--	45	--
Maryland	--	--	--	--	--	--	--	--
Massachusetts	--	--	--	--	--	--	--	--
Michigan	45(b)	--	45(b)	--	45(b)	--	45(b)	--
Minnesota	--	--	--	--	--	--	--	--
Mississippi	30	--	30	--	30	--	30	--
Missouri	50	--	50	--	55	--	55	--
Montana	50	20	50	20	50	20	50	20
Nebraska	50	35	50	35	50	35	50	35
Nevada	55	--	55	--	55	--	55	--
New Hampshire	--	--	--	--	--	--	--	--
New Jersey	--	--	--	--	--	--	--	--
New Mexico	--	--	--	--	--	--	--	--
New York	--	--	--	--	--	--	--	--
North Carolina	30	--	30	--	45	--	45	--
North Dakota	50	--	50	--	50	--	50	--
Ohio	40	--	40	--	40(a)	--	40(a)	--
Oklahoma	50(a)	--	50(a)	--	50(a)	40(a)	50(a)	40
Oregon	60	--	60	--	60	--	60	--
Pennsylvania	45	--	45	--	45	--	45	--
Rhode Island	--	--	--	--	--	--	--	--
South Carolina	45	--	45	--	45	--	45	--
South Dakota	40	--	50	--	45	45	50	45
Tennessee	--	--	--	--	--	--	--	--
Texas	45(a)	--	45(a)	--	45(a)	--	45(a)	--
Utah	--	--	--	--	--	45	--	45
Vermont	35	--	35	--	50	--	50	--
Virginia	35(c)	--	35(c)	--	45	--	45	--
Washington	40	35	40	35	40	35	45	35
West Virginia	40	--	40	--	45	--	45	--
Wisconsin	35	--	35	--	45	--	45	--
Wyoming	45(d)	--	45(d)	--	45(d)	--	45(d)	--

Entries reflect regulations but are presented to show maximum and minimum speeds on various highways at speeds commonly posted.

Notes: (a) Posted truck speed limit supersedes entry.
(b) Speed limit reduced to 35 mph if combination length exceeds 80'.
(c) Speed limit reduced to 25 mph if pavement width is less than 24'.
(d) Entered speed applies only if escorted; otherwise, no restriction.

Source: Glanz et.al.

TABLE 4

TIME OF OPERATIONS RESTRICTIONS FOR 12-FOOT-WIDES

	Allowable Operating Hours					Holiday Restrictions	
State	Monday	Tuesday - Thursday	Friday	Saturday	Sunday	Number of Observed Holidays	Normal Holiday Period
Alabama	D	D	D	D(f)	D(f)	6	H
Arizona	D	D	D	--	--	7	H
Arkansas	D	D	D	--	--	9	H
California	D	D	D	--	--	12	H
Colorado	D	D	D	M	--	11	H
Connecticut(b)	D	D	D	--	--	11	DB-DA
Delaware(b)	D	D	D	--	--	7	H
Florida	D	D	D	--	--	7	H
Georgia	D	D	D	D	--	7	H
Idaho	D	D	D	--	--	6	H
Illinois(a) (d)	D	D	D	M	--	6	NDB-H
Indiana	D	D	D	--	--	6	NDB-NDA
Iowa	D	D	D	--	--	7	DB-DA
Kansas	D	D	D	M	--	10	H
Kentucky	D	D	D	M	--	6	NDB-H
Louisiana	D	D	D	D	--	13	H
Maine	D	D	D	--	--	9	H
Maryland	D	D	D	M	--	8	H
Massachusetts	D	D	D	M	--	12	H
Michigan(i)	D	D	D	--	--	6	NDB-DA
Minnesota(d)	D(h)	D	D	--	--	6	NDB-NDA
Mississippi	D	D	D	M	--	6	DB-DA
Missouri	D	D	D	--	--	9	NDB-H
Montana	D	D	D	--	--	6	H
Nebraska	D	D	D	--	--	7	H
Nevada	D	D	D	--	--	8	H
New Hampshire	D	D	D	--	--	10	H
New Jersey	D	D	D	--	--	7	H
New Mexico	D	D	D	--	--	6	NDB-H
New York	D	D	D	--	--	6	DB-DA
North Carolina	D	D	D	--	--	8	H
North Dakota	D	D	D	--	--	6	NDB-H
Ohio(c)	D	D	D	--	--	6	NDB-H
Oklahoma(d)	D	D	D	M	--	7	NDB-H
Oregon(d)	D	D	D	M(h)	--	6	H
Pennsylvania(d)	D	D	D	--	--	6	DB-DA
Rhode Island(d)	D	D	D	--	--	10	H
South Carolina	D	D	D	--	--	9	H
South Dakota	D	D	D	M	--	9	H
Tennessee	D	D	D	--	--	9	H
Texas(d)	D	D	D	D	D	0(g)	--
Utah(d)	D	D	D	--	--	7	NDB-H
Vermont	D	D	D(h)	--	--	8	H
Virginia	D	D	M	SR-11 a.m.	--	7	NDB-H
Washington	D	D	SR-2 p.m.	--	--	6	NDB-H
West Virginia	D	D	D	--	--	8	H
Wisconsin(d)	D	D	D	--	--	6	NDB-H
Wyoming	D	D	D	D	D	10	H

ABBREVIATIONS

D : Daylight Hours
SR : Sunrise
SS : Sunset
M : Morning Hours

H : Observed Holiday
DB : Day Before
DA : Day After
NDB : Noon Day Before
NDA : Noon Day After

Notes:
(a) Operations permitted from 1 hr. after sunrise until 1 hr. before sunset.
(b) Only mid-day hours allowed on certain routes.
(c) Only 8 a.m. - 4 p.m. operations allowed on Interstates.
(d) Rush hour curfew observed in metropolitan areas.
(e) Rush hour curfew observed on 2-lane highways.
(f) No Interstate travel allowed on Saturday or Sunday.
(g) Travel on holidays is allowed if permit has been previously acquired.
(h) Additional restrictions apply during summer months.
(i) Operations allowed 9 a.m. - 3 p.m. if coach length exceeds 64'.

Source: Glanz *et al.*

TABLE 5 : SIGN REGULATIONS FOR 12- AND 14-FOOT-WIDES

	Sign Characteristics								
State	Location[a]/	Wording[b]/	Length (ft)	Width (in.)	Height Above Road Surface (ft)	Background Color	Color of Letters	Letter Height (in.)	Letter Stroke (in.)
Alabama	--	--	--	--	--	--	--	--	--
Arizona	1,3	1	6	--	--	Yel	Blk	--	1-1/2
Arkansas	1	1	--	--	--	Yel	Blk	10	2
	3	1	--	--	6	Yel	Blk	10	2
California	1,3	1	6	--	--	Yel	Blk	5	1-1/2
Colorado	1,3	1	--	--	--	--	--	12	2
Connecticut	1,3	3,4 or 5	3	36	--	Yel/Org	Blk	6	3/4
Delaware	--	--	--	--	--	--	--	--	--
Florida	1,3	1	--	--	--	Yel/Wht	Blk	--	--
Georgia	1,3	1	6	12	--	Blk	Org/Red	8	1-1/8
Idaho	1	1	4	12	--	Yel	Blk	--	--
	3	1	4	12	8	Yel	Blk	--	--
Illinois	1,3	2	--	--	--	Yel	Blk	12	--
Indiana	1,3	2	6-8	18	--	Wht	Red	12	--
Iowa	1	2	5	14	--	Yel	Blk	10	--
	3	2	5	14	7	Yel	Blk	10	--
Kansas	2	9	4	22	--	Red	Wht	6	--
	3	9	4	22	6	Red	Wht	6	--
Kentucky	--	--	--	--	--	--	--	--	--
Louisiana	1,3	1 or 2	5	12	--	Yel	Blk	9	--
Maine	1	2	--	--	--	Yel	Blk	6	1-5/8
	3	7	5	18	--	Yel	Blk	6	1-5/8
Maryland	1,3	1 or 2	--	--	--	Yel	Blk	--	--
Massachusetts	--	--	--	--	--	--	--	--	--
Michigan	1	14	6	16	--	Yel	Blk	12	--
	3	14	8	18	7	Yel	Blk	16	--
Minnesota	1 or 2	1	5	12	--	Yel	Blk	8	1-1/2
	3	1	5	12	6	Yel	Blk	8	1-1/2
Mississippi	--	--	--	--	--	--	--	--	--
Missouri	1,3	2	7	18	--	Yel	Blk	10	1-5/8
Montana	1	--	--	--	--	Wht	Blk	8	--
	3	--	--	--	6	Wht	Blk	8	--
Nebraska	1,3	6	--	--	--	Red	Wht	6	1-1/8
Nevada	4	11	5-1/2	18	--	Red	Blk	5	1
	3	10	7	24	7	Red	Blk	8	1-5/8
New Hampshire	1	8	--	--	--	Yel/Org	Blk	10	1
	3	7	--	--	--	Yel/Org	Blk	10	1
New Jersey	1,3	1	6	12	--	Yel	Blk	10	--
New Mexico	1,3	1	6	--	6	Yel	Blk	8	1-1/4
New York	1	1 or 2	--	--	--	Yel	Blk	8	1-9/16
	3	1 or 2	--	--	2-5	Yel	Blk	8	1-9/16
North Carolina	1,3	2	--	--	--	Yel	Blk	10	--
North Dakota	1,3	2	7	18	--	Yel	Blk	12	2
Ohio	1	14	6	14	--	Yel	Blk	10	--
	3	14	8	18	7	Yel	Blk	12	--
Oklahoma	2,3	1	5	18	--	Red	Wht	10	--
Oregon	2	1	--	--	--	Yel	Blk	8	1-1/2
	3	12	--	--	8	Yel	Blk	8	1-1/2
Pennsylvania	1,3	2	6	12	--	Yel	Blk	10	--
Rhode Island	1,3	1	--	--	--	--	--	--	--
South Carolina	1,3	1	--	--	--	--	--	12	1-1/2
South Dakota	1,3	1	--	--	--	--	--	12	--
Tennessee	1,3	1	9	18	--	Blk	Org/Red	10	2
Texas	--	--	--	--	--	--	--	--	--
Utah	1	1	6	18	--	Yel	Blk	10	1-9/16
	3	1	6	18	7	Yel	Blk	10	1-9/16
Vermont	3	5 or 13	3	36	--	Yel	Blk	6	--
Virginia	--	--	--	--	--	--	--	--	--
Washington	2	2	--	--	--	Yel	Blk	--	--
	3	2	--	--	8	Yel	Blk	--	--
West Virginia	1	2	6	14	--	Yel	Blk	12	--
	3	2	6	14	6	Yel	Blk	12	--
Wisconsin	--	--	--	--	--	--	--	--	--
Wyoming	--	--	--	--	--	--	--	--	--

a/ Location of Sign

1. Front bumper
2. Top of cab
3. Rear of load
4. Front of load, vertical

b/ Word Configuration

1. Wide Load
2. Oversize Load
3. Caution Wide Load
4. Caution Oversize
5. Caution Overwidth
6. Caution Wide Load
7. Danger Oversize Load Ahead
8. Danger Oversize Load Following
9. Caution Wide and Long Load
10. Caution While Passing
11. Pass With Caution
12. Long Wide Load
13. Danger Oversize
14. Over Size Load (three words)

Source: Glanz *et al.*

TABLE 6

WARNING LIGHT REGULATIONS FOR 12-FOOT-WIDES

	Warning Light Characteristics							
State	Location*	Size (in.)	Color	Height Above Surface (ft)	Candle Power	Operating Mode	Separation (ft)	Horizontal Visibility (ft)
Alabama	--	--	--	--	--	--	--	--
Arizona	--	--	--	--	--	--	--	--
Arkansas	--	--	--	--	--	--	--	--
California	--	--	--	--	--	--	--	--
Colorado	--	--	--	--	--	--	--	--
Connecticut	--	--	--	--	--	--	--	--
Delaware	--	--	--	--	--	--	--	--
Florida	--	--	--	--	--	--	--	--
Georgia	--	--	--	--	--	--	--	--
Idaho	Front, rear	6 to 9	Amber	--	50	Flash	--	--
Illinois	--	--	--	--	--	--	--	--
Indiana	--	--	--	--	--	--	--	--
Iowa	--	--	--	--	--	--	--	--
Kansas	--	--	--	--	--	--	--	--
Kentucky	--	--	--	--	--	--	--	--
Louisiana	--	--	--	--	--	--	--	--
Maine	--	--	--	--	--	--	--	--
Maryland	--	--	--	--	--	--	--	--
Massachusetts	--	--	--	--	--	--	--	--
Michigan	Rear	--	Amber	--	--	Flash	--	--
Minnesota	--	--	--	--	--	--	--	--
Mississippi	--	--	--	--	--	--	--	--
Missouri	--	--	--	--	--	--	--	--
Montana	Front,	5	Amber	--	50	Flash	--	--
	Top rear	5	Amber	7	--	Flash	--	500
Nebraska	--	--	--	--	--	--	--	--
Nevada	Top rear	5	Amber	--	50	Flash	--	--
New Hampshire	--	--	--	--	--	--	--	--
New Jersey	--	--	--	--	--	--	--	--
New Mexico	--	--	--	--	--	--	--	--
New York	Top rear		Yellow	2-5	50	Steady	6	500
North Carolina	--	--	--	--	--	--	--	--
North Dakota	--	--	--	--	--	--	--	--
Ohio	--	--	--	--	--	--	--	--
Oklahoma	--	--	--	--	--	--	--	--
Oregon	Front, rear	6	Amber	--	32	Flash	--	--
Pennsylvania	--	--	--	--	--	--	--	--
Rhode Island	--	--	--	--	--	--	--	--
South Carolina	Rear,	--	Red	--	--	--	--	--
	Front	--	Amber	--	--	--	--	--
South Dakota	--	--	--	--	--	--	--	--
Tennessee	--	--	--	--	--	--	--	--
Texas	--	--	--	--	--	--	--	--
Utah	Top rear	5-1/2	Amber	--	50	Flash	--	--
Vermont	--	--	--	--	--	--	--	--
Virginia	--	--	--	--	--	--	--	--
Washington	Front, Top rear	6	Amber	--	32	Flash	--	--
West Virginia	--	--	--	--	--	--	--	--
Wisconsin	--	--	--	--	--	--	--	--
Wyoming	--	--	--	--	--	--	--	--

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* Warning lights appear in horizontal pairs at locations noted.

Source: Glanz *et al.*

TABLE 7

TOWING VEHICLE REGULATIONS FOR 12-FOOT-WIDES

	Weight Specifications					
State	Manufacturer's Rated Capacity (tons)	Curb Weight (lb)	Gross Vehicle Weight (lb)	Gross Combination Weight (lb)	Minimum Wheelbase (in.)	Other Pertinent Regulations Specified[c]
Alabama	--	--	--	--	--	--
Arizona	1-1/2[a]	--	--	--	90	--
Arkansas	1	--	--	--	--	--
California	1-1/2	6,500	--	--	--	--
Colorado	1/2	--	--	--	--	Brakes
Connecticut	--	--	10,000	--	--	Brakes
Delaware	--	--	--	--	--	--
Florida	1	--	--	--	--	--
Georgia	--	--	--	--	--	--
Idaho	--	7,500	14,000	--	--	Tires, Brakes
Illinois	1	--	--	--	--	--
Indiana	--	--	--	--	120	Length
Iowa	1-1/2	6,000	--	--	120	--
Kansas	2	--	--	--	--	Brakes
Kentucky	1-1/2	--	--	22,000	99	--
Louisiana	1-1/2	--	--	--	--	--
Maine	2	--	--	--	--	--
Maryland	--	--	--	--	--	--
Massachusetts	--	--	--	--	--	--
Michigan	1-1/2	--	--	--	--	Brakes, Cabtop Light
Minnesota	2	--	--	--	100	Brakes
Mississippi	3/4	--	--	--	--	--
Missouri	1-1/2	--	--	--	--	Brakes
Montana	2	--	--	--	--	--
Nebraska	1-1/2	--	12,000	--	120	Hitch, Brakes
Nevada	3/4	--	--	--	--	Cabtop Light
New Hampshire	2	--	--	--	--	--
New Jersey	1-1/2	--	--	--	--	--
New Mexico	1-1/2	--	--	--	99	Length
New York	3/4	--	--	--	--	--
North Carolina	1-1/2	--	--	--	--	--
North Dakota	2	--	--	--	--	--
Ohio	2	4,600	--	--	120	--
Oklahoma	2	--	--	--	118	--
Oregon	--	7,000	--	--	--	Engine, Brakes
Pennsylvania	1-1/2	--	--	--	--	--
Rhode Island	--	--	-	--	--	--
South Carolina	1-1/2	--	-	--	--	--
South Dakota	1-1/2	--	--	--	--	--
Tennessee	--	--	--	--	--	--
Texas	3/4	--	--	--	--	--
Utah	1-1/2	--	--	--	--	--
Vermont	2	--	--	--	--	Cabtop Light
Virginia	1-1/2	--	--	--	--	--
Washington	--	8,000	15,000	35,000	120	Tires
West Virginia	1	--	--	--	90	Cabtop Light
Wisconsin	1-1/2	--	11,000	--	--	Cabtop Light
Wyoming	--	--	--	--	--	--

Notes: a/ Rare capacity requirements vary with coach length, and the greatest required capacity is entered.
b/ Wheelbase requirements vary with truck type (longnose or cabover), and the longest is entered.
c/ Cabtop light is normally a single amber rotating beacon.

Source: Glanz *et al.*,

TABLE 8
ESCORT REGULATIONS FOR 12-FOOT-WIDES

State	Required for All Moves	Conditional Escort Requirements							Additional Requirements
		Escort Designation by Highway Characteristics				Escort Designation by Dimensions			
		2-Lane	4-Lane or Divided	Interstate	Lane Width	Combination Length	Coach Length	Other Escort Designations	
Alabama	--	--	--	--	--	--	--	--	--
Arizona	--	Front and Rear	Front and Rear	--	--	--	--	--	--
Arkansas	--	--	--	--	Front if < 11 ft	--	--	Front on 2-lane if combination > 75 ft	--
California	--	--	--	--	--	--	--	State map designates where front escorts are required	c/
Colorado	--	--	--	--	--	--	--	State map designates where front escorts are required	--
Connecticut	Front	--	--	--	--	--	--	--	c/
Delaware	--	--	--	--	--	Front if > 75 ft	--	Rear also on 2-lane if combination > 85 ft	--
Florida	--	--	--	--	--	--	--	--	--
Georgia	--	--	--	--	--	Rear if > 75 ft	--	--	--
Idaho	--	Front	Front	--	Front, Rear if < 10 ft	--	--	--	a/
Illinois	Flagman	--	--	--	Front if < 11 ft	--	--	--	--
Indiana	--	--	--	--	--	--	--	Front, rear if load exceeds 1/2 of roadway	--
Iowa	--	--	--	NA	--	Front if > 70 ft	--	--	--
Kansas	--	Front	--	--	--	--	--	--	--
Kentucky	--	Front	--	--	--	--	--	--	--
Louisiana	--	--	--	--	Front if < 10 ft	--	--	--	--

TABLE 8 (Cont'd)

		Conditional Escort Requirements							
		Escort Designation by Highway Characteristics				Escort Designation by Dimensions			
State	Required for All Moves	2-Lane	4-Lane or Divided	Interstate	Lane Width	Combination Length	Coach Length	Other Escort Designations	Additional Requirements
Maine	--	Front	Rear	Rear	--	--	--	--	c/
Maryland	Front	--	--	--	--	--	--	--	--
Massachusetts	--	--	--	--	--	Front if > 70 ft	--	--	--
Michigan	--	--	--	--	--	Rear if > 80 ft	--	--	--
Minnesota	--	--	--	--	--	--	--	--	--
Mississippi	--	--	--	--	--	--	--	--	--
Missouri	--	Front	Rear	--	--	--	--	--	--
Montana	Front	--	--	--	--	--	--	--	--
Nebraska	--	--	--	Rear	--	--	--	Front in metropolitan areas on 2-lane	--
Nevada	--	--	--	--	--	--	--	--	--
New Hampshire	--	Front	Rear	Rear	--	--	--	--	c/
New Jersey	--	--	--	--	--	--	--	--	--
New Mexico	--	--	--	--	Front if < 10 ft	Front if > 90 ft	Front if > 70 ft	--	--
New York	--	Front	--	--	--	--	--	--	--
North Carolina	--	Front	--	--	--	--	--	--	--
North Dakota	--	--	--	--	--	--	Front if > 75 ft	--	--
Ohio	--	--	Rear	Rear	--	Front if > 80 ft	--	State map designates where front escorts are required	--
Oklahoma	--	Front	--	--	--	--	--	--	--
Oregon	--	Front	--	--	--	--	--	--	--

TABLE 8 (Cont'd)

		Conditional Escort Requirements							
		Escort Designation by Highway Characteristics				Escort Designation by Dimensions			
State	Required for All Moves	2-Lane	4-Lane or Divided	Interstate	Lane Width	Combination Length	Coach Length	Other Escort Designations	Additional Requirements
Pennsylvania	--	--	--	--	--	--	--	Front on 4-lane or divided; front, rear on 2-lane if combination > 85 ft	--
Rhode Island	--	--	--	--	--	Front if > 80 ft	--	--	--
South Carolina	--	--	--	--	--	--	--	--	--
South Dakota	--	--	--	--	--	--	--	--	--
Tennessee	--	--	--	--	--	Rear if > 75 ft	--	State map designates where front escorts are required	--
Texas	--	--	--	--	--	--	--	Front, rear if load exceeds 1/2 of roadway	--
Utah	--	--	--	--	--	Rear if > 90 ft	--	--	b/
Vermont	--	Front	Rear	Rear	--	--	--	--	--
Virginia	--	Front and Rear	--	--	--	--	--	--	--
Washington	--	Front and Rear	--	--	--	--	--	--	c/
West Virginia	--	Front	Rear	--	--	--	--	--	--
Wisconsin	--	--	--	--	--	--	--	State map designates escort requirements	--
Wyoming	--	--	--	--	--	--	--	Front, rear on 2-lane, rear only on 4-lane, divided if combination > 90 ft	--

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Notes: a/ State map available summarizing specific escort requirements.
b/ Escort must be state certified.
c/ NA Not allowed.

Source: Glanz et al.

D. THE FRAMEWORK FOR EVALUATING INDUSTRIALIZED HOUSING SYSTEMS FOR DISASTER RELIEF

1. METHODOLOGY

The method for evaluating housing systems technology in this report consists of three main elements:

- The cooperation of manufacturers and industries with HUD was a prerequisite. Initially, a wide range of of manufacturers were informed about the study and asked to submit information on their products. Through these initial contacts and a review of the literature, it was possible to identify and organize industry segments and product types in a meaningful fashion.
- HUD incorporated in the study a set of criteria for evaluating housing systems. These criteria had to be integrated in a systematic and hierarchical manner.
- Relevant industry segments and nine basic types of systems were used to form a matrix for classification, systematic evaluation and pre-selection of all potentially applicable products. The matrix was intended to provide for a systematic transition from the initial focus on industries and products to the final focus on generic types of temporary housing systems.

a. General Survey of Industrialized Housing Manufacturers and Initial Contacts

Appendix II lists 404 manufacturers of industrialized housing who were contacted by letter about the study. The list indicates the type of housing produced by each company.

The following sources were used to compile the list.

(1) Directory/Census of Manufactured Housing

From this directory were selected all companies with 1972 production of at least 1,000 mobile homes, 500 packaged homes or 25 modular housing units.

(2) 1971 Request for Information

HUD has a file of responses to a 1971 request for information on temporary housing systems and the agency's preliminary evaluation of these responses. The 80 responses submitted ranged from conceptual proposals by architects and engineers to submissions by nation-wide corporations such as National Homes Corp. and Fleetwood Enterprises. Proposals that were merely conceptual were not given consideration. Companies listed in the Directory/ Census had already been contacted. Twenty-six proposals by companies who had not been contacted were selected for a follow-up. However, only a few of these companies expressed an interest in the subject. These companies are included in Appendix II under the category of "relocatable" systems manufacturers.

(3) Other Sources

Other sources used for the general survey included the 1973 list of Housing's Giants of Professional Builder, the 1973 Builders' Guide to Manufactured Houses issued by the National Association of Building Manufacturers, the 1973 House & Home Directory of Modular Housing Producers and Reidelbach-Simpson Associates. Further contacts were established at the 1973 Industrialized Building Exhibit (INBEX) in Chicago and through announcement of the study in HUD publications.

Tables 9 and 10 summarize statistical information on the 404 manufacturers contacted during the initial stage.

More than 80% of all companies contacted produced only one category of housing. The percentage of plants producing only one category exceeded 90%.

Statistics reveal a high degree of specialization on the plant and company level. Only 17.6% of the manufacturers contacted and 7.7% of all plants produce more than one housing category. Mobile/modular and modular/packaged are the two predominant combinations.

Only 9% of all manufacturers contacted responded to

TABLE 9

GENERAL SURVEY OF INDUSTRIALIZED HOUSING MANUFACTURERS
TOTAL MANUFACTURERS BY HOUSING CATEGORY AND RESPONSE

	Mobile	Relocatable	Modular	Packaged	Total*
Manufacturers Contacted	110	9	239	121	404*
Responses	11	9	17	7	38*
Percent	10	100	7	6	9*

*Since several manufacturers produce more than one category, the total number of manufacturers is less than the sum of the individual categories.

<u>Source</u>: Appendix II

TABLE 10

SURVEY OF INDUSTRIALIZED HOUSING MANUFACTURERS

STATISTICAL PROFILE OF MANUFACTURERS BY HOUSING CATEGORY COMPARED WITH TOTAL 1973 CENSUS OF PLANTS

Housing Category Provided	Number of Manufacturers Contacted	Percent	Total 1973 Census of Plants	Percent
Mobile Only	74	10.3	983	45.8
Relocatable Only	4	1.0	N.R.	N.R.
Modular Only	174	43.1	371	17.4
Packaged Only	81	20.0	630	29.4
Subtotal One Category Only	333	82.4	1,984	92.3
Mobile and Modular	30	7.5	90	4.3
Mobile and Packaged	3	.7	N.R.	N.R.
Modular and Packaged	32	7.9	71	3.4
Other Combination	6	1.5	N.R.	N.R.
Total	404	100.0	2,145	100.0
Temporary Housing (Mobile and/or Relocatable)	78	19.5	1,073	50.0
Manufactured Housing (Modular and/or Packaged	326 + 33	80.7	1,072 + 90	50.0
Total	404	100.0	2,145	100.0

Source: Appendix II
Directory/Census of Manufactured Housing

the initial contact. The rate of response by mobile home manufacturers was highest.* Packaged housing producers showed the lowest rate of response. Several modular manufacturers responded with statements about unsuccessful attempts to supply permanent modular housing to HUD disaster missions.

The information submitted for the initial stage of the study varied from sales brochures to detailed drawings and specifications.

In a subsequent stage of the study a more structured survey was conducted to provide fuller data on potentially applicable housing systems.**

b. Hierarchy of Criteria for Systems Evaluation

The following criteria were established by HUD for cost-effectiveness evaluation of housing systems for disaster relief.

- Livability: The shelter should provide an acceptable private living environment for one family, with provisions for two and three bedrooms, one bathroom, kitchen and eating area and a living room area.

- Transportable: The housing system(s) should be quickly and easily transportable by road or railroad.

- Storage: The housing system(s) should be adaptable to conventional storage techniques. Requirements for preparing the system(s) for storage and use should be minimal.

- Site Erection: The housing system(s) should have the capability of being quickly and easily erected on site, with minimum requirements for site preparation and skilled workmen. Utility hookup should be simplified and adaptable to varying site conditions.

- Maintenance: The housing system(s) should require minimal maintenance by the occupants and be durable for the use intended.

- Economics: The units should be competitively priced

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*Not counting special relocatable manufacturers who were contacted individually.

**See Parts III-B and IV of this report.

and adaptable for low-cost transportation and storage. Consideration should be given to the cost of site preparation, maintenance and repair for reuse.

- Delivery Time: The housing system(s) should be immediately available for mass production or easily adaptable to mass production methods as used in most sections of the country.
- Special Consideration: Three options should be considered by the contractor: 1) The shelter should be disposable after being used once. 2) The shelter should be fully or partly expandable to a permanent home, and the resulting permanent structure must conform to HUD codes and standards as determined in Task I. 3) The housing system(s) should be capable of being reused and stored several times for the same or other disaster areas.*

To make the HUD criteria useful for evaluating systems, they were ranked in a hierarchical order.

(1) Classification of Housing Systems by Intended Use

The last criterion (Special Consideration) requires that housing systems be considered for three types of uses: disposable, reusable and permanent.

This requirement relates to the basic purpose for which a housing system is intended. It is a criterion for classification and can help insure that systems are evaluated for the use for which they are designed.

(a) Disposable and Reusable Housing Systems

The first option is that the shelter is disposable after being used once. The third option is that the housing system be capable of being reused and stored several times.

Both options clearly imply a system designed for temporary use, either in one mission or in several. The question of whether a system is built for one or several missions was integrated in the model for cost-effectiveness

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*HUD contract H2119R

analysis of temporary housing systems in Task Report II. Consequently, the two options significant for the initial system evaluation in Task Report I are temporary housing systems and permanent housing systems.

(b) Temporary or Permanent Housing Assistance

Volume 2 of this study discusses the legislation under which HUD is responsible for providing housing assistance to disaster victims. While the principal purpose is temporary relief, the legislation permits disaster victims to purchase mobile homes furnished by HUD.

HUD officials with disaster housing experience hold two important views on the subject:

- Minimum Space Standards. Space standards to be used for temporary housing should not significantly exceed minimum requirements so as to discourage their use for permanent housing. Therefore, a set of "Minimum Livability Standards for Temporary Housing" (MLS) was developed and approved by HUD as a basis for evaluating and pre-selecting temporary housing systems. In several areas these standards fall short of current standards for minimum space requirements for permanent housing. The Minimum Livability Standards are presented in the following chapter.
- Need for permanent Housing Assistance. Temporary housing assistance works best for families who can return to their homes, but it raises problems for those who lose their homes. In the past, few families have bought a HUD mobile home. For one reason, zoning barriers made it hard to find sites.

Part of HUD's last criterion reflects the agency's concern for providing permanent housing. One option under the last criterion is that the shelter be fully or partly expandable to a permanent home.

This approach, however, is impractical because it would require another interim shelter to cover the period during which the temporary shelter is being expanded to a permanent home. An alternative approach was designed for those permanently displaced by disasters--the Fast Delivery Permanent Home program. As an option to temporary housing assistance, it offers logistical and financial assistance for obtaining a code-complying new home within eight weeks of a disaster declaration. The cost of the two options would be equal, but many displaced families might consider a Fast Delivery Permanent Home preferable to one year of rent-free living in a HUD mobile home. Part III-B discusses this approach in detail.

Manufactured housing systems are generally designed for permanent use. Very few manufacturers produce housing that is clearly relocatable. Therefore, the expertise and and interest of manufactured housing producers in temporary housing is limited.

A Fast Delivery Permanent Home program could make the products of these manufacturers an important additional resource for disaster relief.

Thus, evaluation of industrialized housing systems in this report is focused on two types of systems:

- Housing systems potentially applicable for Fast Delivery Permanent Homes;

- Housing systems potentially applicable for temporary housing.

(2) First-Level Critera for Pre-Selection

Evaluation of the performance of potentially applicable housing systems according to HUD criteria is integrated in the Task Report II analysis. But general first-level criteria were developed to guide the pre-selection in Task Report I. These first-level criteria were designed to screen out inapplicable systems from further analysis.

(a) Temporary Housing Systems

To be pre-selected for detailed cost-effectiveness analysis, a temporary housing system must satisfy the following first-level criteria:

- The system must be adaptable to the Minimum Livability Standards for Temporary Housing.
- Information available must be sufficient to include the systems in the detailed cost-effectiveness analysis.
- The system must be based on existing technology available for large-scale production by existing manufacturers.
- The use for which a system is designed must be reasonably close to the typical use of temporary disaster relief housing.
- A system which shows significant disadvantages if compared with a known temporary housing system is to be pre-selected only if it also shows significant advantages that could favorably influence cost-effectiveness.

To review and evaluate the performance of systems with regard to these criteria, a panel was formed including principals and consultants of the Joint Venture.

(b) Fast Delivery Permanent Home Systems

To qualify as a Fast Delivery Permanent Home in federal disaster relief missions, a housing system should satisfy the following six requirements:

- The system must comply with codes and regulations applicable to manufactured housing and FHA Minimum Property Standards and must qualify for permanent mortgage financing.
- The system must be generally accepted by the consumer.
- The system should be readily available in all disaster-prone sections of the country as a fairly standardized product within a comparable price range.

- The system must have a high degree of factory completion; the need for local skilled labor must be minimal.
- The lead time between placement of an order and completion of the housing unit must be minimal.
- The system must be available at the lowest possible cost to the consumer (compared with other permanent housing).

(3) Quantifiable Characteristics for Cost-Effectiveness Analysis

The performance of a temporary housing system according to the HUD criteria of transportability, storability, site erection, maintenance and economics can be measured in cost and is included in the model developed for life cycle cost-effectiveness analysis in Task Report II.

Likewise, the performance of permanent housing systems pre-selected for Fast Delivery Permanent Home assistance according to the applicable criteria (all except storability) was measured in costs and incorporated in the feasibility analysis of the Fast Delivery Permanent Home program in this report.

Figure 3 illustrates the hierarchy of criteria as applied to the two types of systems.

c. Matrix for Evaluation of Temporary Housing Systems

An important basis for comparing temporary housing systems is their basic configuration. Whether a system consists of one box with integral running gear or whether it is a package of panels with a mechanical core module might greatly influence such factors as transportation, site erection and storage costs.

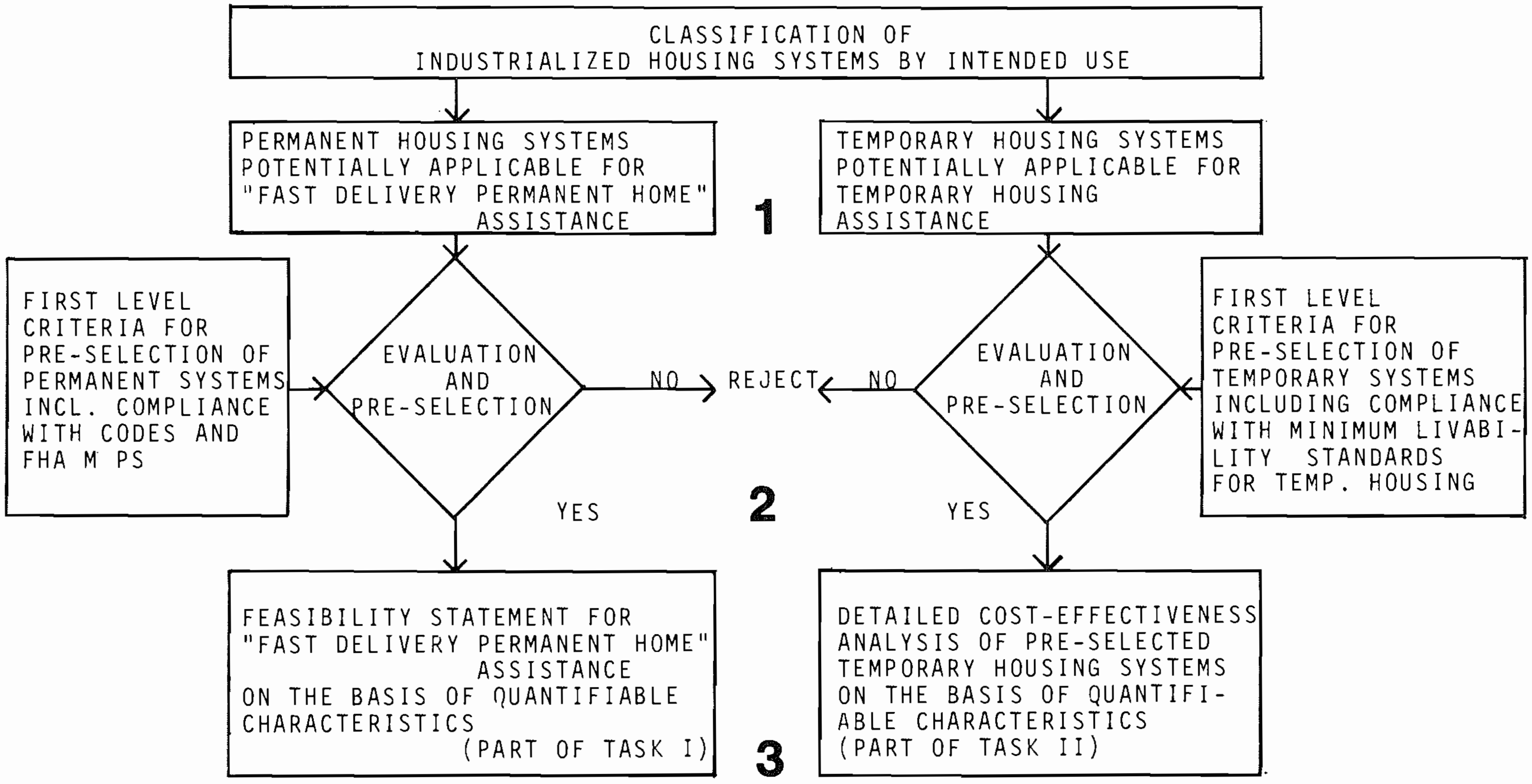
Nine types of basic configuration can be identified. These types can be ranked according to the amount of site assemblage required. Along with the industry segments outlined in Figure 1, they form the evaluation matrix shown in Figure 4.

Every temporary housing system type identified during the study was shown in this matrix according to manu-

FIGURE 3

HIERARCHY OF CRITERIA FOR

EVALUATION AND PRE-SELECTION OF HOUSING SYSTEMS



F I G U R E 4

MATRIX FOR THE EVALUATION OF POTENTIALLY APPLICABLE TEMPORARY HOUSING SYSTEMS BY INDUSTRY SEGMENT AND BASIC CONFIGURATION

BASIC CONFIGURATION INDUSTRY SEGMENT	ONE BOX		EXPANDABLE BOX		TWO OR MORE SECTIONAL BOXES		SECTIONAL BOX(ES) AND KNOCK-DOWN(S)	CORE AND PANELIZED	CORE & SPECIAL PACKAGED ENCL.
	ON WHEELS	GENERAL	ON WHEELS	GENERAL	ON WHEELS	GENERAL			
	1	2	3	4	5	6	7	8	9
MOBILE HOME INDUSTRY									
MANUFACTURERS OF SPECIAL RELOCATABLE SYSTEMS									
a. Military									
(1) Air Force									
(2) Army									
(3) Navy									
b. Private Market Housing Systems									
(1) Camp Systems									
(2) Honeycomb Panel Systems									
(3) Dome Systems									
(4) Miscellaneous Systems									
c. Other Commercial Relocatable Shelter Systems									
(1) Air Structures									
(2) Metal Structures									
(3) Container Vans									

Potentially applicable temporary housing systems facturer and basic configuration. Several types are broadly established and produced by whole industries (e.g., "one box on wheels": mobile homes). Other types are produced by one manufacturer only (e.g., certain "expandable box" systems).

The evaluation matrix was adopted since it allows for cost-effectiveness analysis of specific products leading to the identification of the most promising general systems types. With this approach, it was possible to use the work in Task Reports I and II to develop performance specifications for housing system types in Task Report III.

2. MINIMUM LIVABILITY STANDARDS FOR TEMPORARY HOUSING

a. Purpose

This chapter will define and delineate minimum interior space standards for temporary housing for people displaced by disasters. As defined for this study, temporary housing is disposable or reusable shelter to house a family for up to one year. Interior space standards for temporary accommodations can be lower than standards for permanent housing, since temporary housing must be erected quickly and will be used for a limited period. The livability of a housing unit varies considerably with its inhabitants and its setting. Zoning ordinances usually define livability standards for homes and apartments, expressing them in terms of minimum square feet of space per housing unit and minimum size lot. Local building codes and special codes issued by the Federal Housing Administration, state housing agencies and other agencies prescribe minimum sizes for various kinds of rooms. When the livability of a temporary housing unit is measured, standards vary. The short-term use of a pullman berth, roomette or railroad bedroom suite with limited space is often luxurious for a short trip. The Skylab astronauts living in rooms considered spacious when compared to the Apollo capsule complained of cramped quarters after two or three months.

Physical needs are not the only requirements that must be satisfied. The psychological impact of the dwelling and exterior space on its occupants is also important.

Space must be provided and designed to avoid claustrophobia and prevent bad emotional reactions, especially after a disaster when people may be psychologically vulnerable. Appendix IV notes some psychologically desirable attributes of different types of space for postdisaster housing.

b. Current Livability Standards

To establish new livability standards for temporary housing, a wide range of existing standards for permanent housing were analyzed. Table 11 compares various standards with regard to room size, storage requirements, ceiling heights and total unit areas. All standards relate to two-bedroom units for occupancy by four persons. The major national building codes (such as National Building Code, Southern Standard, and BOCA) have similar standards. Interestingly, these standards are less stringent than codes related to federal or local assistance programs. Although the national building codes establish minimum standards for most housing built in the country, a multiple dwelling or a single-family house is rarely constructed to these minimums.

Frequently, local zoning ordinances will establish the minimum floor area for various housing types. Typically, one-quarter acre zoning for a three-bedroom house will require a minimum of 1,200 to 1,500 square feet. Often, minimum apartment sizes exceed those of national building codes.

The ANSI A119.1 Construction Standard for Mobile Homes stipulates a minimum of 420 square feet for two-bedroom units. The BOCA code for mobile homes is somewhat less restrictive, requiring 310 square feet. Mobile homes are rarely this small. In fact, mobile homes seem to be getting larger -- approximating the size of permanent housing.

The various minimum requirements outlined in Table 11 were used as a guide for this study. However, the purpose and duration of use of temporary disaster relief housing is unusual enough to require a completely new analysis to determine livability standards.

TABLE 11

COMPARATIVE CHART OF MINIMUM REQUIRED AREAS BASED ON A TWO BEDROOM UNIT - OCCUPANCY - 4 PERSONS

AGENCY	TYPE OF PROGRAM	DATE	LR-DA Sq.Ft.	DR Sq.Ft.	LR Sq.Ft.	KIT. Sq.Ft.	BATH # of Fixt.	BR #1 Sq.Ft.	BR #2 Sq.Ft.	GEN'L STOR. Cu.Ft.	# of CLOS.	TOTAL UNIT AREA Sq.Ft.	MIN.RM. WIDTH	MIN.RM HGT.
1. HUD-FHA	Multi-family Hsg.	Feb.'71	210	100	160	60	3	120	80	140	4	600	12'-0" LR 9'-4" BR	8'-0"
2. HDA-NY	Multi-family Hsg.	Mar.'65	250	-	-	60	3	150	130			700	11'-0" LR 10'-0" BR	8'-0"
3. HFA-NJ	Multi-family Hsg.	Dec.'71	250	-	-	60	3	150	130			700	11'-0" LR 10'-0" BR	8'-0"
4. NY Hsg.Auth.	Multi-family Hsg.	Apr.'64	-	-	220	110	3	160	130					
5. BOCA	1 & 2-Family Dwelling Code	1971	-	-	150	50	3	70	70			500	7'-0"	7'-6"
6. Natl.Bldg.Code	1 & 2-Family Dwelling Code	1971	-	-	150	50	3	70	70			500	7'-0"	7'-6"
7. Southern Std. Bldg. Code	1 & 2-Family Dwelling Code	1971	-	-	150	50	3	70	70			500	7'-0"	7'-6"
8. Uniform Bldg. Code	1 & 2-Family Dwelling Code	1971	-	-	150	50	3	70	70			500	7'-0"	7'-6"
9. MDL-NY	Tenements		-	-	132	59	3	80	80			500	7'-0"	7'-6"
10. Typical Low Cost	Single Family Detached House													
11. ANSI	Standard for Mobile Homes A119.1	1973	-	-	150		3	70	70			420	5'-0"	7'-0"
12. BOCA	Mobile Homes	1970	140 (2 persons); 240 (3 persons) + 70/each add'l person									310		
13. BOCA	Travel Trailers	1970	Max.Wgt: 4,500 lbs.(any length); 28' length (any weight)									224		
14. ANSI	Std.for Recreational Vehicles A119.2 Travel Trailer	Apr.'73	Maximum width 8'; maximum length 32'									256		
15. HUD-FHA	One & Two Fam. Dw.	1973	210	100	160	60	3	120	80	200	4	620	11'-0"LR 9'-4"BR	7'-6"

c. Space Requirements and Family Activities

Before determining space requirements, it is necessary to study activities that will take place in the spaces provided. The basic activities can be divided into the following categories:

- conversation
- eating
- sleeping: (a) parents, (b) children
- cooking
- bath
- study
- play
- television viewing
- other household activities
- laundry and clothes care
- storage

(1) Conversation

While this activity takes place throughout a dwelling, it requires an area where the whole family can gather for an event or a discussion. Therefore, it is important to provide one area large enough to seat the family and to accommodate any visitors. In most households this function is served by a living room. Eight feet between the participants is considered a maximum distance at which conversation levels can easily be maintained. Since a person requires a seat approximately 2'x2' and another 2'x2' to stretch the legs, it follows that an area approximately 8'x8' will comfortably seat six people for an informal gathering.

(2) Eating

This is a major activity in a household. For temporary housing, the family's meals are more important than entertainment of guests. Nearly all studies on the subject call for provision of a permanent eating place. Studies made for public housing show that most families prefer to eat in the kitchen or near it. A temporary dining area in the corner of a living room seemed unsatisfactory. Therefore, provision of a permanent dining table near the cooking area is considered highly desirable. A 2'6"x6'0" table will seat six people and with seats would fit in a space 6'10"x6'0".

(3) Sleeping

Sleeping accommodations are generally provided in bedrooms. This activity can be further subdivided according to the age of the occupants. A double bed is necessary for an adult couple; bunk beds would suffice for children. One study of public housing shows that a family of four would have an average of 28 days of illness a year. This would be an important factor in planning sleeping accommodations. Furthermore, infants would require a crib in or near the parents' bedroom. Dressing and undressing is also closely related to sleeping. All these factors indicate that room layouts rather than room sizes will determine the adequacy of sleeping spaces. For example, bunk beds can be placed in a space of 3'3"x6'6". By adding one small table 1'6"x2'6", a compact study and sleeping area is achieved in a space of 6'3"x6'6". To accommodate a 4'6"x6'6" double bed, a minimum space of 7'6"x9'0" is required.

(4) Cooking

Cooking needs are easier to determine. Along with necessary appliances -- range, oven, sink and refrigerator -- counter space is needed for food preparation. Sufficient cabinet space for food storage should also be provided. It is important to remember that under temporary living conditions, eating-out will probably be minimal. This results in a sharp increase in household cooking and underscores the need for a permanent, adequate cooking-dining unit. A 28"-wide sink with counter space on both sides would fit into a space 9'6" wide by

6'0" deep. With wall cabinets above the counter, the whole unit functions efficiently as a compact cooking area.

(5) Bath

A full bath with a lavatory, water closet and a tub/shower (combination) is considered adequate for a family of four to six. Usually, a full bath is also considered a minimum requirement for a single family. The bath should be very near the bedrooms, but in a good layout any suitable location is accessible from inside the dwelling unit. A full bath unit fits into a 5'0"x7'6" space.

(6) Study

This activity varies considerably with the age and habits of the occupants. Young teenagers require specific areas for homework. When space is at a premium, this activity can be best accommodated in the sleeping areas where there is quiet and privacy. General adult reading can take place in the living room area.

(7) Play

This is another activity which varies with the age of the children in the family. Studies indicate that this activity can take place in the kitchen or living room areas when limited areas are available. This activity will greatly benefit by the provision of a patio or other exterior enclosed space.

(8) Television Viewing

In the past three decades, television has commanded an increasing share of a family's leisure time. According to the 1970 Census, 96% of all households have one or more TV sets. According to a 1972 Nielsen TV research report, average TV viewing per household per day is 6.12 hours. This activity generally takes place in the living room.

(9) Other Household Activities

Activities like sewing and knitting can be combined with the master bedroom or living room. Storage area for a sewing machine should be provided.

(10) Laundry and Clothes Care

Needs for laundry space depend on overall community provisions. If public laundries are not available, provision for washing machines must be made inside the dwelling units. Automatic washers and dryers can be provided near the bath or kitchen area. Ironing and clothes sorting can take place in the kitchen or bedroom areas. A 24"-wide space with a stacked washer/dryer unit would meet the basic needs of a family of six.

(11) Storage

Storage needs are difficult to specify. Families affected by a disaster may require storage for the contents of their entire household -- furniture, clothing and the like. Others may need only storage for clothing and cooking utensils for a temporary stay. It is assumed that space for storing household belongings like furniture will not be included in the temporary dwelling units. However, storage space for clothing, kitchen utensils and some household articles is important and should be provided for. In general, minimum storage standards established by the Federal Housing Administration for multi-family housing should be adequate.

d. Recommended Minimum Livability Standards for Temporary Housing

It is necessary to determine what minimum room sizes are spacious enough to be psychologically acceptable. This analysis indicates that most living functions occur within small areas. However, there is no tested example of confined spaces occupied for a long period, such as one year, by a family of six.

The approach is to provide spaces which although minimum in area will be adequate and aesthetically pleasing. Each room and its specific function was analyzed to determine minimum adequate size and configuration.

For example, bedrooms with floor areas below the standards of permanent housing can still function adequately and be psychologically satisfactory. However, significantly reducing minimum space requirements for bathrooms and kitchens is hardly possible without adverse effects. A family suddenly moving from a familiar and adequate residence into an unfamiliar, small, temporary housing unit must not have the additional shock of adjusting to a completely unfamiliar environment. Typically, the bathroom and kitchen are the most important factors in a residential environment. If they are spacious, well designed, and attractive, other rooms may be somewhat smaller. However, if the kitchen and bathrooms are inadequate and hard to use, large rooms will still be unacceptable. It is recommended that the basic core of the temporary house be constructed in accordance with the FHA Minimum Property Standards. Figures 8 and 9 illustrate these standards.

Figures 10 and 11 illustrate two minimum bedroom types which are below national standards but adequate for temporary use. All storage requirements, including closets and drawers, are built into the unit, as is the desk. The master bedroom is designed for a double bed and has provision for a crib. The second bedroom is designed for bunk beds.

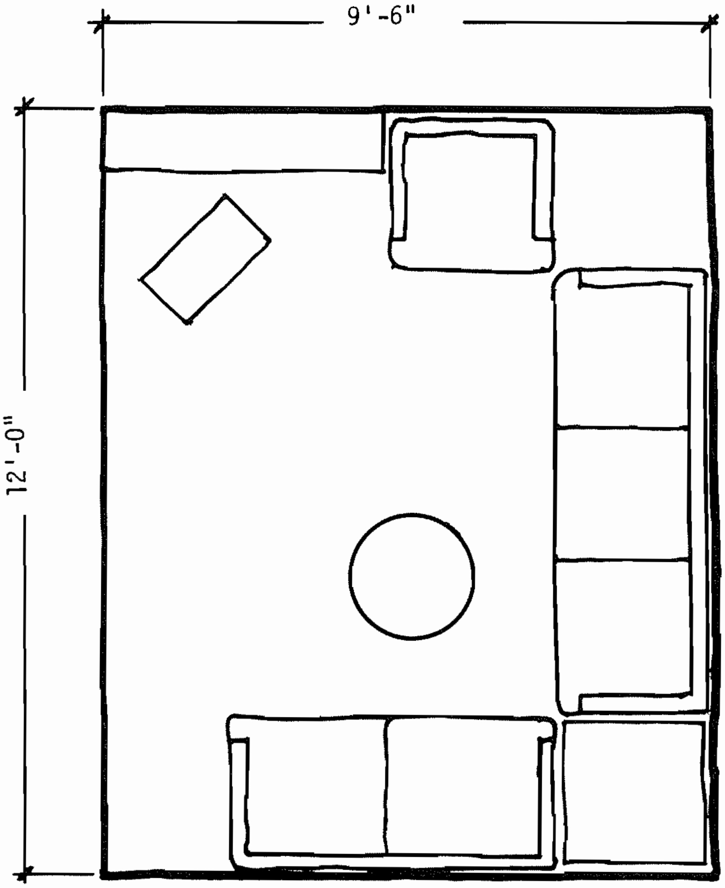
The living and dining functions illustrated in Figures 5, 6 and 7 are sufficient for a family of six, plus a few guests. The living and dining areas are below national standards, but are adequate for temporary use. These two spaces should be combined when designed to create a single large room with provision for partial separation. The combination of kitchen, living and dining spaces should permit flexibility. Furniture should not be fixed in order to permit this flexibility.

FIGURE 5
MINIMUM LIVABILITY STANDARDS
LIVING ROOM

Storage:
  Built-in shelving 4l.f.
  T.V. on stand

Seating for 6:
  1 couch 7'-0" x 2'-6"
  1 love seat 5'-0" x 2'-6"
  1 side chair 2'-6" x 2'-6"

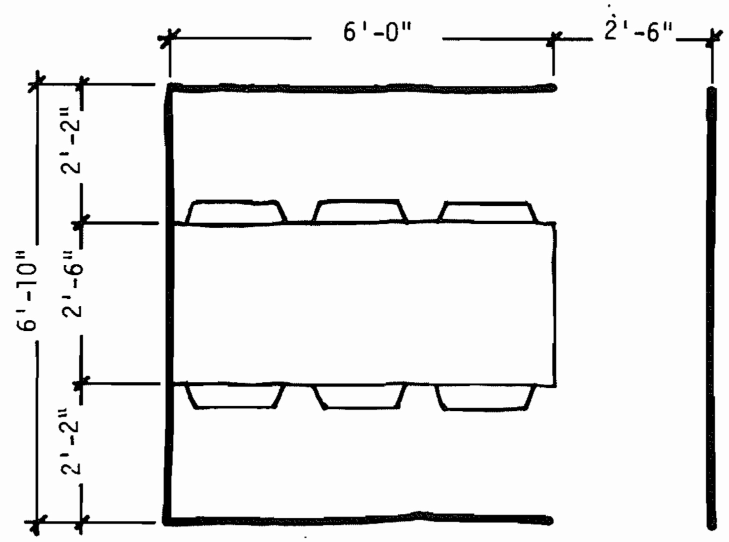
Tables:
  1 side table 2'-6" x 2'-6"
  1 coffee table 15"diameter



LIVING ROOM
9'-6" x 12-0"
114 sq.ft.

FIGURE 6
MINIMUM LIVABILITY STANDARDS
DINING AREA 1

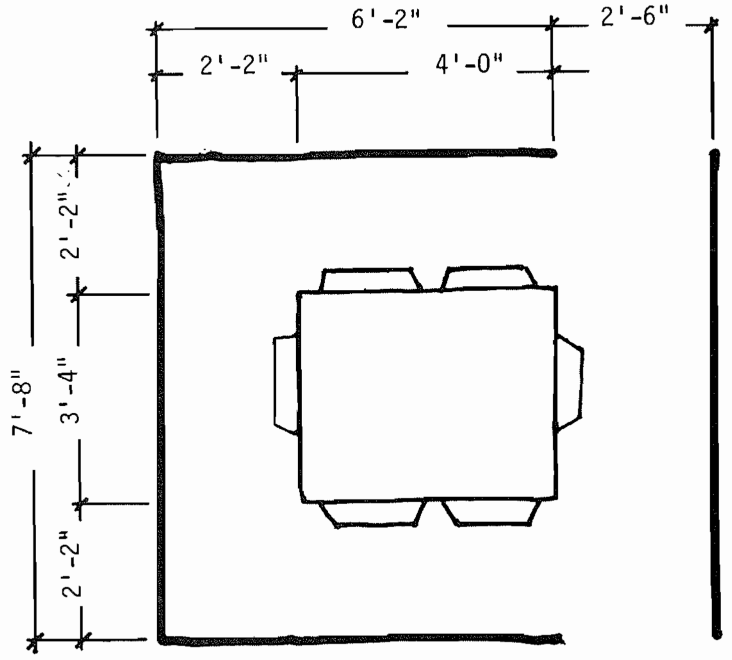
Furnishings:
Table 2'-6"x6'-0"
6 Chairs



DINING 1
6'-10" x 8'-8"
58 sq.ft.

FIGURE 7
MINIMUM LIVABILITY STANDARDS
DINING AREA 2

Furnishings:
Table 3'-4" x 4'-0"
6 Chairs

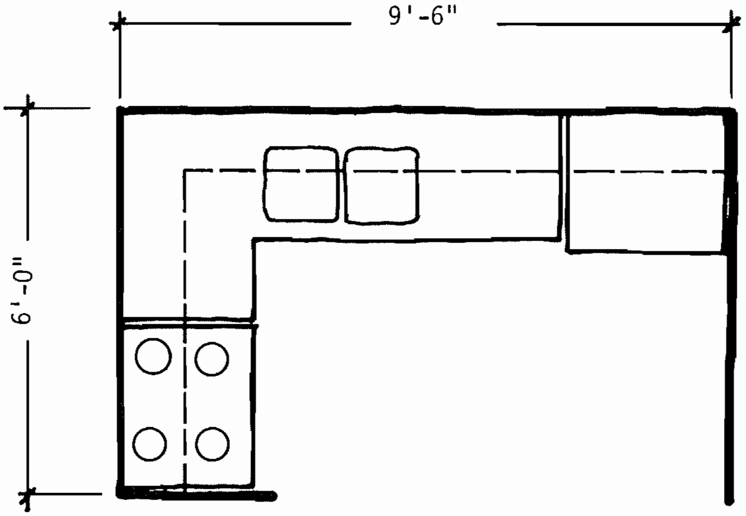


DINING 2
7'-8" x 8'-8"
66 sq.ft.

FIGURE 8
MINIMUM LIVABILITY STANDARDS
KITCHEN

Appliances:
- 4-burner range w/oven 30"
- double sink 2'-8"
- refrigerator 14 cu.ft. 2'-4"

Storage:
- minimal shelf area 44sq.ft.
- minimal drawer area 10sq.ft.
- 41f. clear counter



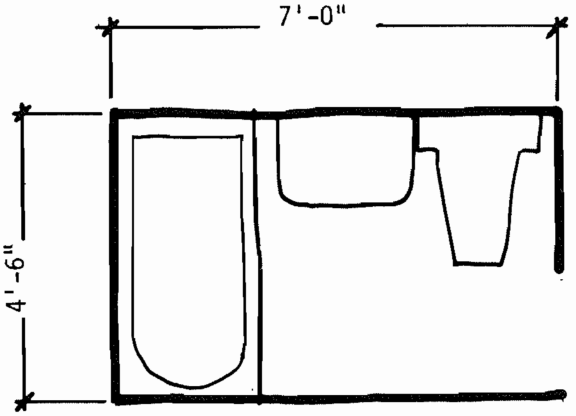
KITCHEN
6'-0" x 9'-6"
57sq.ft.

FIGURE 9
MINIMUM LIVABILITY STANDARDS
BATHROOM

Fixtures:
- 1 lavatory
- 1 commode with top and seat
- 1 tub/shower and curtain

Accessories:
- 1 hamper
- 1 tumbler & toothbrush holder
- 1 soap dish
- 1 toilet paper holder
- 1 towel bar
- 1 medicine cabinet

Storage:
- cabinet under sink

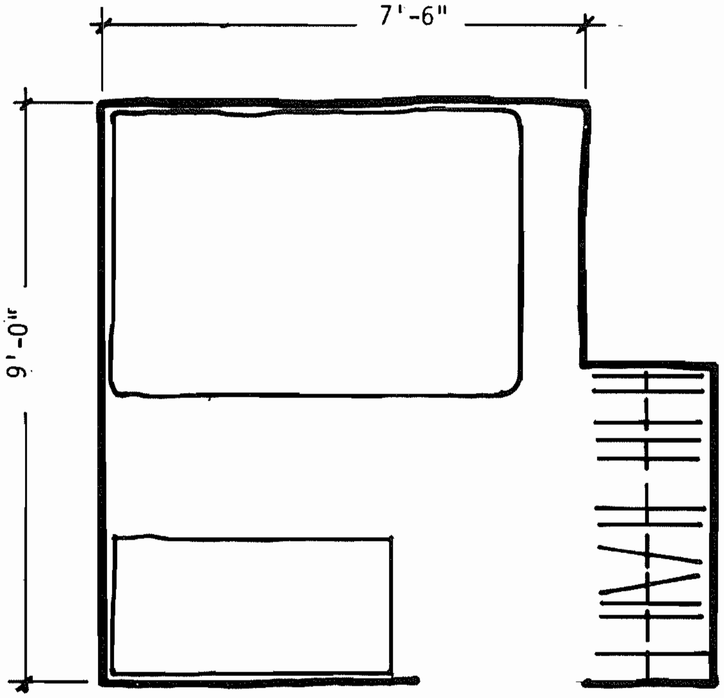


BATHROOM
4'-6" x 7'-0"
31.5 sq.ft.

FIGURE 10
MINIMUM LIVABILITY STANDARDS
MASTER BEDROOM

Beds:
- 1 double bed 4'-6" x 6'-6"
- 1 crib 2'-4" x 4'-5"or
- 1 desk 2'-0"x 4'-0" or
- 1 free-standing chest

Storage:
- 1 chest (built-in)1'-10"x5'-0"
- 1 closet 2'-0" x 5'-0"



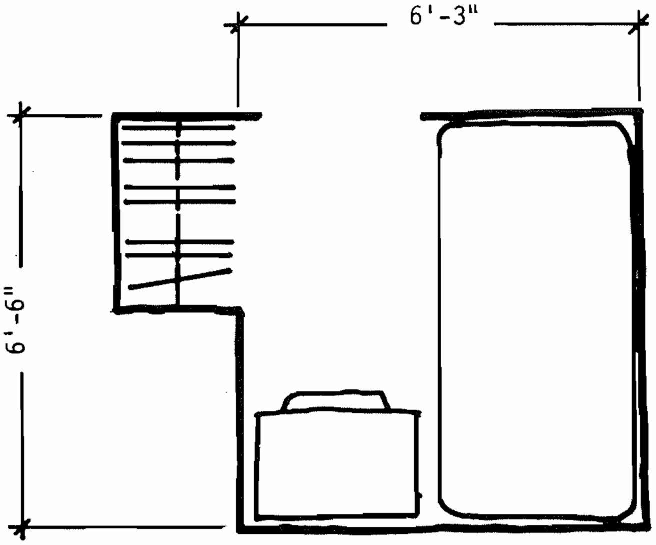
MASTER BEDROOM
7'-6" x 9'-0"
68 sq.ft.

FIGURE 11
MINIMUM LIVABILITY STANDARDS
SECOND BEDROOM

Beds:
- 1 bunk bed 3'-3" x 6'-6"
- or 1 single bed

Storage:
- 1 chest (built-in) 3'-0"x1'-10"
- 1 closet 2'-0" x 3'-0"
- 1 desk 1'-6" x 2'-6"

Chairs:
- 1 desk chair 1'-6" x 2'-6"



BEDROOM
6'-3" x 6'-6"
41 sq.ft.

A sheltered outdoor space adjacent to the living area should be provided, possibly with a large window between the two spaces to visually enlarge the living room.

Table 12 summarizes the dimensional standards for temporary units. The total area approximates those national codes and is 100 to 200 square feet less than federal or state assisted housing.

In summary, it is recommended that a temporary two-bedroom housing unit for displaced families should have an average of 500 square feet of interior space. An additional bedroom would increase the interior space by 54 square feet. Additional corridor and storage space would also be needed. Each unit should also have 64 square feet of private, sheltered outdoor space.

If activities like laundry are provided collectively or if community facilities (see Appendix IV) are provided on a group site, they could be considered an increase to the cost of the housing unit. The cost-effectiveness calculation might include a proportional share of the cost of these facilities.

TABLE 12

RECOMMENDED INTERIOR SPACE STANDARDS FOR TEMPORARY HOUSING

Room	Minimum Area	Minimum Width	Minimum Height	Remarks
Living Room	115 sq.ft.	9'-6"	7'-3"	
Dining Room	58 sq.ft.	6'10"	7'-3"	To be combined with living room and/or kitchen
Kitchen	57 sq.ft.	6'-0"	7'-0"	
Bath	32 sq.ft.	4'-6"	7'-0"	
Bedroom with double bed or 2 twin beds	68 sq.ft.	7'-6"	7'-0"	Space for crib provided with double bed only
Bedroom with single bed or bunk beds	41 sq.ft.	6'-3"	7'-6"	

Minimum Livable Area for Two-Bedroom Unit - 500 sq. ft.

Minimum Livable Area for Three-Bedroom Unit - 580 sq. ft.

III INDUSTRY REPORTS

This part of this volume contains four industry reports on the mobile home industry, manufactured housing industry, manufacturers of special relocatable systems and manufacturers of selected components.

The main part of each industry report consists of two chapters: a profile of the industry and an evaluation of the housing systems provided by the industry for use in disaster relief. The evaluation leads to pre-selection of the most applicable systems for cost-effectiveness analysis.

A. THE MOBILE HOME INDUSTRY

1. INTRODUCTION AND SUMMARY

The mobile home industry is presently the strongest and fastest growing segment of the construction industry. Today's mobile home can be described as an ambiguous, complete housing system still qualifying as a vehicle but primarily intended for quasi-permanent use in one location.

Mobile homes do not have to conform to building codes. Instead mobile home construction in most states now must conform to the national Standard for Mobile Homes. Exemption from local building codes has been a major reason for the spectacular growth of the mobile home industry during the past 15 years.

Volume 2 of this study deals with government experience in providing imported temporary housing assistance to disaster victims under the Disaster Relief Act of 1970.*

So far, only mobile homes and travel trailers purchased from available supplies have been used for this purpose. This industry report will examine how the resources of the industry can best be used for disaster relief.

The first chapter contains an introduction and summary. The second chapter discusses the background of the industry and its emergence as a principal supplier of low-cost housing. The last chapter contains an evaluation of mobile

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* Report for Task I-A, "Past Experience with Federal Disaster Housing Assistance."

home systems for use in disaster relief missions, including a pre-selection of specific types of systems for cost-effectiveness analysis.

From its humble beginning before World War II, the mobile home industry has expanded to a production level of nearly 600,000 units in 1973. With the acceptance of 12'-wide units in the early 1960's, the industry achieved its greatest production surge. Production declined in only one year between 1961 and 1972. Because of its low purchase cost the mobile home has captured an increasing share of the low-cost housing market. This share has grown so large that the industry produces almost two-thirds of all new housing units selling for under $25,000. Low costs are achieved for three reasons: mobile homes are not subject to building codes, mobile homes are typically mass produced on an assembly line and semi-skilled labor is extensively employed.

Mobile homes are especially attractive to two groups: young families who purchase a mobile home as a steppingstone to a conventional home and retired families who no longer need a large conventional home. These groups comprise over 70% of all households living in mobile homes.

Of the 3.4 million mobile homes in use today, half are located on private lots and most of the rest are in mobile home parks. These parks, usually unwelcome when they first appeared, have recently gained wider acceptance.

The top 50 companies or 15% of all mobile home manufacturers account for 80% of total annual production. There are over 1,000 mobile home manufacturing facilities, 45% of which are owned by the top 50 producers. They have a median annual output of nearly 5,000 units, compared to less than 500 units average output of the remaining 280 companies. This high degree of market concentration sharply differs from the typical fragmentation of the construction industry.

Mobile home manufacturing and living is centered in these states: California, Texas, Alabama, Georgia, Florida, North Carolina, South Carolina, Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York.

The 12' single-wide standard mobile home has been successfully used by the government for disaster relief. It is readily available and has a built-in chassis and running gear. However, it is not built to withstand the rigors of extended travel.

If it were structurally upgraded, the single-wide standard mobile home would have great potential as a reusable temporary housing system. This might involve using higher quality components and redesigning the unit to meet disaster relief standards. The resulting "special design mobile home," which would be smaller and more rugged, can be expected to be more suitable for temporary disaster housing than the standard mobile home as presently marketed.

Aside from the single-wide standard mobile home and the special design mobile home, an expandable mobile home was pre-selected for cost-effectiveness analysis.

Because mobile home shipping dimensions are scrupulously regulated by each state, the overall dimensions are important and the width is critical. Since 1955, many states have relaxed their initial eight-foot wide limitations and normally permit up to 12-foot wide shipments. Several permit units up to 14 feet in width, but with stringent restrictions. Table 13 depicts the growth in wider units as a portion of production in the United States.

Mobile home occupancy has followed the sun. Figure 12 indicates a crescent-like pattern, showing that the majority of mobile home occupants reside in the Southeast, South Central, and Southwestern U.S.

TABLE 13

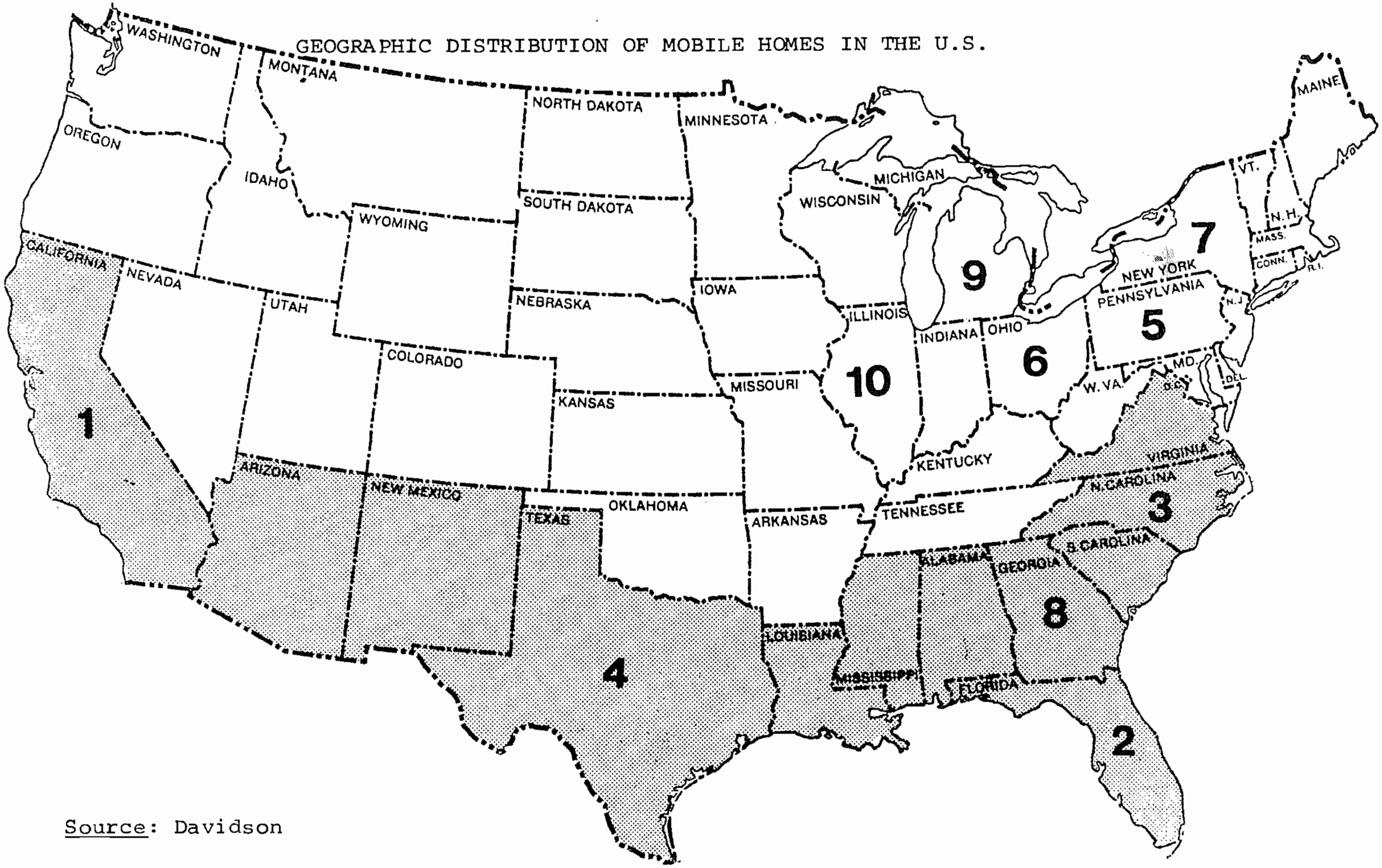
MOBILE HOME WIDTHS AS A PERCENTAGE OF MOBILE HOME PRODUCTION

	Width				Expandables, Double Wides, and Triple Wides
	8 Feet	10 Feet	12 Feet	14 Feet	
1955	100.0%	--%	--%	--%	--%
1956	91.0	9.0	--	--	--
1957	75.0	25.0	--	--	--
1958	31.0	69.0	--	--	--
1959	20.9	79.1	--	--	--
1960	9.5	90.5	--	--	--
1961	1.9	98.1	--	--	--
1962	2.0	72.7	5.0	--	20.3
1963	1.5	73.3	6.4	--	18.8
1964	0.9	59.8	21.1	--	18.2
1965	0.9	41.4	45.1	--	12.6
1966	0.5	24.6	65.3	--	9.6
1967	0.3	7.3	84.1	--	8.3
1968	0.1	2.2	85.9	--	11.8
1969	0.5	1.1	84.2	2.3	11.9
1970	0.3	0.5	78.6	8.1	12.5
1971	0.4	0.7	69.6	16.2	13.1

Source: Mobile Home Manufacturers Association.

FIGURE 12

GEOGRAPHIC DISTRIBUTION OF MOBILE HOMES IN THE U.S.



Source: Davidson

▨ States having 45% of U.S. mobile homes and 33% of U.S. housing units.

1 Rank of states having most mobile homes used as year round dwelling units.

2. Mobile Home Manufacturing

a. Location of Manufacturers

Map 1 shows the number of plants per state in 1973 and mobile home production per state in 1972. Map 5 in Appendix II shows the locations of plants and headquarters of the dominant segment of the industry. of the more than 1,000 plants, 267 are located in four southern states: Florida, Georgia, Alabama and North Carolina. These states, which constitute the only clear geographical concentration of mobile home manufacturers, are responsible for a third of the industry's entire output. A smaller production region includes Indiana, Michigan and Pennsylvania. Texas and California have the most mobile home plants and Georgia and Indiana lead in production. Table 14 ranks the 50 states according to mobile home production in 1972 and number of plants in 1973. Interestingly, California, which produces a third fewer units than Georgia, has almost 25% more plants.

Table 15 compares the ranking of the top 10 states in mobile home production and the ranking of the states according to number of mobile homes used for year-round occupancy. States with the most year-round mobile home residents correspond to or are adjacent to at least one major producing state, except for South Carolina, which is in neither ranking. By combining production and occupancy ranking, four distinct market-production regions for mobile homes are revealed. They are: California; Texas; Florida, Georgia, Alabama, North Carolina and South Carolina; and the production region of Indiana-Pennsylvania-Michigan, coupled with the market region of those three states along with New York, Ohio and Illinois. These regions are illustrated in Figure 13. Boundaries of these regions will probably change in a few years as the influx of people and mobile homes into Arizona, Oregon and Mississippi continues.

b. Travel Trailer Manufacturers

Today's travel trailers and mobile homes have the trailer coach of the 1930's and 1940's as their common ancestor.

As discussed in Part II of this report above, the construction of travel trailers was subject to the same standards as the construction of mobile homes until 1963. The standard for recreational vehicles ANSI A119.2, first issued in that year, distinguishes four basic types of recreational vehicles. These original four basic types have developed into eight more specialized systems currently produced by the industry and shown on Figure 14. Table 16 shows the 1971 and 1972 retail sales volume for each category.

The one housing system provided by the recreational vehicle industry used as temporary post-disaster housing is the travel trailer, the system on which the industry was originally founded. As shown on Table 16, production of travel trailers now accounts for approximately one-third of the industry's total sales volume.

Table 17 shows the total annual production statistics for 1960-1972 for the eight types. While the annual output of travel trailers increased by 500%, their share of total production fell from above 70% in 1960 to about 30% in 1972. The decline of this market share was steady, except during the 1969-71 recession and is connected with the sharp rise of self-propelled recreational vehicles in the mid-1960's. Due to the growth of new types of recreational vehicles, the industry's total output increased by 1,340% during the 12-year period.

Table 18 compares annual output of travel trailers and all recreational vehicles with mobile home shipments in 1960-1972. Production of travel trailers, the recreational vehicle most like the mobile home, has maintained a fairly constant ratio of 40% to 50% of mobile home production. But total annual production of recreational vehicles in relation to mobile homes has dramatically tripled, climbing from 50% of mobile home shipments in 1960 to nearly 150% in 1972.

TABLE 14

PRODUCTION AND RANK BY STATE, 1972
NUMBER AND RANK OF PLANTS BY STATE, 1973

	1972 Production	1972 Rank	1973 # Plants	1973 Rank
Alabama	43,980	5	55	7
Alaska	*	**	3	24
Arizona	5,863	24	16	16
Arkansas	14,408	12	22	11
California	46,948	4	104	1
Colorado	5,378	26	12	18
Connecticut	0	**	1	26
Delaware	0	**	0	27
Florida	41,632	7	70	5
Georgia	69,334	1	84	4
Hawaii	0	**	0	27
Idaho	14,911	10	18	14
Illinois	2,106	31	6	21
Indiana	61,638	2	96	2
Iowa	*	**	7	20
Kansas	23,157	9	26	9
Kentucky	3,680	27	12	18
Louisiana	9,524	18	21	12
Maine	*	**	0	27
Maryland	*	**	4	23
Massachusetts	0	**	1	26
Michigan	14,779	11	26	9
Minnesota	8,364	20	23	10
Mississippi	13,562	13	18	14
Missouri	6,473	23	15	17
Montana	*	**	2	
Nebraska	10,562	17	15	17
Nevada	0	**	0	27
New Hampshire	*	**	4	23
New Jersey	0	**	2	25
New Mexico	*	**	2	25
New York	2,919	29	15	17
North Carolina	33,828	8	58	6
North Dakota	*	**	1	26

TABLE 14

(Cont'd.)

	1972 Production	1972 Rank	1973 # Plants	1973 Rank
Ohio	11,711	14	22	11
Oklahoma	5,805	25	17	15
Oregon	8,053	21	15	17
Pennsylvania	42,446	6	54	8
Rhode Island	0	**	0	27
South Carolina	7,251	22	21	12
South Dakota	2,470	30	5	22
Tennessee	9,520	19	19	13
Texas	49,096	3	92	3
Utah	*	**	3	24
Vermont	*	**	1	26
Virginia	11,105	15	9	19
Washington	3,479	28	6	21
West Virginia	*	**	2	25
Wisconsin	10,919	16	18	14
Wyoming	0	**	1	26

*Concealed to prevent disclosure of individual plant production.

**Unranked.

Source: Mobile Home Manufacturers Association.

TABLE 15

RANKING OF TOP 10 STATES IN MOBILE HOME PRODUCTION AND USE AS YEAR ROUND DWELLINGS

State	Units Produced	Units Used as Year-Round Dwellings
Georgia	1	8
Indiana	2	*
Texas	3	4
California	4	1
Alabama	5	*
Pennsylvania	6	5
Florida	7	2
North Carolina	8	3
Kansas	9	*
Idaho	10	*
Ohio	*	6
New York	*	7
Michigan	*	9
Illinois	*	10

*Not in top 10.

Source: Directory/Census of Manufactured Housing, 1973.

FIGURE 13

MAJOR MOBILE HOME MARKET/PRODUCTION REGIONS

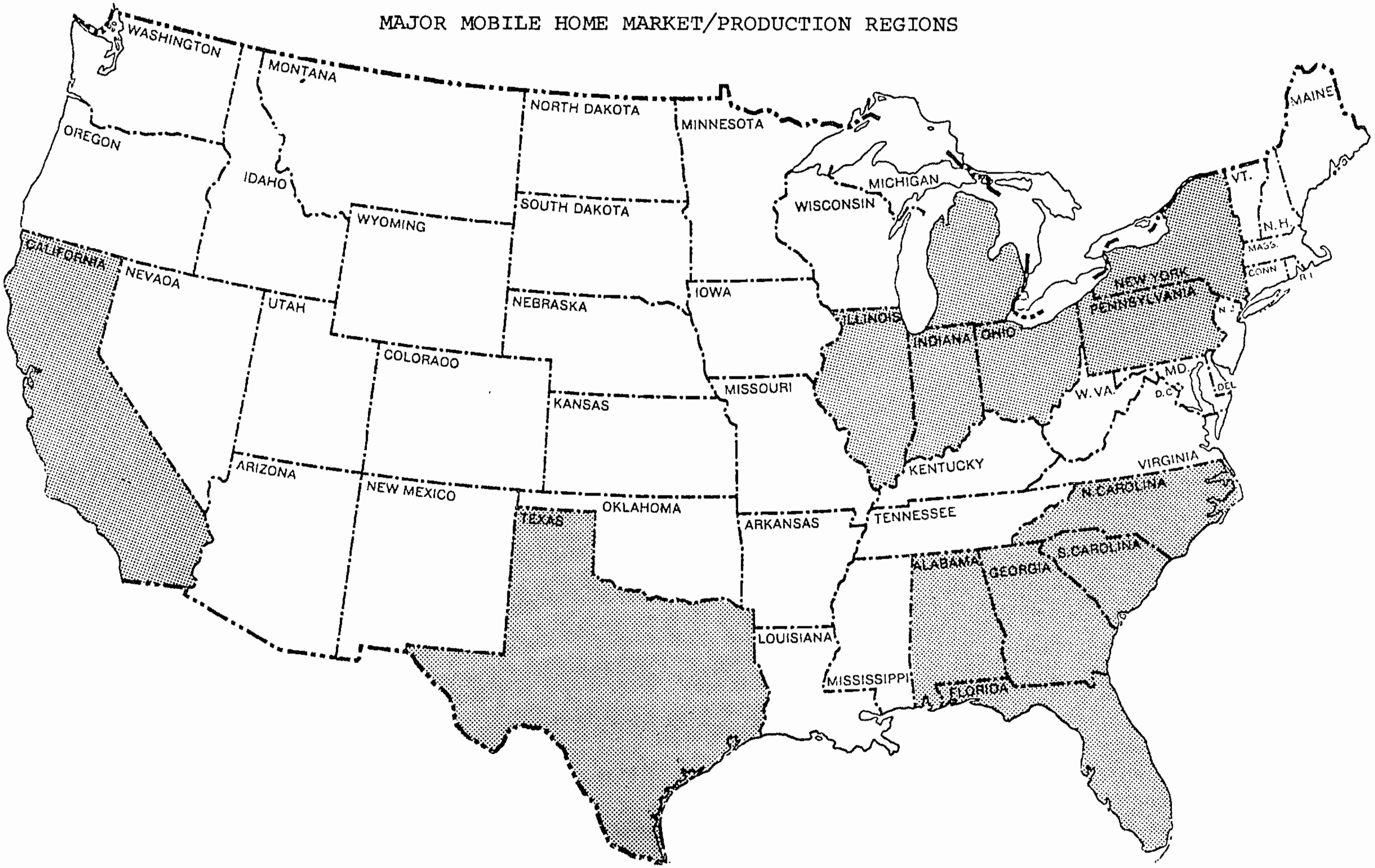
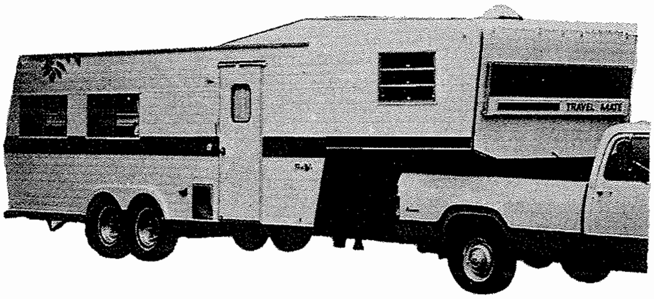


FIGURE 14

THE EIGHT SYSTEMS CURRENTLY PRODUCED BY THE RECREATIONAL VEHICLE INDUSTRY

1. TRAVEL TRAILER
   a. Regular Travel Trailer

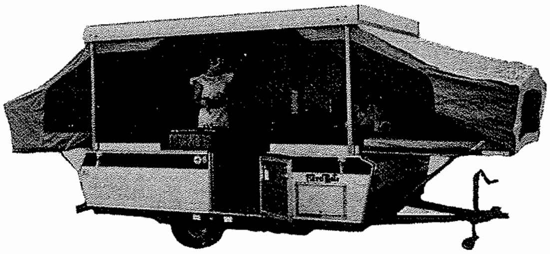
   b. Fifth Wheel



2. TRUCK CAMPER
   a. Slide-in (Pickup Cover)

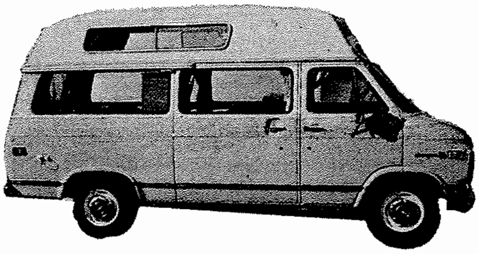
   b. Chassis-Mount Truck Camper

3. CAMPING TRAILER



4. MOTOR HOME
   a. Regular Motor Home

   b. Van Conversion



   c. Mini-Motor Home

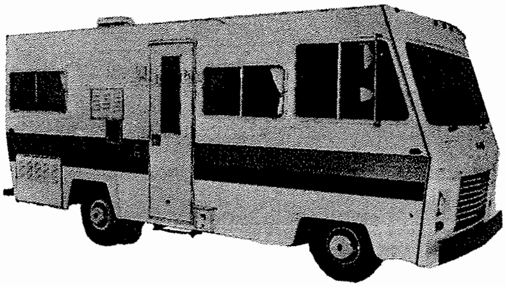


TABLE 16

RETAIL SALES VOLUME OF RECREATIONAL VEHICLES, 1971-1972

	Travel Trailers	Fifth Wheels	Truck Campers	Pickup Covers	Camping Trailers	Motor Homes	Van Conver-sions	Mini-Motor Homes	Total R.V. Sales	Total Mobile Home Sales	Ratio RV Sales to Mobile Home Sales
1971	$497,884,441	.	156,702,517	26,429,294	116,618,300	368,482,348	47,330,600	77,743,094	1,291,190,594	3,297,225,000	39.2
% of Total	38.6	*	12.1	2.0	9.0	28.5	3.7	6.1	100%		
1972	769,478,346	89,327,278	188,119,510	48,307,889	124,860,348	662,858,308	66,482,707	192,965,583	2,142,399,969	4,002,783,000	53.5
% of Total	35.9	4.1	8.8	2.3	5.8	30.9	3.1	9.1	100%		

* 1971 fifth wheel figures included in 1971 travel trailer figures

Source: R.V. Dealer Magazine, July, 1973.
Mobile Home Manufacturers Association

TABLE 17

PRODUCTION OF RECREATIONAL VEHICLES BY TYPE, 1960-1972

Year	Travel Trailers*	Fifth Wheels*	Truck Campers**	Pickup Covers**	Camping Trailers	Motor Homes***	Van Conversions***	Mini-Motor Homes	Total R.V.	Percent Annual Increase	Travel Trailers as % of Total
1960	41,745	-	14,358	-	-	-	-	-	56,103	-	74.4
1961	41,964	-	23,703	-	8,272	-	-	-	73,939	31.8	56.8
1962	56,489	-	37,524	-	not avail.	-	-	-	94,017+	27.2+	60.0-
1963	72,950	-	50,740	-	34,986	-	-	-	158,676	68.8	46.0
1964	94,343	-	67,889	-	48,403	-	-	-	210,635	32.7	44.8
1965	112,048	-	86,148	-	70,256	3,012	-	-	271,464	28.9	41.3
1966	124,801	-	85,231	35,404	72,803	6,092	-	-	324,331	19.5	38.5
1967	132,479	-	98,643	72,399	79,687	6,234	-	-	389,442	20.0	34.0
1968	161,547	-	125,721	99,226	96,495	18,289	-	-	501,278	28.8	32.2
1969	179,532	-	120,345	97,104	107,380	17,185	11,277	-	532,823	6.3	33.7
1970	166,675	-	109,747	103,992	82,337	21,933	11,953	-	496,637	-6.8	33.6
1971	205,597	-	113,557	110,000	99,337	37,795	9,457	12,732	588,475	18.5	35.0
1972	248,555	17,182	114,416	197,715	110,263	72,762	16,608	30,677	808,178	37.3	30.8

* 1971 fifth wheel figures included in 1971 travel trailer figures.

** Until 1966, caps were included with the production figures for truck campers.

*** Until 1969, motor home and van conversion figures were combined.

Source: *R.V. Dealer Magazine*, January, 1973, and July, 1973.

TABLE 18

COMPARISON OF MOBILE HOME PRODUCTION WITH PRODUCTION OF TRAVEL TRAILERS AND ALL RECREATIONAL VEHICLES, 1960-1972

Year	Mobile Homes[a]	Travel Trailers[b]	Ratio Travel Trailers to Mobile Homes (%)	All R.V.	Ratio All R.V. to Mobile Homes (%)
1960	103,700	41,745	40.3	56,103	54.1
1961	90,200	41,964	46.5	73,939	82.0
1962	118,000	56,489	47.9	94,017	79.7
1963	150,840	72,950	48.4	158,676	105.2
1964	191,320	94,343	49.3	210,635	110.0
1965	216,470	112,048	51.8	271,464	125.4
1966	217,300	124,801	57.4	324,331	149.3
1967	240,360	132,479	55.1	389,442	162.0
1968	317,950	161,547	50.8	501,278	157.7
1969	412,690	179,532	43.5	532,823	129.1
1970	401,190	166,675	41.5	496,637	123.8
1971	496,570	205,597	34.5	588,475	118.5
1972	575,940	248,555	43.2	808,178	140.3

Source: (a) Mobile Home Manufacturers Association.
(b) *R.V. Dealer Magazine*.

3. EVALUATION OF MOBILE HOME SYSTEMS FOR USE IN DISASTER RELIEF MISSIONS

The mobile home industry produces four types of housing systems: single-wide mobile homes, expandable mobile homes, double-wide mobile homes and travel trailers.*

This chapter presents an overview of these existing mobile home system types, analyzing the usefulness of each type for federal disaster relief missions. The chapter also presents proposals for adapting existing mobile home systems to requirements of disaster relief housing and concludes with the pre-selection of three system types for cost-effectiveness analysis.

a. <u>Range of Existing Systems</u>

(1) Single-Wide Standard Mobile Homes (Figure 15)

Single-wide mobile homes are still the most important product of the industry. As defined by the MHMA, a single-wide mobile home is a one-piece

> ...transportable structure, which exceeds either 8 feet in body width or 35 feet in body length, built on a chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities.**

---

* Travel trailers are recreational vehicles rather than housing systems. But they are included in this report because they have been used in disaster relief missions and because the leading mobile home manufacturers are also leading travel trailer producers.

** "Flash Facts," MHMA.

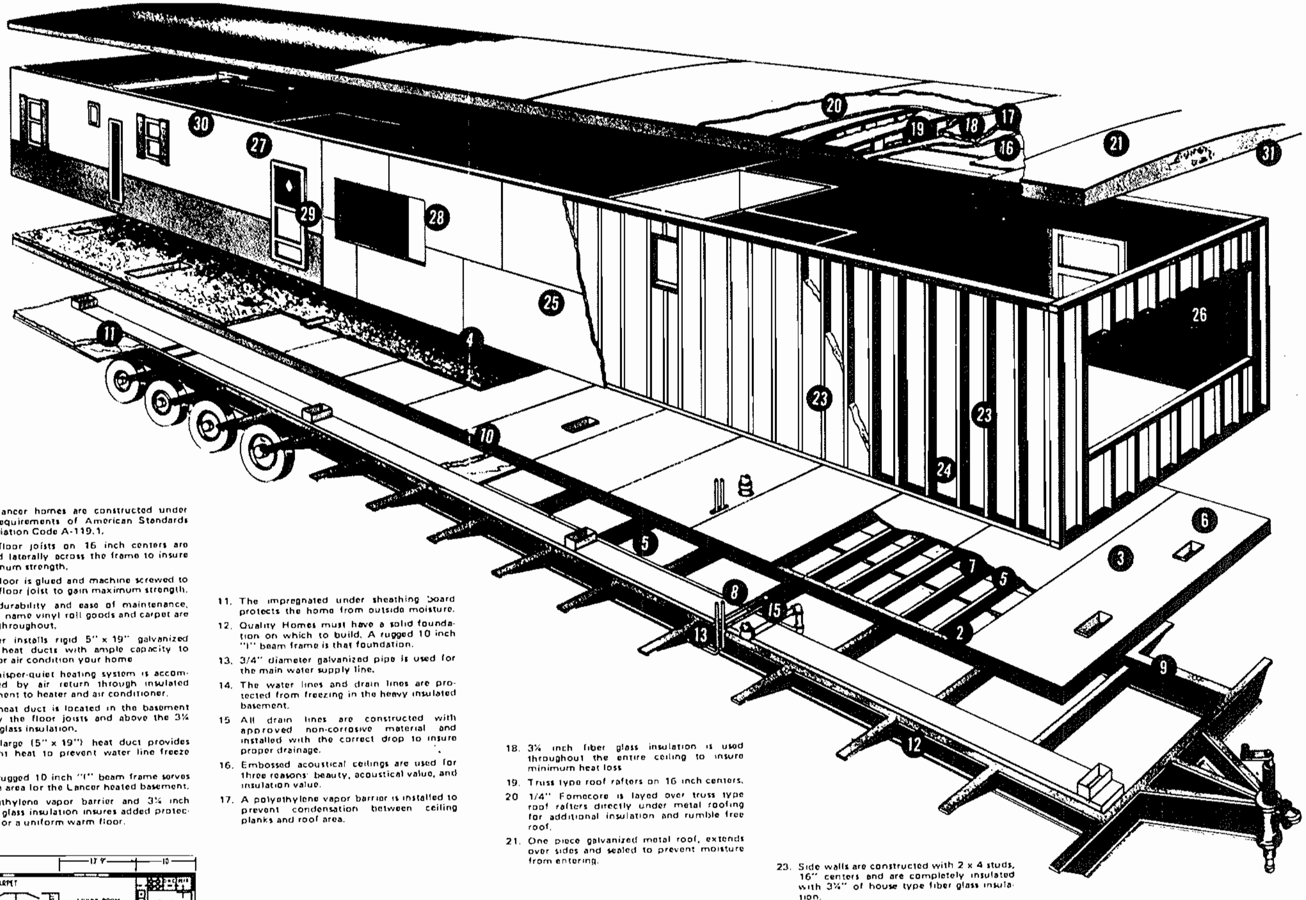
The range of sizes and the respective market shares of single-wide mobile homes are shown on Table 19.

TABLE 19

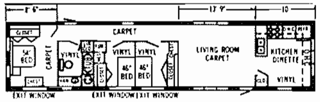
SIZES AND MARKET SHARES OF SINGLE-WIDE MOBILE HOMES, 1971 and 1972

Width	Average Length	% of Total Shipments 1971	1972
8' and 10'	35' to 60'	1.1	0.4
12'	60' to 70'	69.6	64.7
14'	50' to 70'	16.2	17.8
16'	50' to 70'	0.1	0.1
Total single-wide		87.0	83.0

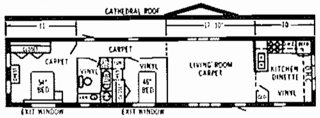
Source: Mobile Home Manufacturers Association.



1. All Lancer homes are constructed under the requirements of American Standards Association Code A-119.1.
2. The floor joists on 16 inch centers are placed laterally across the frame to insure maximum strength.
3. The floor is glued and machine screwed to each floor joist to gain maximum strength.
4. For durability and ease of maintenance, brand name vinyl roll goods and carpet are used throughout.
5. Lancer installs rigid 5" x 19" galvanized steel heat ducts with ample capacity to heat or air condition your home
6. A whisper-quiet heating system is accomplished by air return through insulated basement to heater and air conditioner.
7. The heat duct is located in the basement below the floor joists and above the 3¼ fiber glass insulation.
8. The large (5" x 19") heat duct provides radiant heat to prevent water line freeze up.
9. The rugged 10 inch "I" beam frame serves as the area for the Lancer heated basement.
10 Polyethylene vapor barrier and 3¼ inch fiber glass insulation insures added protection for a uniform warm floor.
11. The impregnated under sheathing board protects the home from outside moisture.
12. Quality Homes must have a solid foundation on which to build. A rugged 10 inch "I" beam frame is that foundation.
13. 3/4" diameter galvanized pipe is used for the main water supply line.
14. The water lines and drain lines are protected from freezing in the heavy insulated basement.
15 All drain lines are constructed with approved non-corrosive material and installed with the correct drop to insure proper drainage.
16. Embossed acoustical ceilings are used for three reasons: beauty, acoustical value, and insulation value.
17. A polyethylene vapor barrier is installed to prevent condensation between ceiling planks and roof area.
18. 3¼ inch fiber glass insulation is used throughout the entire ceiling to insure minimum heat loss
19. Truss type roof rafters on 16 inch centers.
20 1/4" Fomecore is layed over truss type roof rafters directly under metal roofing for additional insulation and rumble free roof.
21. One piece galvanized metal roof, extends over sides and sealed to prevent moisture from entering.
23. Side walls are constructed with 2 x 4 studs, 16" centers and are completely insulated with 3¼" of house type fiber glass insulation.
24 Side walls are set on top of the floor and lag screwed to the floor.
25. Maximum strength is achieved by double wall construction using 5/16 solid plywood sheets from the bottom of the floor to the top of the roof rail.
26. 1/4 inch hardwood plywood paneling is glued and bonded to the sidewalls.
27. The color-weld pre-finished aluminum exterior is installed with a water-proof lock seam.
28 Lancer Homes features aluminum house type double hung windows, eliminating the unsatisfactory roll-in, roll-out type mobile home windows.
29. The front entrance has a house type door with combination storm and screen.
30 All windows are framed with color co-ordinated aluminum shutters.
31. All Lancer Homes have a perimeter drip cap to help keep the exterior clean.
32. All electrical installations meet or exceed code requirements.
33 The water heater compartment is sealed off from the interior of the home with access to it from the exterior with a hinged door and lock.



965D Model—60' x 12' • 3 Bedrooms • Front Kitchen • Center Living Room



SINGLE-WIDE MOBILE HOME

Example: Lancer Homes (Lanchart Industries)

FIGURE 15

As shown on Table 19, 14-foot-wides have been the fastest growing category since 1969, when their shipment was first permitted. Eight-foot-wides accounted for all shipments until 1956, but their production has dropped to less than .5% and has been practically discontinued. Correspondingly, the MHMA definition above defines a mobile home as a unit exceeding "either 8 feet in body width or 35 feet in body length" -- in other words, the maximum dimensions of travel trailers.

Most mobile homes are now built to the ANSI standard. In 1972, 84% of all shipments were to states requiring compliance with the standard. In the same year, 66% of all shipments were produced by members of the two mobile home associations who must build to the standard.* Assuming that these member companies also shipped into states not requiring compliance with the ANSI standard, it can be estimated that less than 10% of all currently produced mobile homes fail to meet the standard and that non-complying mobile homes will gradually disappear from the market.

The single-wide mobile home complying with the ANSI standard has been the most readily available housing system for HUD's temporary housing assistance to disaster victims.** Based on experience with 20,000 units HUD purchased for disaster assistance, certain "Criteria for Determining Disposition of Mobile Homes" have been drafted by the HUD/EPS field staff. These criteria, which may help guide future acquisitions, are more restrictive than the corresponding ANSI requirements. Of primary importance are the Level I criteria, which cover structural features which "are not economically feasible to upgrade."***

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* "Flash Facts," MHMA.

** For a detailed report on past experience with this housing type in post-disaster relief, see Volume 2.

*** HUD/EPS, "Mobile Home/Travel Trailer Handbook," Draft.

The following list is taken from the draft Level I criteria:

Frame. The maximum vertical deflection over the full length of the main longitudinal members is specified in the following table:

Mobile Home length (ft.)	50	54	60	65	70
Maximum deflection (in.)	11/16	3/4	7/8	15/16	1

Outside Walls. Outside wall studs shall be minimum of "2 x 4" (finished size) lumber on 16" average centers. Inside paneling shall be glued to outside wall studs.

Roof. The roof shall be arched or peaked a minimum of five inches and of glued truss construction. Trusses shall be on 16" average centers. There shall be no evidence of structural failure in the roof trusses.

Floor. Floor decking shall be glued to the floor joists.

Insulation. The minimum nominal insulation thickness shall be as follows:

	Wall	Ceiling	Floor
Gas or Oil Heat	1"	1½"	1"
Electric Heat	2"	2½"	2½"

Plumbing. Metal pipe with screwed fittings or tubing with flared fitting shall be used for the water distribution system.

<u>Electrical System</u>. Type NM or SE cable with copper conductors and an equipment grounding conductor shall be used for the electrical system.

<u>Deluxe Features</u>. Mobile homes with deluxe features which limit their transportability such as expando rooms, foldouts, double-wide units, 14'-wide units shall be rejected.

Since these criteria now guide HUD's decision on the retention and disposal of government mobile homes, only mobile homes complying with these requirements are considered in subsequent discussions. They are referred to as "single-wide HUD/ EPS approved" mobile homes.

(2) Expandable Mobile Homes

The MHMA defines expandable mobile homes as follows:

> "An expandable mobile home is a mobile home with one or more room sections that fold, collapse or telescope into the principal unit when being transported and which can be expanded at the site to provide additional living area."*

They range in body length from 50 to 70 feet and accounted for 1% of total shipments in 1971 and 2.2% in 1972.

---

* "Flash Facts," p. 2.

Two kinds of expandable mobile homes are on the market: the expando home, and the expandable home produced by Guerdon Industries, Inc.

(a) Expando Mobile Homes

The expando home is a single-wide unit with a telescopic expansion of the living room (see Figure 16). This system is produced by four of the 50 leading manufacturers listed in Appendix III-A. It is less practical for disaster relief than the single-wide standard mobile home without comparable advantages. The increase in size made possible through the expando mechanism amounts to less than 25% of total volume. Therefore, expando homes were excluded from further analysis.

(b) Expandable Mobile Home by Guerdon Industries

Figure 17 shows layout and folding scheme of this special mobile home system.

The unit has deluxe space standards and does not seem suitable for disaster relief. However, if applied to a smaller layout designed to meet the Minimum Livability Standards developed earlier in this report, the principle of the expandable mobile home could reduce transportation and storage costs. The system can be compressed to less than half its full size.

For these reasons the expandable mobile home was included as a special adaptation in subsequent discussions.

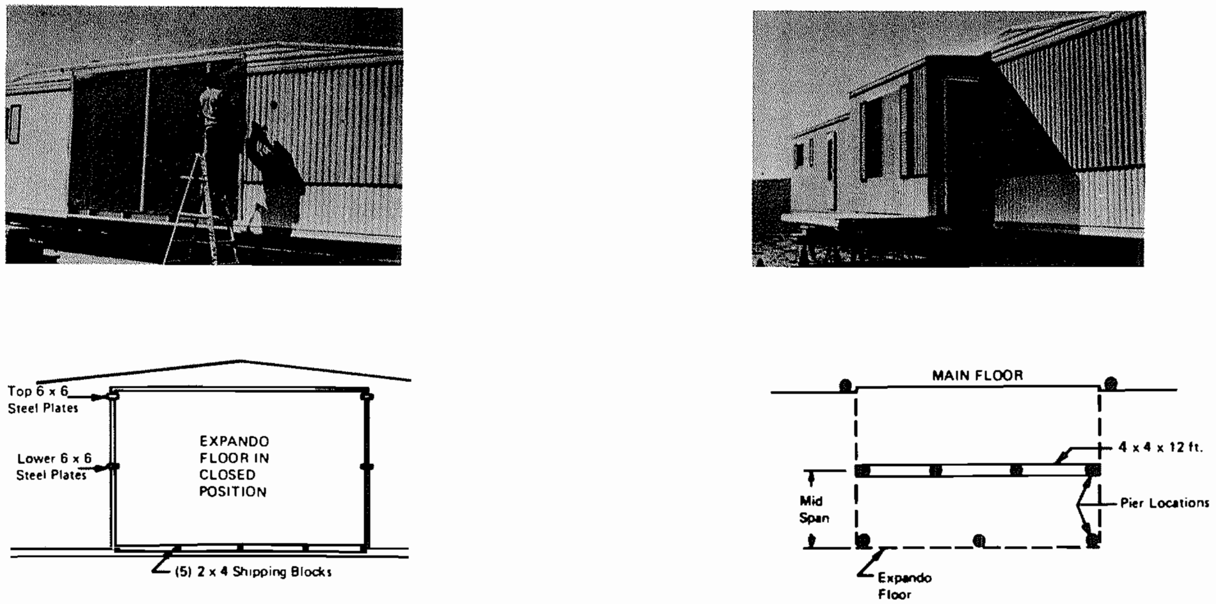
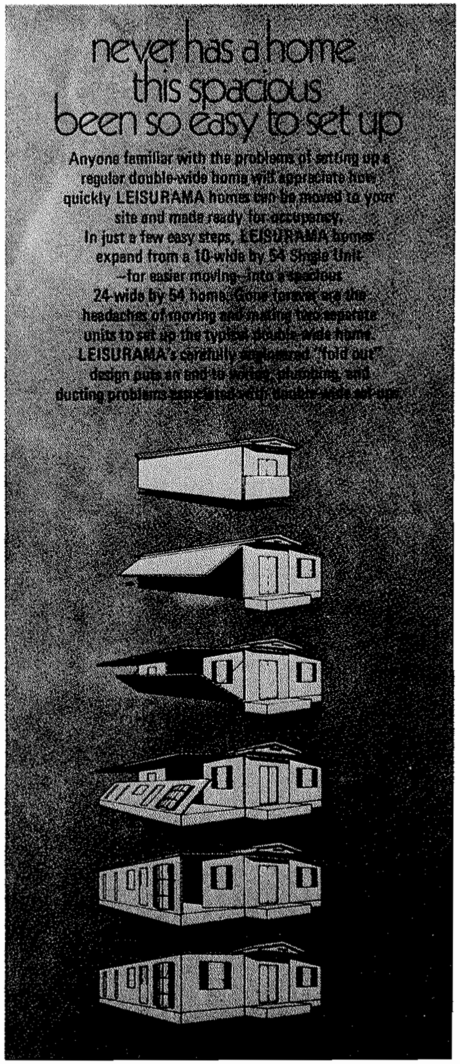


FIGURE 16

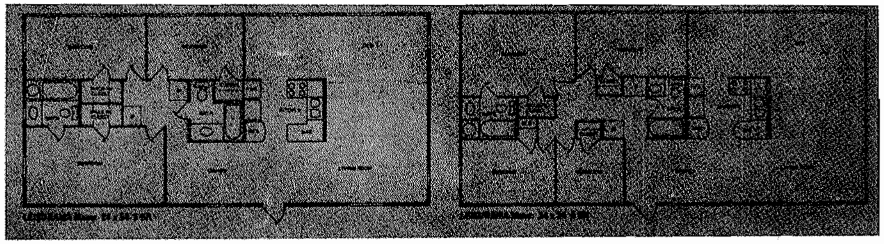
EXPANDO MOBILE HOME

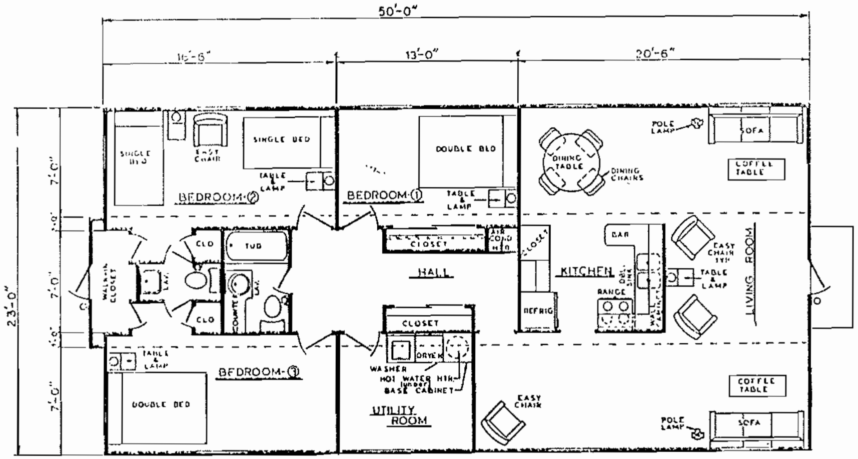
Example: Fleetwood Enterprises



Anyone familiar with the problems of setting up a regular double-wide home will appreciate how quickly LEISURAMA homes can be moved to your site and made ready for occupancy.

In just a few easy steps, LEISURAMA homes expand from a 10-wide by 54 Single Unit —for easier moving—into a spacious 24-wide by 54 home. Gone forever are the headaches of moving and mating two separate units to set up the typical double-wide home. LEISURAMA's carefully engineered "fold out" design puts an end to wiring, plumbing, and ducting problems associated with double-wide set-ups.





EXPANDABLE MOBILE HOME

Example: Guerdon Industries

FIGURE 17

(3) Double-Wide Standard Mobile Homes (Figure 18)

As defined by the MHMA,

> A double-wide mobile home is a mobile home consisting of two sections combined horizontally at the site while still retaining their individual chassis for possible future movement.*

They range in body length from 50 to 70 feet.

Double-wides are currently the fastest growing segment of the mobile home industry. As shown on Table 24, their share of total shipments rose from 9.6% in 1970 to 14.8% in 1972. Forty-three of the 50 leading manufacturers listed in Appendix III-A produce double-wides.

Since double-wides are built in the same standard lengths as single-wide mobile homes, they offer substantially more space. They also look more like houses. Their design resembles the two-piece modular/sectional home, the most common product of the modular housing industry. But the modular/sectional homes are built as permanent housing and meet the same construction, health and safety requirements as conventionally built homes.**

Double-wide mobiles provide more space than single-wides, but they are more expensive to transport, set up and store. Double-wides are rarely moved after having been set up once on a site.

HUD/EPS has recognized the economic disadvantages of double-wides for disaster relief by including them in the list of undesirable "deluxe features."

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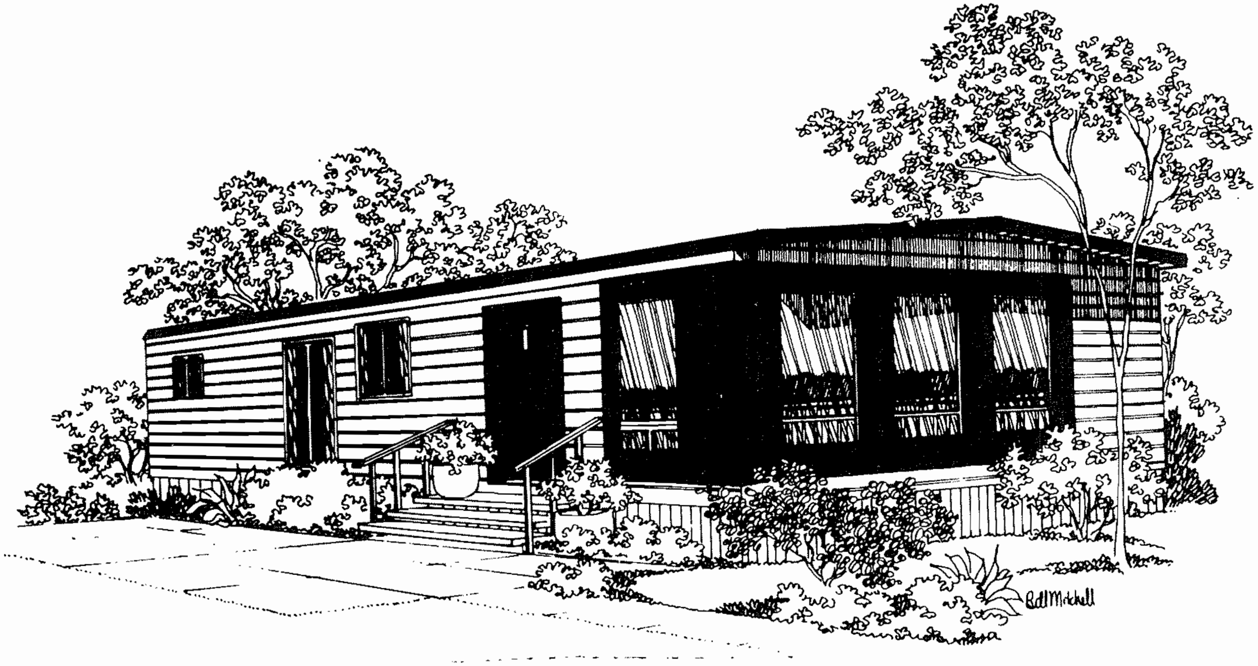
* "Flash Facts," p. 2.

** See Task Report III-B: "The Manufactured Housing Industry."



STANDARD FEATURES

- I-Beam frame with basement floor.
- Copper tubing for fresh water system.
- Outside water heater door.
- Electrical systems conform to Nat'l Electric Code.
- Prefinished, fitted cabinet doors with self closing hinges.
- Plumbed for washer.
- Hollow-core, swinging passage doors.
- full length, closet doors in all bedrooms.
- Tough, chip resistant acrylic tub and sink in bathrooms.
- 24" surface mounted bath cabinet.
- Stainless steel sink.
- Full, fibre glass insulation.
- Floor joist, wall studs and truss type rafters all on 16" center or less.

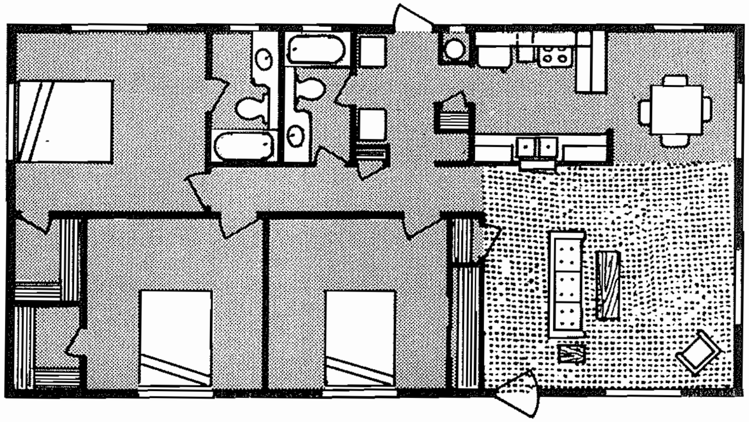


FIGURE 18

DOUBLE-WIDE MOBILE HOME

Example: Champion Home Builders

This study concluded that a temporary housing system consisting of more than one box and, therefore, causing higher costs for transportation, site erection, storage and maintenance than a one-box system should only be considered for disaster relief if it offers substantial economic advantages that can be weighed against these higher costs. The double-wide mobile home does not offer such advantages. Therefore, it was excluded from further consideration.

(4) Travel Trailers (Figure 19)

The Standard for Recreational Vehicles ANSI A119.2 defines a travel trailer as:

> A vehicular portable unit, mounted on wheels, of such a size or weight as not to require special highway movement permits when drawn by a motorized vehicle; primarily designed and constructed to provide temporary living quarters for recreational, camping, or travel use; and of a body width of no more than eight feet (8') and a body length of no more than thirty-two feet (32') when factory equipped for the road.*

The principal asset of the travel trailer is that it is designed to be transported thousands of miles and does not suffer the damage to which the standard mobile home is susceptible.

Travel trailers have been successfully used as short term temporary housing in disaster relief missions. In Wilkes-Barre, for example, trailers were placed next to dwellings that needed only minor repairs. For the few months duration of the "mini-repair" program, the cramped quarters of the trailers sufficed. This program was highly popular and has been officially recognized by the Disaster Relief Act of 1974. HUD/EPS intends to continue using travel trailers for this special purpose.

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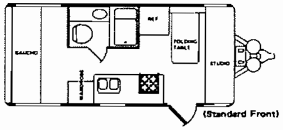
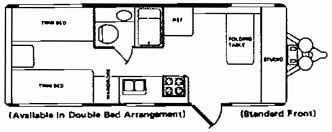
* ANSI A119.2, p. 12 (The maximum body length was extended to 35 feet in 1973).

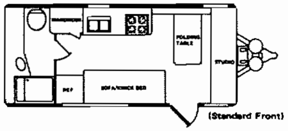
Model 321 Center Bath – $5965



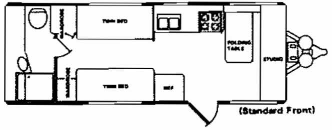
Model 325 Center Bath – $7579

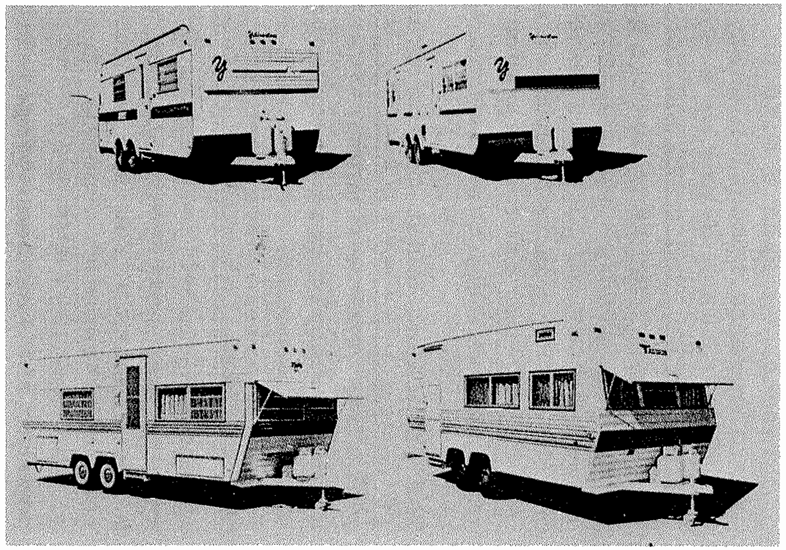


Model 321 Rear Bath – $6040



Model 325 Rear Bath – $7654





Specifications

RUNNING GEAR

- 85 ½" wide track axles
- Heavy duty running gear with Monroe shock absorbers on all wheels
- MOR/ryde Suspension System
- 12" electric brakes on all wheels
- Dexter tandem axles on all models
- B 55 × 15 Goodyear Special Trailer Service whitewall tires

GENERAL CONSTRUCTION

- 6" tubular steel frame - all models
- 2 5/16" heavy-duty coupler
- 2 5/16" ball and plate for tow vehicle
- Engineered sandwich floor construction
- Alumaframe construction
- Aluminum and Styrofoam underbelly sandwich construction
- 3/4" extruded Styrofoam insulation
- Heavy gauge aluminum skin and roof
- Top and bottom seamless riveted aluminum exterior panels
- Gold unitized 4" bumper with sewer hose storage
- 93" body width with 96" overall width

INTERIOR FEATURES

- Love seat and free standing chair (rear bath model)
- Love seat (center bath models)
- Free standing sofa (front bath models)
- Plush 100% rayon upholstery material
- Color keyed interiors
- Deep pile, 100% nylon carpet by Armstrong
- Pleated rayon and acetate living room drapes
- AM/FM radio and stereo tape system with four speakers and remote control
- Sharp color television
- One 110V living room light
- 60" slide out table
- Battery operated clock
- Overhead awning type vent windows (various models)
- 12V incandescent lights
- Full length screen door
- GE Textolite interior surfaces
- Overhead cabinets
- Insta matic 13,500 BTU air conditioner
- Royal Dometic RM77 gas/electric refrigerator with padded insert
- Suburban 4 burner stainless steel range with continuous cleaning oven and matchless solid state ignition
- Range exhaust hood and light
- Stove cover
- Twin bowl stainless steel kitchen sink and single handle mixing faucet
- Water filtration system (kitchen sink)
- Silverware tray
- Positive catches on all wardrobe and cabinet doors
- Automatic closet lights
- PVC molded drawers
- Decorator designed lavatory
- Built in lavatory hamper (various models)
- Decorator styled vanity
- ABS bathtub and shower enclosure
- Adjustable telephone type shower with fingertip shut off
- Spacious medicine cabinet
- Three roof vents with 2 speed 12V fans
- Full length mirror
- Built in central vacuum system
- Pleated rayon and acetate bedroom curtains
- Bedspreads on fixed beds
- Divider folding door

EXTERIOR FEATURES

- Travel awning – front and rear
- Gold awning rail with Holiday side awning
- Positive seal, sliding picture windows with fiberglass screens
- Weather sealed around all windows and door
- Winegard manual television antenna with television jack
- Battery powered jacks for front
- Retractable stabilizing jacks (rear)
- Leveling device at retractable stabilizing jacks
- One-piece molded wheel wells with matching fender skirts
- Gold snap-on trim moulding
- Gold clip-on bumper
- Anodized trim and accent panels
- High style wheel covers
- Rear trunk with light and flush mounted lock
- Recessed water intake valve with door and air bleeder
- Hot sprayed automotive paint finish
- Spare tire and underbelly wheel well mounting

ELECTRICAL, GAS, PLUMBING AND HEATING SYSTEMS

- Suburban 30,000 BTU gas furnace with blower and wall mounted thermostat
- Fully ducted underfloor heating system
- Special air circulation outlets storage areas
- Fully insulated water system
- 42 gal. water tank
- 8 gal. gas water heater
- 12V air compressor on water system
- 42 gal. capacity holding tank with 3" gate valve
- Two 12V 95 amp power cells in battery case
- 50 amp converter
- 12V wiring harness
- 25 ft. 110V power supply cord
- 8 point connector
- Twin 25 lbs. steel gas tanks with automatic change over regulator and see level gauges
- Refrigerator service access door

SAFETY FEATURES

- Code approved and protected wiring system
- 12V circuit breakers in converter
- 110V circuit breakers in service panel
- 12V Thermal breaker
- 12V breakaway switch
- All appliance outlets are flush mounted
- ICC approved exterior clearance and running lights
- Four stop and tail lights
- Two back-up lights
- Electronic monitoring panel
- Ventilated and trapped code approved plumbing system
- Sealed combustion furnace
- Safety glass in all windows and door
- Emergency egress exit
- Recessed entrance grab handle and porch light
- Entrance door with flush handle and lock
- Hide away entrance step with step entrance light
- Formed GE Textolite corners and cabinetry
- Fire retardant bed mattresses

FIGURE 19

TRAVEL TRAILER

Example: Holiday Rambler Corp.

The drawbacks of the travel trailer are twofold. First, its small size -- usually 25' by 8' -- makes extended occupancy for a family extremely uncomfortable. It is unreasonable to expect disaster victims to live in a travel trailer for more than three months even if they can look forward to seeing their homes repaired. Second, the travel trailer is unsuitable for cold weather occupancy. In fact, travel trailers were replaced by mobile homes in Wilkes-Barre when families could not reoccupy their damaged dwellings before the winter. Since travel trailers can only be used for short-term occupancy during the warmer months, they can be used extensively for disaster relief only in the southern tier states. Use in the northern tier is at best limited to July and August.

Generally, then, the travel trailer has limited applicability for disaster relief.* It was excluded from further analysis because it falls far short of the Minimum Livability Standards for temporary housing established for this study.

On the other hand, travel trailers are built by a strong, dynamic, inventive industry and represent the only widely marketed housing system clearly intended for temporary use and for extended, repeated travel. Therefore, travel trailer manufacturers might be particularly qualified to help develop specially adapted temporary housing systems for disaster relief. Elements of travel trailer technology might be eminently applicable to such systems.

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* One EPS staff member with extensive experience in disaster relief operations said the travel trailer had such limited applicability it should be discarded totally as a temporary housing resource.

b. Analysis of Applicable Existing Systems

(1) The Single-Wide HUD/EPS Approved Mobile Home as a Reusable Housing System

Experience with single-wide standard mobile homes in disaster relief missions has revealed major factors influencing cost-effectiveness. Significant unfavorable factors have been considered in the HUD/EPS criteria discussed earlier. The single-wide HUD/EPS approved mobile home meets both the ANSI standard and the more restrictive HUD/EPS criteria.

The principal advantages of single-wide mobile homes for disaster relief are availability, low initial cost* and the incorporation of the running gear as an integral part of the system -- a factor facilitating repeated use of the unit. Furthermore, the single-wide mobile home comes as a one-box system. No site assemblage is required, and the unit comes complete with furniture; it can be erected and readied for occupancy fast and inexpensively. However, the mobile home is not really designed as a relocatable temporary housing system involving repeated transport and storage. Today's standard mobile home can suffer considerable damage if hauled over long distances; particularly under the conditions of a disaster relief mission, the longer and wider the unit, the greater the risk of damage. Extensive or

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* As noted earlier, the acquisition cost of the mobile home is low, compared to other types of housing. But its financing costs are comparatively high, reflecting its limited durability and depreciating value.

repeated hauling subjects the mobile home to stress and wear that were not considered when the product was designed and engineered* Some conditions, such as the fastening of the exterior aluminum skin, can be easily corrected. But problems such as racking and structural failure are more inherent in design and are not easily overcome without major design changes.

Generally, the mobile home manufactured today is satisfactory within its designed limits. It is unlikely that a mobile home designed to travel less than 800 miles will survive several long trips without major repairs. One reason major manufacturers have plants throughout the country is to limit the distance units must travel to their final destination. Manufacturers are aware of the damage caused by transportation and do not expect their product to be transported far or often.

For mobile homes produced for government purchase during disaster relief, HUD required only that they meet ANSI standards; HUD did not require that they be capable of relocation and re-use and the resulting transportation. Basically, HUD received the standard mobile home designed and manufactured for a limited life in one location. Because HUD required the mobile homes so urgently and because some manufacturers did not impose proper quality control, many mobile homes delivered to HUD were not even adequate as standard units. In retrospect, quality control is regarded as

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* With the increasing popularity of wider and longer mobile homes, the prevalent industry product is becoming even more susceptible to the rigors of long or repetitive hauling.

critically important to the reusability of standard mobile homes for disaster relief. Now, the mobile home as currently marketed is reusable only to its design limits. To be made truly reusable and transportable without costly repairs, the mobile home may have to be re-engineered (made more rugged) and perhaps redesigned to meet specific requirements of disaster relief missions.

(2) Conversion of Single-Wide HUD-Owned Mobile Homes Into Permanent Housing for Disaster Victims

Experience of converting temporary housing systems for disaster relief into permanent housing is based only on the sale of HUD-owned mobile homes to disaster victims occupying them. As of August, 1973, HUD had sold 1,348 such units. These units represent 4% of all families whom HUD has helped find permanent housing. The total sales price of the units is about $3.5 million. The average unit sold for $2,890; prices ranged from $1,600 to $4,000 per unit. Most units sold were ones which HUD did not want to retain, based on features which affect long-term transportability.

The most important factor limiting the use of mobile homes as permanent dwellings is local zoning. As discussed earlier, many communities prohibit mobile homes as permanent dwellings. Since many communities have trouble accepting mobile homes as temporary housing, these prohibitions are not likely to be relaxed.

Thus, while conversion of HUD-owned disaster relief mobile homes into privately owned permanent housing may be an attractive solution to a family's housing need, it is only of marginal importance for federal disaster assistance.

c. Analysis of Special Adaptations

The single-wide HUD/EPS approved mobile home, despite its design limitations discussed above, has proven to be more suitable for temporary disaster relief housing than other marketed housing systems. To explore the possibility of improving its cost-effectiveness in disaster relief, the Joint Venture considered three special adaptations.

The first is a single-wide standard 12'x60' mobile home structurally ruggedized to improve transportability. The second is a single-wide mobile home redesigned to the Minimum Livability Standards for Temporary Housing, also structurally ruggedized. The third is an expandable Guerdon mobile home conforming to the Minimum Livability Standards.

(1) The Ruggedized Single-Wide HUD/EPS Approved Mobile Home

A memorandum to the HUD Director of Mobile Home Operations states the condition limiting the use of the standard mobile home for disaster relief:

> The single and most important characteristic requirement of a mobile home intended for future disaster use is transportability. The mobile home must be structurally capable of withstanding the stresses of long distance hauling over all types of road surfaces and conditions of speed. The production-run mobile home is one which has limited transportability characteristics. It is expected to be transported up to eight hundred miles... the manufacturer builds a mobile home with the idea that it will become "permanent" at the end of its first trip; therefore, it is designed to be "mobile" only to that extent. It would be unreasonable to extend this limited ability to unlimited transportability... it must be understood that the design of the mobile home is principally influenced by the economics of the market place. *

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* HUD Memorandum from Joseph Rohlic, Chief, Quality Control Branch to John Skapura, Acting Director, Mobile Home Operations, February 16, 1973.

Based on discussions with HUD/EPS field personnel, the joint venture determined that a ruggedized temporary housing unit should be reusable six times -- alternating one year of use and up to one year of storage -- and capable of traveling about 10,000 miles. On this basis, the ruggedized unit would have to be six times more transportable than commercially produced mobile homes.

The following discussion, based on material provided by HUD and manufacturers, presents suggestions for specific changes to meet the above performance.

The mobile home is basically a built-up beam. The floor and roof act mainly as sidewall positioners, keeping the walls vertical and parallel. The sidewalls act as girders. They are built of a wood frame with an exterior metal skin and interior plywood skin and absorb most stress placed on the mobile home in transit. In transit, the weight of the rigid coach is absorbed by the cross-members and main longitudinal members and transferred to the spring and axle assembly, the hitch and the road. But it is the total roof-sidewall-floor assembly that gives the mobile home the rigidity necessary for transport. To remain rigid, all the mobile home's structural components and connections must be designed and manufactured for repeated transport and use. Failure to maintain the structural integrity of the box will lead to rapid deterioration of the unit and a limited useful life.

HUD has had continuous problems with plastic plumbing. To reduce a high rate of major repairs, HUD would prefer copper piping. It is difficult to determine whether the failure of plastic piping is due to transportation damage or lack of initial quality control during assembly. Clearly, copper pipe with sweated connections will last longer than plastic pipe with cemented connections. But it is impossible to determine whether properly installed plastic piping will not last the life of the unit, thereby reducing costs. This type of change is typical of many that may be needed to successfully adapt the standard mobile home for disaster relief. However, without design, engineering and tests conclusive statements cannot be reached.

If HUD continues to buy standard mobile homes, the agency would like to develop its own specifications that in many areas go beyond ANSI requirements. HUD also realizes it must directly supervise quality control on units built for disaster relief. The suggested ruggedizing features in Table 20 are based on estimated values and assumptions that quality control will be improved. The list is divided into six sections conforming to the basic parts of a mobile home. Four of these sections are shown in Figure 20: roof, sidewall, floor and chassis and running gear. The first column lists the name of the section to be upgraded; the next column is the type or size of the part now used in commercially available mobile homes, and the last column is the change suggested to ruggedize the unit.

Along with structural features listed in Table 20 plumbing, heating and electrical systems will also require upgrading. However, it is not possible to determine the specific nature of these systems now. Table 21 lists elements that must be considered if units built for disaster relief are to meet the criteria of reusability and livability. They have been compiled from HUD reports and can guide future investigations.

TABLE 20

PROPOSED RUGGEDIZING FEATURES FOR THE MOBILE HOME

Part or Section	Typical Type or Size of Part or Construction Now Used in the Standard Mobile Home	Suggested Change to Ruggedize the Standard Mobile Home
A. CHASSIS AND RUNNING GEAR		
1. Tires	1. 8-ply - load not to exceed 1.5 times manufacturer's rating	1. 14-ply[1]
2. Axles	2. Load not to exceed manufacturer's rating	2. Two axles on units under 60', 3 axles on units 60' and over; 2" positive camber on all axles[1]
3. Shock absorbers	3. None	3. For all axles[1]
4. Brakes	4. Not to exceed manufacturer's rating	4. On all wheels[1]
5. "A" frame	5. Rigidly constructed and securely fastened, sometimes detachable	5. Continuously welded to front cross member and main longitudinal members[1]
6. Hoist assembly	6. None	6. Should be provided, securely attached and capable of withstanding replated raisings and lowerings, and support over extended periods of time.[1]
7. Main Longitudinal member ("I" beam) deflection	7. Designed to take designs load requirements without causing unsafe deformation - usually from "I" or rolled channel	7. Mobile home length in feet; Maximum deflection in inches; [1] 50 54 60 65 70 11/16 3/4 7/8 15/16 1

TABLE 20

(Cont'd.)

Part or Section	Typical Type or Size of Part or Construction Now Used in the Standard Mobile Home	Suggested Change to Ruggedize the Standard Mobile Home
8. Length of "I" beam relative to length of mobile home and floor system	8. Varies - no specific requirement	8. a. Mobile home with 2x4 longitudinal floor joists - "I" beam to extend within 18" of rear. [2] b. Mobile home with 2x6 longitudinal floor joists - "I" beam to extend within 36" of rear. [2] c. Mobile home with transverse floor joists - "I" beam to extend within 6" of rear. [2]
9. Outriggers	9. No specific requirement or practice - usually from channels or "Z" shapes	9. Maximum 4'-0" o.c. and shall extend to perimeter of mobile home [1]
B. FLOOR		
10. Weather board	10. Asphalt impregnated paper or board	10. Asphalt impregnated with ventilation holes [1,3]
11. Vapor barrier	11. .004 polyethylene sheet	11. .004 polyethylene sheet[3]
12. Insulation	12. 2" fiberglass roll	12. 3" fiberglass roll[4]
13. Joists	13. 2x4 longitudinal or traverse @ 20" o.c. 2x6 longitudinal or traverse @ 16" o.c.	13. 2x6 longitudinal @ 16" o.c. only [4,5]
14. Blocking	14. Usually none	14. 2x4 @ 4'-0" o.c. except between heating duct run[1,4]
15. Subfloor	15. 5/8" particleboard - 1/2" plywood	15. 3/4" plywood glued and screwed to floor joists; 3/4" marine grade plywood in bathroom glued and screwed to floor joists.[1,4]

TABLE 20

(Cont'd.)

Part or Section	Typical Type or Size of Part or Construction Now Used in the Standard Mobile Home	Suggested Change to Ruggedize the Standard Mobile Home
16. Finish floor	15. Roll linoleum or carpet	16. Roll lineoleum only [1]
C. SIDEWALL		
17. Studs	17. 2x3 or sometimes 2x2 @ 20"-24" o.c.; 2x4 used for door framing	17. 2x4 @ 16" o.c. - graded lumber [1]
18. Top plate	18. 1x3	18. 1x4 or 2x4 [1]
19. Bottom plate	19. 1x3	19. 1x4 or 2x4 [1]
20. Interior sheathing	20. 1/4" plywood with vinyl surface	20. 1/4" plywood with vinyl surface glued and stapled to studs only [1,4,6]
21. Belt Rails	21. 2 - 1x2 dadoed to studs	21. 3 or 4 - 1/2" dadoed to studs [4,5]
22. Window and door framing	22. 2x3's	22. 2x4's doubled if necessary[1]
23. Exterior sheathing	23. .019" crimped, prefinished aluminum	23. .024" corrugated prefinished aluminum; fastened at all studs with deep penetrating screws @ 12" o.c.; 2" overlap of sheet connections.[1,5]
24. Exterior sub-sheathing	24. Rarely used	24. 1/4" exterior grade plywood, glued and stapled to studs. If this is used, belt rails (21) are not necessary [5]
25. Vapor barrier	25. None	25. Probably not necessary [4]
26. Insulation	26. 2" fiberglass roll	26. 3" fiberglass roll[4]

TABLE 20

(Cont'd.)

Part or Section	Typical Type or Size of Part or Construction Now Used in the Standard Mobile Home	Suggested Change to Ruggedize the Standard Mobile Home
D. ROOF		
27. Truss	27. Low-string truss @ 16"-24" o.c., 2" high at ends, 5" at center, 1x2 top chord, 2x2 bottom chord, 1/4" plywood gusset plates	27. Same @ 16" o.c. only [4]
28. Rafter rim plate	28. 1x4	28. 1x4 [3]
29. Ceiling board	29. 5/8" x 2' x 12' composition board	29. Panels should be smaller to facilitate replacement - or should be rigid insulation [4]
30. Vapor barrier	30. .004 polyethylene sheet	30. .004 polyethylene sheet [3]
31. Insulation	31. 2 - 3" fiberglass roll	31. 2 - 4" fiberglass roll [4]
32. Roof	32. 30 gauge sheet metal - one piece	32. 30 gauge steel or aluminum - one piece or fiberglass [3]
33. Roof sealant	33. Rubberized compound	33. Method should be found to eliminate required resurfacing every two years [6]
34. Gutters and Spouts	34. Drip rail	34. Same
E. INTERIOR (Sheer) WALLS		
35. Studs	35. 1x3 @ 24" o.c.	35. 2x3 @ 16" o.c. [1,4]
36. Top Plate	36. 1x3	36. 2x3 [1,4]
37. Bottom Plate	37. 1x3	37. 2x3 [1,4]

TABLE 20

(Cont'd.)

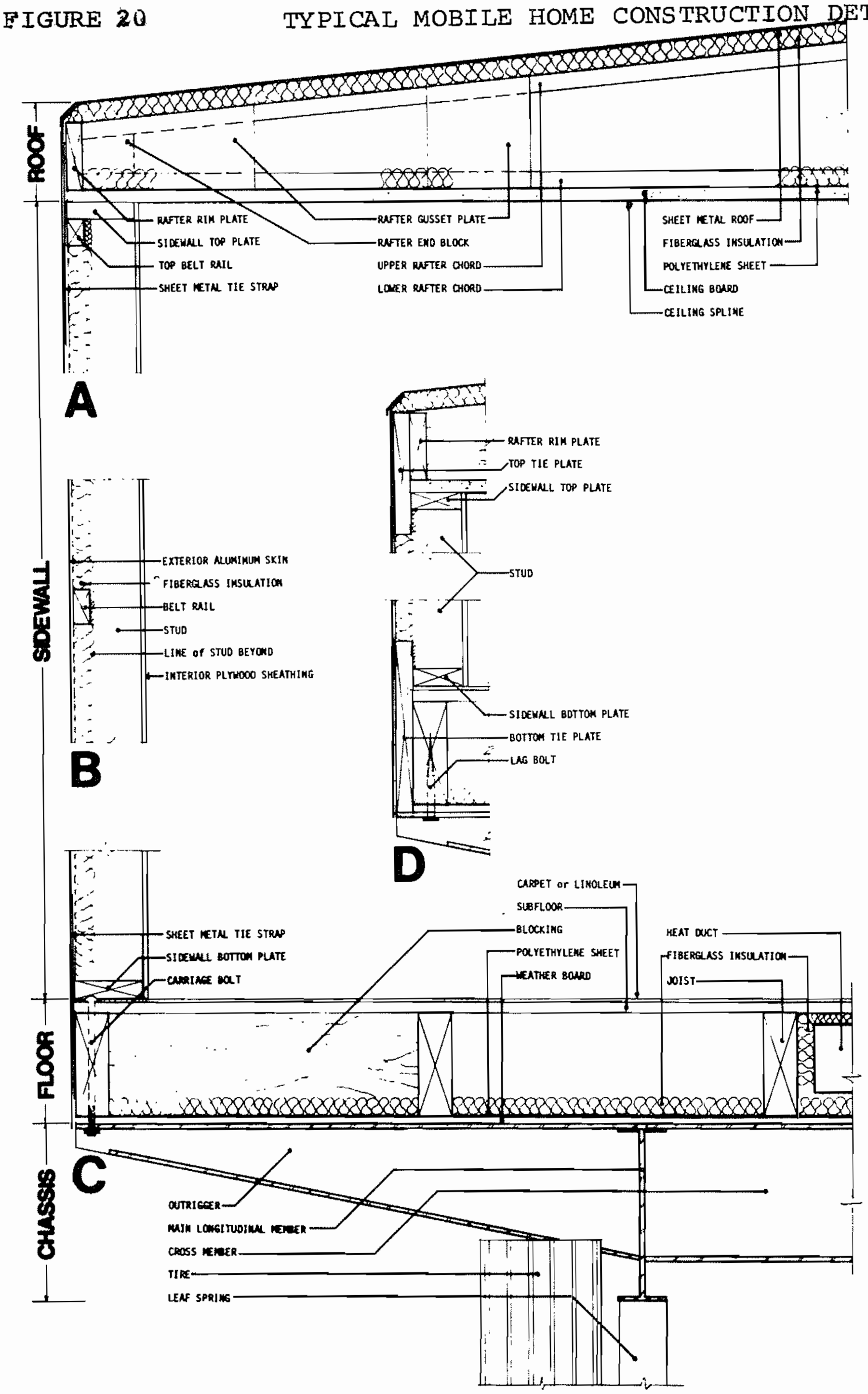
Part or Section	Typical Type or Size of Part or Construction Now Used in the Standard Mobile Home	Suggested Change to Ruggedize the Standard Mobile Home
38. Interior sheathing	38. 1/4 prefinished plywood	38. 1/4 prefinished plywood[3]
39. Sound Insulation	39. None	39. Should be provided [1]
F. CONNECTIONS*		
40. Fasteners	40. Rosin coated nails and staples	40. Wherever possible materials should be of glued and screwed construction. Where this is not possible rosin coated staples should be used.[4,5]
41. Chassis/ floor connection	41. Usually lag bolted as shown in Fig. Detail D	41. Carriage bolt through outermost joist and at every outrigger. Five carriage bolts at front and rear crossmembers - as shown in Figure , Detail C [4,5]
42. Floor/Sidewall connection	42. Typically 1x10 tie plate stapled to floor joist and stud as shown in Figure , Detail D	42. Use of metal tie straps at every stud. A more positive connection must be developed. See Figure , Detail C [4,5]
43. Sidewall/ roof connection	43. Typically 1"x7" tie plate stapled to rafter rim plate and studs	43. Use of metal tie straps at every stud and rafter. See Figure , Detail A. A more positive connection should be developed.[4,5]

*Connections in the mobile home are the weakest link in the structural system and cause the greatest amount of unit deterioration. Higher quality and more positive connection systems must be developed and specified to improve the ruggedness of the mobile home.[4,5]

NOTES TO TABLE 20

1. HUD: Pennsylvania Housing Recovery Office, Management Planning Division, Engineering Branch, Report R32-19: "Mobile Home Housing: A ANSI A119.1, Evaluation and Recommendations, May 29, 1973."
2. HUD: "Emergency Preparedness Staff," Mobile Home/Travel Trailer Handbook (draft)
3. Typical mobile home construction.
4. Suggested by manufacturers and conclusions drawn from conversations with manufacturers.
5. Conversations with Pennsylvania Housing Recovery Office, Engineering Branch.
6. Conversations with Bluegrass Strategic Storage Center personnel.

FIGURE 20 TYPICAL MOBILE HOME CONSTRUCTION DETAILS



A TYPICAL ROOF CONSTRUCTION; TYPE 1 ROOF/SIDEWALL CONNECTION

B TYPICAL SIDEWALL CONSTRUCTION

C TYPICAL FLOOR & CHASSIS CONSTRUCTION; TYPE 1 SIDEWALL/FLOOR/CHASSIS CONNECTION

D TYPE 2 ROOF/SIDEWALL/FLOOR/CHASSIS CONNECTION

TABLE 21

MECHANICAL SUB-SYSTEMS AND MISCELLANEOUS ITEMS TO BE CONSIDERED FOR RUGGEDIZING THE STANDARD MOBILE HOME

- Plumbing System
  - water piping materials (plastic vs. metal)
  - compression fittings
  - piping joints and connections
  - water shutoff value
  - water line valves
  - water heaters
  - water heater safety devices
  - flexible connections
  - drain point
  - pipe freezing
  - location of drain outlet
  - cutting of structural members for pipe placement
  - cleanouts

- Heating System
  - insufficient size of duct system
  - locations of registers
  - duct heat loss
  - pipe material
  - gas supply connection

- Electrical System
  - power supply
  - ground and bonding
  - safety equipment
  - smoke detectors
  - wiring materials (copper vs. aluminum)

- Miscellaneous
  - doors, interior and exterior
  - windows, regular and storm
  - water heater access
  - screens
  - hurricane anchoring straps
  - use of gypsum board for fireproofing
  - drawings of utility system location
  - kitchen and bath fixtures and appliances
  - furniture
  - cabinets and drawers

(2) Single-Wide Special Design Mobile Home

The "special design" mobile home proposed in this section is a design adaptation, based on the Minimum Livability Standards for Temporary Housing set forth in Part II of this report. It also incorporates suggested engineering features for ruggedization outlined in Table 20

Figure 21 shows the plans for a two- and three-bedroom unit. The most important aspect of these special design units is that the overall length has been greatly reduced from the 60' that is currently the industry standard. The shorter units will be much more structurally stable and less susceptible to damage from over-the-road shipments. The significance of this change cannot be underestimated, since the standard mobile home's basic flaw is that its size causes transportation difficulties and rapid deterioration over long distances. The special design mobile home (12' wide), when ruggedized, should have a superior cost-effectiveness in disaster relief.

(3) Expandable Special Design Mobile Home

Figure 22 shows the plans for a two- and three-bedroom unit. The design of these units is based on the folding principle of the much larger unit currently manufactured by Guerdon Industries under the trade name of "Leisurama."* Similar to the special design single-wide mobile home, these units are much smaller than standard expandable mobile homes and, thus, more structurally sound for over-the-road transportation. These units were designed within limitations imposed by Guerdon. Such limitations do not affect the livability of the plan but make the unit adaptable to existing production procedures.

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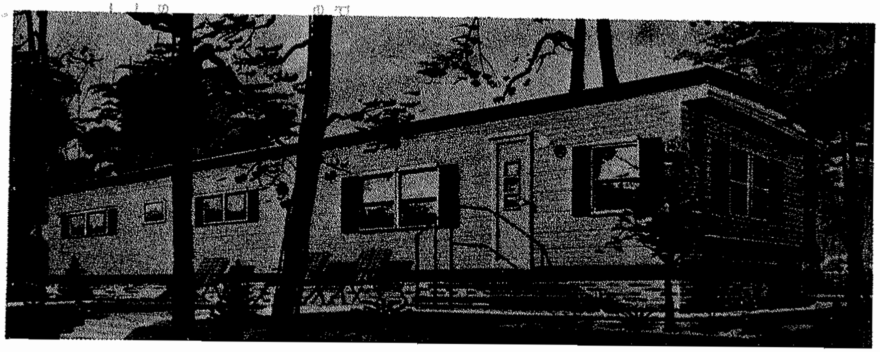
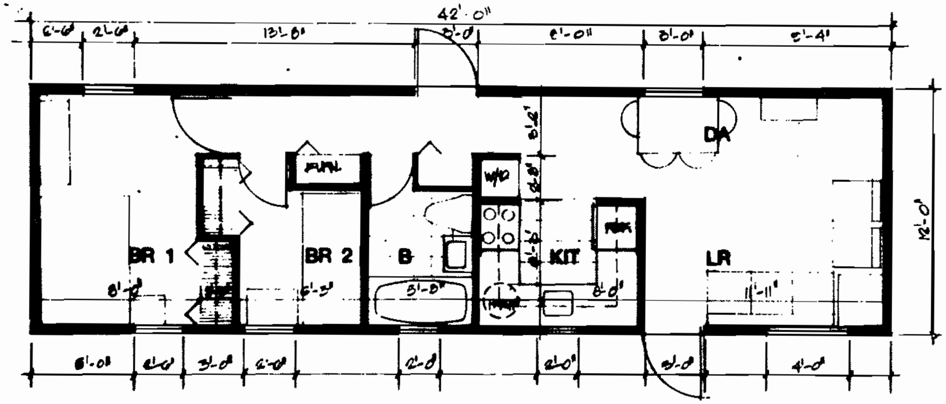
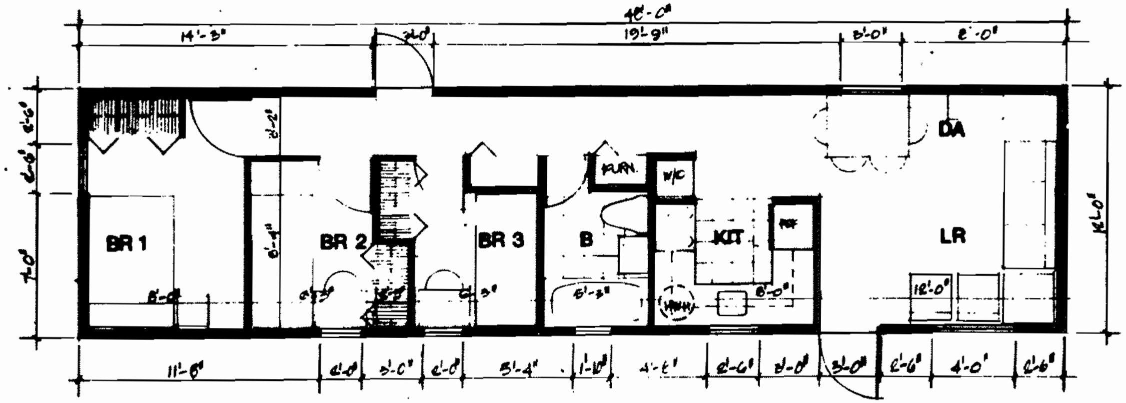
* See Figure 17 .

FIGURE 21
SINGLE-WIDE SPECIAL DESIGN
MOBILE HOME
(PROPOSED SPECIAL ADAPTATION)



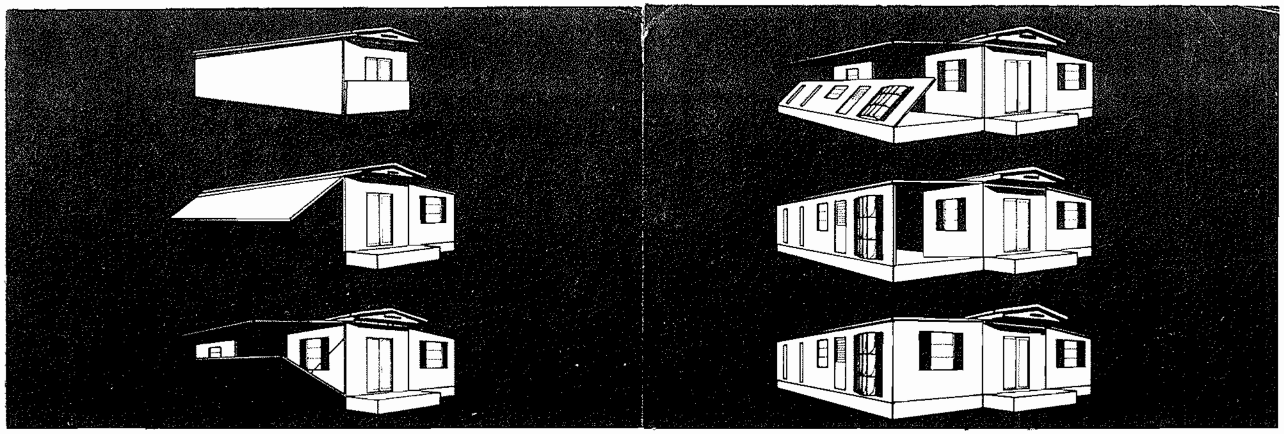
UNIT AS PRESENTLY MANUFACTURED



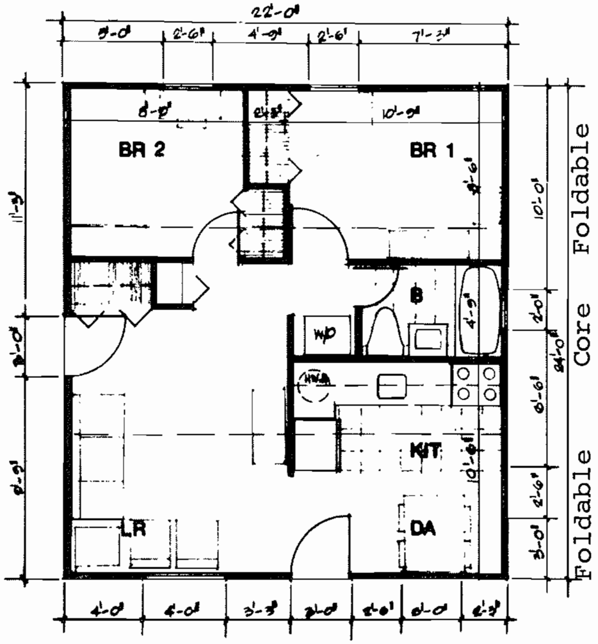


SPECIALLY ADAPTED PLAN

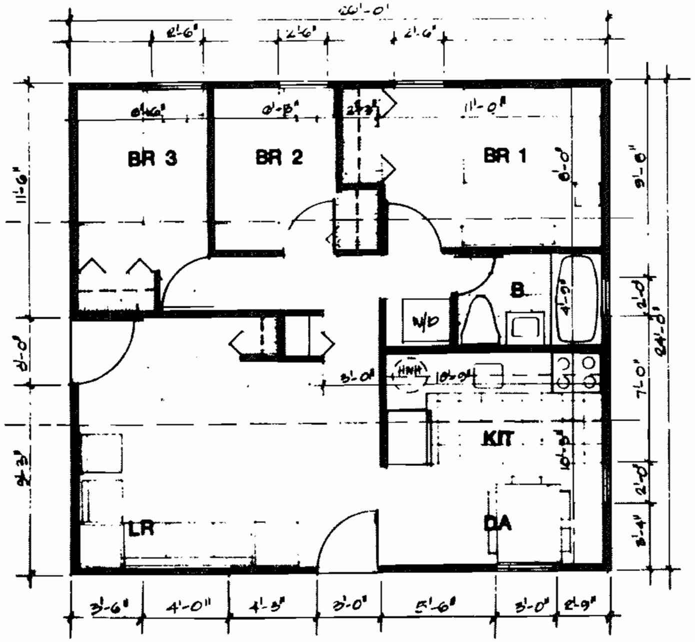
FIGURE 22
EXPANDABLE MOBILE HOME
(PROPOSED SPECIAL
ADAPTATION)



UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN



d. Conclusions and Pre-Selection for Cost-Effectiveness Analysis

The mobile home industry is currently the strongest and fastest growing segment of the construction industry. Its spectacular growth during the past 20 years has been due largely to the fact that mobiles are exempt from building codes and, therefore, can be produced for larger markets and at lower costs than conventional housing. Mobile homes can best be classified as a hybrid form of vehicle normally used as permanent housing.

For disaster relief, standard mobile homes offer three advantages:

--The single-wide mobile home, the most common product of the industry, represents the only existing and widely marketed housing system consisting of one factory-completed structural box. It also has an integral chassis and running gear assembly. Therefore, no site assemblage work is required and less effort and expense is needed for transportation, storage and site erection than for any other housing system meeting minimum space standards for permanent occupancy. In other words, the single-wide mobile home is the most easily relocatable marketed housing system permitted for permanent occupancy.

--The mobile home is the most inexpensive existing housing system in terms of initial cost per square foot.

--The mobile home is universally available and can be obtained anywhere in the country within shortest lead times.

There are also disadvantages:

- The system is not engineered for extended travel and requires major repair costs if transported long distances.
- Shipment of masses of mobile homes can seriously congest highways.
- Due to its low construction standards and non-permanent legal status, the standard mobile home tends to depreciate while permanent housing typically appreciates.

The mobile home industry produces four types of systems: single-wide mobile homes, expandable mobile homes, double-wide mobile homes and travel trailers. Only single-wides and one expandable model were found potentially usable as temporary housing for disaster relief. Special adaptations of basic structure as well as layout were suggested for both types.

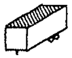
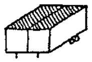
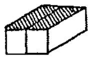
Three systems were pre-selected for detailed cost-effectiveness analysis in Task II -- the single-wide standard mobile home, the single-wide special design mobile home and the specially adapted expandable mobile home.

The ruggedized single-wide standard mobile home was not included because the suggested ruggedizing features require special, custom-built production and can, therefore, be connected with the design adaptation of the special design mobile home.

Figure 23 shows all mobile home systems analyzed with special emphasis on the three pre-selected systems in relation to the nine basic configuration types of temporary housing systems.

FIGURE 23

MOBILE HOME SYSTEMS BY BASIC CONFIGURATION

BASIC CONFIGURATION / INDUSTRY SEGMENT	ONE BOX		EXPANDABLE BOX		TWO OR MORE SECTIONAL BOXES		SECTIONAL BOX(ES) AND KNOCK-DOWN(S)	CORE AND PANELIZED	CORE & SPECIAL PACKAGED ENCL.
	ON WHEELS	GENERAL	ON WHEELS	GENERAL	ON WHEELS	GENERAL			
									
	1	2	3	4	5	6	7	8	9
. MOBILE HOME INDUSTRY	*Single-Wide Standard M.H.[2] Ruggedized Standard M.H.[2] **Special Design Mobile Home[2] Travel Trailer[2]		Expando Mobile Home[2] Expandable **Guerdon M.H.[2]		Double-Wide Standard M.H.[2]				

2 - Existing technology with potential integral mechanical core.

* - Included in cost-effectiveness analysis as marketed (meeting HUD/EPS Level I retention criteria).

**- Included in cost-effectiveness analysis with a floor plan specially adapted to meet the Minimum Livability Standards for Temporary Housing established for this study.

B. THE MANUFACTURED HOUSING INDUSTRY

1. INTRODUCTION AND SUMMARY

The manufactured housing industry is that segment of the construction industry producing factory-built permanent housing meeting the same construction, health and safety requirements as conventionally built housing.

Since World War II the role of manufactured housing has dramatically increased. As shown on Table 22, 23% of total housing starts in 1973 (excluding mobile homes) were factory-built. The market penetration of factory-built housing is expected to increase during the years ahead. It may exceed 30% of total housing starts at the end of this year and 50% before the end of the decade.

There are two major categories of manufactured housing, distinguished primarily by degree of factory completion. The older and larger one produces packaged housing, also known as panelized or prefabricated housing.* Approximately 80% of all manufactured housing is currently produced by this method. The 1,100 plants producing packaged housing throughout the country are operated by about 700 companies.**

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* See Appendix I, "Glossary."

** "Industrialized Housing Portrait," p. 30. The Directory/Census of Manufactured Housing lists only 700 plants for 1973 (Table 29).

TABLE 22

PENETRATION OF THE TOTAL PERMANENT HOUSING MARKET BY MANUFACTURED HOUSING, 1950-1974

Year	Total Housing Starts[a] Excl. Mobile Homes (Thousands of Units)	Total[b] Manufactured Housing (Thousands of Units)	Degree of Penetration
1950	1,899.3	55.0	2.9%
1955	1,619.9	93.0	5.7
1960	1,296.1	126.9	9.8
1965	1,509.7	232.8	15.4
1966	1,195.8	230.0	19.2
1967	1,321.9	225.0	17.0
1968	1,545.4	240.0	15.5
1969	1,499.5	289.0	19.3
1970	1,469.0	290.0	19.7
1971	2,084.5	360.0	17.3
1972	2,378.5	Estim. 440.0	18.5
1973 Prel.	2,053.8	Estim. 475.0	23.1
1974 Estim.	1,800.0	Estim. 563.0	31.3

Sources: (a) U.S. Department of Commerce for 1950-1973; Consultant's estimate for 1974.

(b) National Association of Building Manufacturers; *Professional Builder* estimates for 1973 and 1974.

The younger and smaller segment of the industry are manufacturers of modular housing, the manufactured housing system with the highest degree of factory completion. The modular housing industry, which emerged within the last five years, is expected to enter a period of sustained growth and become a major factor of the construction industry. Modular systems can be lightweight (predominatly wood-framed) or heavy-weight (concrete) and come in single and multifamily units. The predominant type of modular construction is the wood-framed, two-piece modular/sectional home. It is designed for single-family use in subdivisions or scatter sites and available as a standardized product from many manufacturers. Though the system is fairly standardized, a wide variety of different models are on the market. For example, one manufacturer, Continental Homes, offers 24 different models with 30 different floor plans.

With few exceptions manufactured housing systems are not designed for temporary use. Nevertheless they could become an important and growing resource for disaster relief. After first describing a brief industry profile, this industry report will discuss and evaluate how permanent manufactured housing systems could be used as an alternative to temporary housing in relief missions.

So far HUD has not used manufactured housing to any significant degree for disaster relief because HUD is only authorized to provide temporary housing assistance. Permanent housing assistance can be made available only through low interest loans from other federal departments. The emphasis on temporary housing would have to be modified if disaster victims are to benefit from the important and growing resource of manufactured housing.

The "Fast Delivery Permanent Home" approach outlined in this report would make it possible to offer such alternative assistance to families displaced by disasters. HUD should utilize and augment existing efforts such as the Flood Disaster Protection Act of 1973 to provide for predisaster planning required for this approach. HUD should also develop a new, complementary program offering logistical and financial assistance for purchasing Fast Delivery Permanent Homes.

On the average, the government now pays at least $8,000 to accommodate one displaced family rent-free for one year in a mobile home. If the same amount were available for purchase of a manufactured single-family home, many families, including renters, could resolve their long-term housing problem without further government assistance.

2. Industry Profile - Manufacturers of Modular and Packaged Housing

Information on producers of manufactured housing is often outdated, contradictory and incomplete. This is partly due to the rapid changes in the industry. In addition, manufacturers tend to be secretive about such statistics as annual production per plant and are sometimes uncooperative with publishers of surveys and directories. Therefore, even information in a complete and updated list like the Directory/Census of Manufactured Housing, published by the Manufactured Housing Newsletter, can be inaccurate and misleading. Nevertheless, this source appears more complete and reliable than any other. It is significant that Professional Builder magazine did not publish a directory of its own in 1973 but used the statistics of the Directory/Census for its 1973 issue on the industry.*

To present a condensed profile of the major manufacturers, their production levels, plant locations and corporate structure, the following sources were consulted and are summarized in Appendix III-B-1 and III-B-2**

- Unpublished list of the Top Modular Housing Producers and the Top Packaged Housing Producers, prepared by the publisher of Directory/Census of Manufactured Housing for the Professional Builder in July 1973, and made available to this study;

- The list of "Housing's Giants," published by the Professional Builder in July 1973;

- Manufacturers who responded to the Joint Venture's nationwide mailing in November 1973, expressing interest in this study.

- The Directory/Census of Manufactured Housing, Section 2-6, 1973 and Section 1, 1974;

The explanatory notes at the end of each appendix identify the information sources. Maps 2 and 3 show the total number of plants manufacturing lightweight modular and packaged systems by state. Maps 6 and 7 complement Appendix III-B-2 and show the location of headquarters and plants of the leading and selected manufacturers. The maps illustrate the patterns of industry locations in relation to the areas of major demand for disaster housing.

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* "Where It's At in Factory-Built Housing"

** For a summary see Tables 45 and 49

TABLE 23

LEADING MODULAR HOME MANUFACTURERS AND THEIR SUBSIDIARIES

SUMMARY OF APPENDIX III-B-1 FOR 42 LEADING COMPANIES WITH REPORTED AND PROJECTED PRODUCTION RATES FOR 1972 AND 1973

	No. of Plants	Units Produced 1972	1973	% Increase
Total number of units		28,860	41,193	+43%
Average number of units per company		687	981	+43
Total number of plants	63			
Average number of plants per company	1.5			
Average number of units per plant		424	606	+43

Source: See Appendix III-B-1.

a. The Modular Housing Manufacturers

With few exceptions, notably the giant Boise Cascade Corporation, modular producers operate one or two plants. Average production of firms for whom 1972 data are available was 687 units. The average estimated 1973 production was 981 units. Almost all leading companies (for those manufacturing concrete systems) produce single-family units along with multi-family housing, vacation homes and/or light commercial units. The units are typically wood-framed, comply with the applicable FHA Minimum Property Standards, building codes and/or, where applicable, state codes. Only 14 out of 60 leading and selected companies are included in the 1973 list of "Housing's Giants".

In 1973 the total number of plants producing modular units was reported to be 532.* The states with the highest number of plants were Pennsylvania (40), California (35), Ohio (30), New York (29), Texas (27), Michigan (26), Florida (24), Indiana (23) and Georgia (20). The largest numbers of plants belonging to leading manufacturers were in Pennsylvania (13) and Indiana (7). Maps 2 and 6 show that the areas of major demand for disaster housing are all within easy reach of modular plants.

To provide data on other typical characteristics of modular manufacturers, information from an unpublished survey conducted by National Gypsum in 1973 is summarized on Tables 24 and 25.**

The average manufacturer, according to this survey, prefers to ship up to 300 miles, markets eight models, produces 150 to 350 units per plant per year and has been in business two to four years. In more than 10% of the cases, site preparation work is done by builder/contractors, while the manufacturer in most cases is responsible for erecting the unit.

If compared with the mobile home industry, the accumulated market share of the 10 leading manufacturers of modular housing is modest. As shown on Table 26, they produced 14.8% of all modular housing manufactured in 1972.*** Again, the low degree of market concentra-

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* See Table 29 .

** The survey specifically covered manufacturers of modular/sectional housing.

*** This is less than one-third of the cumulative share of the 10 top mobile home producers but still three times more than the share of the 10 top producers of total housing.

tion reflects initial problems large corporations had in establishing themselves in the modular field. Also, the beginning phase of a new industry generally limits the size of operations.

b. The Packaged Housing Manufacturers

With few exceptions, notably National Homes Corporation, packaged housing producers operate one or two plants. Average production of manufacturers for whom 1972 data are available was 2,634 units. The average estimated 1973 production was 3.156 units. Again, almost all leading manufacturers, except those producing heavy-weight systems, produce single-family units along with multi-family housing, vacation homes and/or light commercial structures. Wood is the preferred material and only 11 out of 53 selected companies are included in the 1973 list of "Housing's Giants."*

The total number of plants producing packaged housing in 1973 was reported to be 701.** States with the largest number of plants were California (44), Ohio (43), Pennsylvania (40), Michigan (39), New York (33), Indiana (32), Illinois (31) and Washington (29). The largest numbers of plants of leading manufacturers were in Ohio (8) and Indiana (6).

As Map 3 shows, the pattern of locations of packaged housing plants is very similar to that of modular housing industry. Likewise, the areas of major demand for disaster housing are within easy reach of packaged housing plants.

As shown on Table 28 the market share of the 10 top manufacturers of packaged housing is nearly 21% and is 6% higher than the cumulative share of the 10 leading modular producers. This situation is due to the fact that the packaged housing industry is much older and more established than the modular segment.

c. The Role of the National Association of Building Manufacturers (NABM)

In 1943, during the first major growth period of the manufactured housing industry, a group of manufacturers formed the Prefabricated Home Manufacturers Institute.

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* See Appendix III-B-2.
** See Table 10.

This organization was the predecessor of the association representing the industry today: the National Association of Building Manufacturers (NABM). The institute, and later the association, have been active as a spokesman of the industry and have influenced legislation, policy, codes and standards and labor rulings. One of the association's important objectives for the years ahead is to achieve a completely free and uniform market for manufactured housing with universal reciprocity of codes and standards between the states. The association also serves as a link to other related industry groups such as the National Association of Home Builders, the Mobile Home Manufacturers Association and the Mortgage Bankers Association.* Recently, the association participated as co-sponsor of the Industrialized Building Exposition (INBEX), 1973 in Chicago and as co-author of the "Industrialized Housing Portrait" in Automation in Housing magazine.

If the industry is to become "the dominant force of home building in this country" over the next five to 10 years, active participation of manufacturers in NABM will probably have to grow. As of 1973, NABM had 99 active members, a relatively small portion of the 1,162 modular and packaged housing producers accounted for in that year.*

The lists of leading manufacturers in Appendix III-B-1 and III-B-2 show that only 13 out of 60 leading modular home manufacturers and their subsidiaries and 20 out of 53 leading packaged home manufacturers and their subsidiaries are members of the NABM.

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* Directory/Census of Manufactured Housing, Section 1, 1974; Table 29.

TABLE 24

1973 SURVEY OF MODULAR/SECTIONAL HOUSING MANUFACTURERS
TYPICAL SITE ERECTION PROCESS OF MODULAR/SECTIONAL HOMES AND ITS PARTICIPANTS

	Source of Interim Financing	Responsibility for		
		Site Preparation	Unit Erection	Finishing
Company	30%	10%	70%	50%
Builder/Contractor	52%	83%	30%	50%
Other	18%	7%	0%	0%
Total	100%	100%	100%	100%

<u>Source</u>: E. F. Grosse, "Profile of Sectional Housing," August 17, 1973, unpublished report of a survey of 88 manufacturers conducted by National Gypsum.

TABLE 25

1973 SURVEY OF MODULAR/SECTIONAL HOUSING MANUFACTURERS
1973 TYPICAL COMPANY CHARACTERISTICS

	Maximum	Average/ Typical	Minimum
Marketing Area	0 - 300 miles	0 - 200 miles	
Sales Staff	6	4	
Number of Floor Plans Needed to Satisfy the Market	12	8	
Number of Elevations Needed to Satisfy the Market		8	
F.O.B. Cost of Unit	$40,000	$12,000-16,000	$ 7,000
Number of Units Manufactured Per Plant Per Year	2,000	150-350	25
Number of Years in Business	15	2 - 4	½

Source: E. F. Grosse, "Profile of Sectional Housing," August 17, 1973, report of a survey of 88 manufacturers conducted by National Gypsum.

TABLE 26

MARKET SHARES OF THE LEADING 10 MANUFACTURERS OF MODULAR HOUSING, 1972

	Company	Units	Prof. Builder		Automation in Housing	
			Market Share (%)	Cumulative Share (%)	Market Share (%)	Cumulative Share (%)
1.	FCE-Dillon	2,133(a)	1.7	1.7	2.4	2.4
2.	Boise Cascade Mfrd. Housing	1,800	1.5	3.2	2.0	4.4
3.	Weil McLain Company	1,593	1.3	4.5	1.8	6.2
4.	Hessee Industries, Inc.	1,250	1.0	5.5	1.4	7.6
5.	Unitized Systems	1,228	1.0	6.5	1.4	9.0
6.	Aurora Modular Industries	1,200	1.0	7.5	1.3	10.3
7.	Capital Industries	1,100	0.9	8.4	1.2	11.5
8.	Development International Corp.	1,050	0.9	9.3	1.2	12.7
9.	Cardinal Industries	1,000	0.8	10.1	1.1	13.8
10.	Donn Building Systems	1,000	0.8	10.9	1.1	14.9
	Total of 10 largest companies in 1972	13,354(a)		10.9		14.8*
	Total production of modular housing units in 1972					
	1. Professional Builder	122,000(b)		100.0		
	2. Automation in Housing	90,000(b)				100.0

*Differs from cumulative shares because of rounding.

Sources: (a) *Directory/Census of Manufactured Housing*, Section 1-5, 1973;
(b) For source information, see Table 2.

TABLE 27

THE LEADING PACKAGED HOME MANUFACTURERS AND THEIR SUBSIDIARIES

SUMMARY OF APPENDIX III-B-2

FOR 46 LEADING COMPANIES WITH REPORTED AND PROJECTED PRODUCTION RATES FOR 1972 and 1973

	# of Plants	Units 1972	Produced 1973	Projected % Increase
Total number of units		121,148	145,153	+20%
Average number of units per company		2,634	3,156	"
Total number of plants	72			
Average number of plants per company	1.6			
Average number of units per plant		1,683	2,016	"

Source: See Appendix III-B-2.

TABLE 28

MARKET SHARES OF THE LEADING 10 MANUFACTURERS OF PACKAGED HOUSING, 1972

	Company	Units	Market Share (%)	Cumulative Share (%)
1.	National Homes Corp.	21,000(a)	6.0	6.0
2.	Boise Cascade Mfrd. Housing	17,392	5.0	11.0
3.	Sanford Company, Inc.	10,000	2.9	13.9
4.	Clearspan Components	4,500	1.3	15.2
5.	Components, Inc., E. Chicago	4,150	1.2	16.4
6.	Wood Components Co.	4,000	1.1	17.5
7.	Wausau Homes	3,085	0.9	18.4
8.	U.S. Steel Homes	3,075	0.9	19.3
9.	Components Inc., Denver	3,000	0.9	20.2
10.	Pease Company	3,000	0.9	21.1
	Total of 10 largest companies in 1972	73,202(a)		20.9*
	Total production of packaged housing in 1972			
	1. Total manufactured housing	440,000(b)		
	2. Modular housing	90,000(c)		
	Packaged housing	350,000		100.0

*Differs from cumulative shares because of rounding.

Sources: (a) Directory/Census of Manufactured Housing, Section 1-5, 1973;
(b) NABM, "Industrialized Building Portrait," Automation in Housing, p. 28;
(c) "Industrialized Building Portrait," Automation in Housing, p. 58.

TABLE 29

SUMMARY OF MANUFACTURED HOUSING PLANTS, 1970-1973

	Modular Only	Modular/ Packaged	Modular/ Mobile	Total Modular	Packaged Only	Modular/ Packaged	Total Packaged	Total Mfrd.
1970 TOTAL	457	82	152	691	620	82	702	1,311
1972 TOTAL	351	72	105	528	756	72	828	1,284
1973 TOTAL	371	71	90	532	630	71	701	1,162

Source: Directory/Census of Manufactured Housing, Section 1, 1974.

3. EVALUATION OF MANUFACTURED HOUSING SYSTEMS FOR USE IN DISASTER RELIEF MISSIONS

Although the manufactured housing industy grew from the demand for relocatable structures for World War II defense workers, the emphasis has shifted away from relocatability. Today packaged and modular housing is generally defined as factory-produced permanent housing.

Only a few packaged housing manufacturers contacted for this study produce systems which can be considered relocatable. These manufacturers are included in Part III-C, "Manufacturers of Special Relocatable Systems," of this report. There is general agreement in the industry that manufactured homes are built for permanency on permanent foundations. They are designed to qualify for mortage financing and to meet the same construction, health and safety requirements as conventionally built housing.

This study is intended to identify the most cost-effective housing systems for HUD to use in disaster relief. HUD's present role, however, is to provide temporary housing assistance. To define the potential of permanent housing systems for disaster relief, the temporary approach must be examined in the context of the overall framework of federal disaster relief.

a. "Fast Delivery Permanent Homes," A Complementary Alternative to Temporary Housing Assistance

(1) The Existing Framework of Federal Housing Assistance to Disaster Victims

The present basis of federal disaster assistance is the Disaster Relief Act of 1970 (P.L. 91-606), as amended.* This act authorizes two major types of housing assistance and assigns them to different federal agencies. Permanent housing assistance is available to homeowners in form of Small Business Disaster Loans and Farmers Home Administration Emergency Loans. Temporary housing assistance is available from HUD for all families displaced by major disasters.

(a) SBA and FmHA Permanent Housing Assistance

The small Business Administration (SBA) of the U.S. Department of Commerce and the Farmers Home Administration (FmHA) of the U.S. Department of Agriculture are authorized under the Disaster Relief Act of 1970 (Sections 231 and 232) to make low-interest loans available for repair, rehabilitation or replacement of property damaged or destroyed by major disasters. These loans are designed to cover damage or loss not compensated for by insurance or other methods. The inception of these programs dates back to the early 1950's. Table 30 shows that the SBA granted nearly 505,000

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* During the last phase of this study the Disaster Relief Act of 1974 (P.L. 93-288) was signed into law. Major changes of existing relief programs effected by this act will be noted in the following discussion.

TABLE 30

DISASTER LOAN ASSISTANCE BY THE SMALL BUSINESS ADMINISTRATION (SBA), 1953-1973

Calendar Year	Number of Loans	Total Amount	SBA Share
1953	41	$ 92,475	$ 92,475
1954	929	5,322,245	5,249,245
1955	2,339	32,355,556	31,609,123
1956	1,582	17,938,063	16,640,594
1957	2,006	15,779,620	14,920,289
1958	1,223	16,325,032	15,891,033
1959	799	6,415,152	6,261,794
1960	2,207	18,989,315	18,089,041
1961	4,647	27,609,852	27,322,826
1962	2,958	26,804,094	26,097,376
1963	2,423	23,351,921	22,384,656
1964	3,870	87,326,620	84,389,613
1965	26,246	189,957,088	187,134,510
1966	7,818	59,328,203	58,515,815
1967	9,921	91,465,805	91,059,430
1968	6,000	44,308,961	43,937,194
1969	9,329	103,402,601	103,211,605
1970	31,758	222,333,857	222,273,867
1971	96,071	388,633,847	388,122,037
1972	197,927	1,324,869,473	1,323,692,763
1973	94,293	589,593,553	588,734,595
TOTAL	504,387	$3,292,203,333	$3,275,629,881

Source: Small Business Administration, Reports Management Division.

TABLE 31

DISASTER LOAN ASSISTANCE BY THE FARMERS HOME ADMINISTRATION (FmHA), 1950-1973

Fiscal Year	Number of Counties Designated	In number of States	Number of Loans Made	Amount
1950	983	35	25,506	$ 31,580,777
1951	897	30	13,471	20,381,480
1952	987	33	21,380	32,467,909
1953	1,243	29	35,585	44,094,598
1954	1,226	25	46,991	94,078,763
1955	1,504	35	56,444	89,126,550
1956	2,032	38	45,847	86,984,324
1957	1,053	30 and P.R.	28,887	66,673,841
1958	893	34	24,247	63,419,194
1959	186	14	11,404	39,841,471
1960	379	20	9,188	22,858,368
1961	917	34	7,926	26,512,165
1962	568	34	20,861	63,340,076
1963	770	35	19,333	62,461,382
1964	726	36 and P.R.	15,302	50,095,845
1965	1,265	41	22,279	78,396,660
1966	1,048	39	24,371	100,414,795
1967	1,220	40	22,174	94,604,930
1968	1,326	39 and P.R.	22,228	108,008,150
1969	1,110	38	20,686	114,716,153
1970	477	25	12,862	89,430,160
1971	782 plus 54 municipalities in Puerto Rico	29 and P.R.	19,869	127,635,905
1972	799	33	13,056	108,911,810
1973	1,828	48 and P.R. & V.I.	128,677	557,776,140
TOTAL			668,574	$2,173,811,446

Source: Farmers Home Administration.

loans totaling approximately $3.3 billion from 1953 through 1973. The FmHA has granted nearly 670,000 loans totaling $2.2 billion from 1950 through 1973 (Table 31). While the FmHA only grants loans for property damage on farm tracts the SBA has provided assistance to owners of non-farm properties. Provisions of the program have changed repeatedly. As of December, 1973 the SBA program had the following regulations:

- Amount of Loan: The maximum SBA loan for structural damage is $50,000. In addition, up to $10,000 can be loaned for repair or replacement of household goods and personal property. The maximum total loan available for repair or reconstruction to one borrower is $55,000. In addition, any mortages or liens outstanding against a destroyed or substantially damaged property can be refinanced by SBA up to the amount of the physical loss sustained.

- Terms: SBA may grant a $5,000 forgiveness on such disaster loans.* Loans are granted for a term of up to 30 years. Debt service payments begin five months after disbursement while principal repayment may be suspended for up to five years in special hardship cases.

- Loan Procedure:

  1. The applicant submits a loan application to SBA. If the loan exceeds $7,500, the application must include documentation of the property destroyed, damaged or lost in the disaster and an estimate of the cost of repairs or restoration.

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* With P.L. 93-288, the Disaster Relief Act of 1974, the forgiveness program has been shifted to the states on a 75-25 percent federal state matching basis. (Individual and Family Grant Programs.) In 1973 the interest rate of SBA loans was 1%. In 1974 the interest rate for both SBA and FmHA loans was raised to 5%.

2. SBA contracts with private appraisers to verify individual losses. SBA pays for these estimates.

3. On the basis of these estimates, SBA determines the loan a family is eligible for.

4. Within one year from disbursement, SBA appraisers inspect the property to determine if the loan has been used properly.

- Eligibility: Any property owner is eligible for a loan for disaster damage of up to $7,500. For loans over $7,500, SBA will determine the applicant's ability to repay.

SBA loans have been an effective form of assistance to owners whose property has been destroyed or damaged in major disasters. The program has been criticized because it neither requires nor encourages pre-disaster planning. As a result, loans have been granted for the rehabilitation or reconstruction of structures which are likely to be subject to future disasters. Furthermore, SBA does not provide logistical assistance for disaster prevention and economic reconstruction of destroyed properties. Because of the time needed to rebuild homes, families displaced by disasters usually need temporary housing along with SBA assistance for permanent relief. Finally, these SBA loans have been available only to homeowners. Displaced renters cannot benefit from this program except by obtaining a small loan for loss of personal property.*

(b) HUD Temporary Housing Assistance

Under Section 226(a) of the Disaster Relief Act of 1970, as amended, the Administration "is authorized to provide temporary housing or

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* The new federal/state Individual and Family Grant Programs under P.L. 93-288 improve this situation.

other emergency shelter including but not limited to, mobile homes or other readily fabricated dwellings for those who, as a result of such major disaster, require temporary housing or other emergency shelter, except that for the first twelve months of occupancy no rentals shall be established for any such accommodations."*

Responsibility of this temporary housing assistance has been assigned to HUD. Volume 2 of this study (Report for Task I-A) details HUD's experience in providing temporary housing. Basically, the Emergency Preparedness Staff (EPS) of HUD has used two major resources as temporary housing: vacancies in the existing housing stock and so-called "imported" housing systems. So far the only readily available "imported" systems have been mobile homes and travel trailers.

(2) Problems Associated With the Use of Imported Housing Systems for Temporary Housing Assistance

(a) Extent and Cost

Despite HUD's attempt to minimize the use of "imported" housing systems, 59% of all temporary units provided since the program began have been mobile homes or travel trailers.

Based on this experience and on projections of the need for future disaster housing, Volume 3 of this study (Report for Task I-B-1) concluded that more than 50,000 households will need temporary housing over the next 10 years on a temporary basis using "imported" units.

Volume 5 of this study (Report for Task II) concluded that the most cost-effective use of HUD/EPS approved mobile homes would cost

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* Section 404(a) of P.L. 93-288 includes, "unoccupied habitable dwellings, suitable rental housing".

about $8,000 per family assisted, excluding administrative expenses. Approximately 80% of these costs would be borne by the federal government, the rest by the state in which the disaster occurred.*

The objective of the study is to determine "The Most Cost-Effective Housing System(s) That Can Be Used for Temporary Housing for Families Displaced by Disasters..."** The study was commissioned to investigate whether other temporary housing systems would be more cost-effective than the standard mobile home. Part IV of this report presents the results of an investigation of the present state of the art of industrialized temporary housing and shelter systems. Twelve existing and adapted systems were pre-selected for detailed cost-effectiveness analysis in Task II in order to rank them. But cost data for use of these systems in relief missions are based on estimates and assumptions rather than on actual experience. Therefore, the question of whether any system is more cost-effective than the standard mobile home used by HUD/EPS can only be determined on the basis of prototype development of the highest ranking systems and a systematic, controlled field test of these prototypes.

(b) Lead Time

Temporary housing is not emergency shelter. At the earliest, mobile homes can be provided for disaster victims one week after the President declares a major disaster. Currently, mobile homes can be made available within one week, if they are shipped from among the units HUD has assembled at Mobile Home Storage Centers and if they are used at rented commercial mobile home park sites or individual sites. If the disaster requires more than the number of units at the storage centers or if they are to be located at group sites, delivery may take four to six weeks.

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*The actual cost per family assisted in the past is estimated to be substantially higher. Improved procedures in procuring and using mobile homes are expected to result in savings. Also, it has been difficult to obtain complete and reliable cost information on the use of mobile homes in previous disasters.

**Contract Schedule, p. 3.

Due to this time lag, displaced families may have to live for up to one month in emergency accommodations provided by organizations like the American Red Cross or with friends and relatives until they can move into a temporary housing unit provided by HUD.

(c) The Limits of the Approach

High per family costs and the possibility of a long lead time are two measurable drawbacks of providing temporary assistance with "imported" relocatable housing. There are other, less tangible but equally serious social and psychological problems. A recent article in the Wall Street Journal summarized some criticisms by social scientists:

> Not only have government and voluntary agencies largely neglected the emotional impact of disasters while caring for the physical, but in the very process of providing food, shelter and medical care they often inadvertently contribute to conditions that can inflict serious psychological wounds, the critics say.
>
> In fact, it might be argued that if a deranged social scientist were to design a system of disaster intervention that could maximize pathology, it's likely that he would do precisely what was done in Buffalo Creek, says Dr. Dwight Harshbarger, associate professor of psychology at West Virginia University.
>
> The nucleus of the problem, psychologists say, is the loss of all sense of individual and community identify brought about by the mass use of mobile homes to house survivors. The phenomenon is a new one, dating back only to 1969 when the Department of Housing and Urban Development turned to

trailers when Hurricane Camille ravished the Gulf Coast. In 1972, the agency supplied 13,000 trailers to families displaced by floods here, in Rapid City, S.D., and in Wilkes-Barre, Pa. Although designed as temporary housing, 2,762 families were still living in these mobile homes as of Nov. 30.

Shattered Ties

There is, of course, a practical rationale for the use of mobile homes; they can be moved quickly into a disaster area and can house many people at relatively low cost. But the identical units, crammed closely together on whatever level land is available, bear little resemblance to the neatly landscaped mobile home courts advertised in the Sunday supplements of big-city newspapers. Disaster victims complain that in them, they feel like prisoners. "It's like living in a matchbox - that's what people call them," says Dr. Church. "Everything is intensified. Rain hits harder and louder, wind rocks them and lives are too compacted."

Most discouraging of all, however, is that normal ties of family, friends and even religion - those supporting elements that most people call on in time of crisis - have been shattered. Trailers are assigned on a first-come, first-served basis in a manner that leaves "friends and neighbors scattered to hell and back," says Dr. Edward Whalen, medical director of the Wilkes-Barre, Pa. Mental Health Center. Survivors, he says, rarely risk expressing their grief with strangers.

Furthermore, the racially integrated HUD trailer communities sometime disrupt

> neighborhood patterns of de facto segregation, thrusting together people who have difficulty living with one another in the best of times and who find it intolerable in times of stress. The director of Rapid City's Girls' Club, Barbara Fierro, says racial strife between whites and Sioux Indians erupted when a HUD camp opened across the street. "Everyone was so touchy," she says. "Someone would use the word 'Indian' and suddenly it was taken as a dirty word. Girls would be down on the floor in out-and-out fighting."
>
> Dr. Carl Keener, a Denver psychiatrist who worked with survivors in Rapid City, explains, "A person has only so much emotional energy. If too much of that energy is taken up just in living, there'll be little left to cope with other aspects of survival." Indeed, mental health workers say that many HUD trailer parks are rife with alcohol and drug abuse, neighborhood squabbles, marital problems and 'psychic numbing' - a dazed, apathetic withdrawal from life."*

The greater attention to such psychological problems which will be necessary is likely to further increase the cost of temporary housing assistance.

There are other serious problems connected with temporary housing. Imported units can become a trap for people who cannot find adequate permanent rehousing within their economic means. While the Disaster Relief Act allows assisted families to buy mobile homes for permanent occupancy, zoning regulations often make it very difficult to find a permanent site at a suitable location.**

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* Morris, Jack H., <u>The Wall Street Journal</u>

** See part III-A of this report

If the limitations and drawbacks of the temporary housing approach are to be kept to a minimum, its "hardware," organization and delivery must be improved. If the need for temporary housing aid is to be lessened, complementary alternative approaches should be developed.

(3) The Need for a Complementary Approach as an Alternative to Temporary Housing Assistance

The use of imported temporary housing for disaster relief is probably here to stay. But while temporary housing assistance may be adequate and cost-effective for those whose homes can be repaired within a reasonably short period after a disaster there is a clear need for an alternative approach for families whose homes were destroyed beyond repair and who may get trapped in temporary accommodations.

(a) The Concept of Fast Delivery Permanent Housing Assistance

For families displaced by disasters, the option of logistical and financial assistance for purchasing a new, permanent home within the shortest possible time may be a far more attractive and cost-effective form of assistance than one year of rent-free living in a HUD mobile home. This option is not provided for by present legislation. It is termed a Fast Delivery Permanent Home approach for this discussion.

The need for a Fast Delivery Permanent Home approach has already been recognized. In a 1972 report, the Building Research Advisory Board (BRAB) of the National Academy of Sciences-National Research Council acknowleged that attention to technology alone may not be enough to improve disaster housing assistance. The report outlines the basic elements of an optional permanent approach for those disaster victims who lose their houses.

It must be noted here, however, that if the term "housing alternatives" is construed to include options of strategy as well as of hardware and if the intent of the applicable public laws is broadly interpreted, it is fairly apparent that a post-disaster process that deliberately fosters the restoration and provision of new permanent housing as quickly as possible in a disaster-affected area could be, under certain conditions, the most cost-effective process. For example, if an individual's home has been destroyed beyond repair, he might opt to provide his own emergency or temporary shelter if the comparable cost to government of providing a mobile home (or some other type of shelter) for a period of a year could be applied to the purchase and construction of a permanent home.*

Thus, the basic concept of the Fast Delivery Permanent Home approach can be outlined as follows:

- As a prerequisite, federal activities for temporary and permanent relief should be better coordinated.

- The program should be prepared and adopted by the federal government in conjunction with disaster-prone states and communities before disasters strike.

- Eligibility should be limited to families who lost their home in major disasters and who meet certain other criteria.

- To avoid increased federal outlays, the cost per family under this approach

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* "Housing Technology Alternatives for Use in Planning Post-Disaster Housing Assistance Programs," National Academy of Sciences-National Research Council, p. 11.

- should be no greater than that using the most cost-effective imported temporary housing. In 1974 dollars, this would be $8,000. (80% HUD, 20% state).*

- The program is optional; a family can choose temporary housing assistance if it wishes.

(b) Requirements of the Physical Housing System

To qualify as a Fast Delivery Permanent Home, a housing system must satisfy six requirements:

- It must be generally accepted by the consumer.

- It should be readily available in all disaster-prone regions as a standardized product within a comparable price range.

- It must meet the construction, health and safety requirements for permanent housing and qualify for permanent mortgage financing.

- It must have a high degree of factory completion; the need for local skilled labor must be minimal.

- The lead time between placement of an order and completion of the housing unit must be minimal.

- The system must be available at the lowest possible cost to the consumer, compared with other permanent housing.

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* See Volume 5, (Report for Task II). Administrative costs are not included in this figure.

Manufactured housing offers great advantages over conventionally built housing in all those areas. Among manufactured homes, established modular systems such as the two-piece modular/sectional home meet the requirements best because of their high degree of factory completion and the resulting shorter lead time.

Indeed, the Fast Delivery Permanent Home approach is technologically possible because of the existence of the manufactured housing industry, especially its modular segment, just as the temporary housing approach now used by HUD is possible only because of the existence of the mobile home industry.

(c) Requirements for Applying the Physical Housing System

Physical housing systems suitable for Fast Delivery Permanent Home assistance are readily available in the form of manufactured housing. But these systems can only be used in connection with a suitable delivery system planned and organized before a disaster strikes.

Although modular manufacturers have often tried to make their products available to the government for disaster relief, these attempts have generally been unsuccessful. HUD statistics on temporary housing assistance do not include modular housing. The 1972 BRAB study presented results of a survey of 64 modular manufacturers to determine how much their products had been used for disaster relief. Seven manufacturers said they had furnished units or were under contract to do so. Eight other manufacturers who had not been able to provide units traced their difficulties to various factors including the complexities of contract awards, discrimination against out-of-state producers and bias by government officials.

BRAB concluded that use of permanent housing systems would depend on a "concise, coordinated pre-disaster housing program."* Discussion of issues involved in such a pre-disaster program was beyond the scope of the BRAB study and is beyond the scope of this study. But failure to recognize these issues could lead to the erroneous conclusion that permanent manufactured housing systems are of minimal use for federal disaster assistance. To compare potential benefits of the Fast Delivery Permanent Home approach with the known temporary housing approach, the following factors should be considered.

A pre-disaster housing program requires preparedness on two levels: state/local and federal. There should be a nationwide, coordinated approach to pre-disaster land use planning and development controls. Also needed is a complementary federal disaster relief housing program offering Fast Delivery Permanent Home assistance as an optional alternative to temporary housing.

(4) Pre-disaster Planning for the Use of Permanent Housing Systems in Disaster Relief Missions

(a) Pre-disaster Land Use Planning and Development Controls

The importance of preventive pre-disaster land use planning is paramount in flood-prone communities. A Fast Delivery Permanent Home approach requires that all questions about flood-resistant development and construction be resolved before a flood strikes. In addition, such planning could help renters participate in the benefits of a Fast Delivery Permanent Home program by becoming either single-family homeowners or owners of cooperative or condominium apartments.

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*National Academy of Sciences-National Research Council, p. 24.

i. Land Use Planning for Flood Prone Areas

According to the estimates presented in Volume 3 of this study (Report for Task I-B-1) 80% of the families requiring "imported" temporary housing assistance during the next 10 years will be victims of flood-related disasters, such as hurricanes, floods and tropical storms.

In the past, reconstruction of built-up areas destroyed by floods has been highly problematic. Relatively few communities and individuals participated in the federal Flood Insurance Program and there were no nationwide controls prohibiting permanent rebuilding in flood-prone areas. For example, only two families in the Wyoming Valley of Pennsylvania reportedly had flood insurance when tropical storm Agnes struck. Existing uninsured mortages and the lack of pre-disaster land use planning forced many families to rehabilitate houses that should have been removed and replaced by flood-resistant construction. In fact, the availability of low-interest SBA loans often encouraged rebuilding in flood-prone areas.

In response, Congress has mandated adequate pre-disaster land use planning for all flood-prone communities. The Flood Disaster Protection Act of 1973 should become the first nationwide tool for preventing or safeguarding new development and reconstruction in flood-prone areas. By July, 1975, all affected communities must have adopted appropriate land use and development controls. Either they must prohibit development in areas below 100-year-flood levels or they must require flood-proof construction -- that is, construction on levels above the flood level. Unless a community enacts such controls, property owners will not be able to purchase flood insurance from the government. And without such insurance, practically no bank or savings and loan association will be allowed to provide a construction loan or mortagage on the property. Furthermore, HUD Federal Insurance Administrator George Bernstein has indicated that no property owner in a community that has not joined the program before the deadline will be eligible for any disaster relief.*

The Federal Insurance Administration (FIA) is now working with the Army Corps of Engineers, the U.S. Geological Survey and affected communities on detailed flood hazard boundary maps and flood insurance rate maps. This work, combined with controls to be adopted by individual communities, will be an important element of pre-disaster land use plans and could be directly related to a Fast Delivery Permanent Home program.

When the Flood Disaster Protection Act of 1973 is successfully implemented, every property owner in a flood-prone area will know in advance whether he can rebuild after a flood and under what conditions. If he is not allowed to rebuild on the same site, he will know where he can secure flood-proof land and development rights in exchange for development rights to his flood-prone property.

ii. Preventive Measures for New Housing in Earthquake- and Tornado-Prone Areas

Flood-related disasters account for the largest share of all housing missions and

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* "Tough Rules for Flood Relief," Business Week. "Mortgage Money Affected by New Flood Insurance," Engineering News Record.

are the only disasters so predictable that preventive land use planning is meaningful. Tornadoes and eathquakes cannot be predicted as well and structures destroyed by such disasters are typically rebuilt at the same location. However, other preventive measures might reduce damage by non-flood related disasters. Building code provisions responsive to earthquake damage have long been used in seismic risk areas here and abroad. The National Bureau of Standards has conducted a study of structural damage caused by the 1971 San Fernando earthquake to evaluate the adequacy of present seismic building code requirements.*

The system most suited for the Fast Delivery Permanent Home approach -- modular housing -- may have an inherent structural advantage over conventionally built housing in terms of earthquake resistance. Modules are designed to sustain the dynamic stresses of transportation and site erection. Therefore, it has been claimed that modular construction can help minimize earthquake damage.

Likewise, certain measures to minimize tornado damage have become part of building code requirements or consumer habits. Damage due to strong winds can be reduced by secured anchoring of structures to their foundations and of roofs to wall systems.** Most important is a basement designed to serve as a storm cellar.

iii. Planning for Renters

Past experience with federal disaster housing assistance shows that renters often have great trouble obtaining adequate permanent rehousing. The economic feasibility analysis

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* "Engineering Aspects of the 1971 San Fernando Earthquake".

** Mehta, Kishor C., _et al._, _Response of Structural Systems to the Lubbock Storm_.

presented later in this chapter shows that many renters could afford an individually owned Fast Delivery Permanent Home if they could obtain land at fair market costs. Cooperatively owned or condominium Fast Delivery Permanent housing could be purchased by even more people. Therefore, HUD should encourage disaster-prone communities to reserve and pre-plan suitable sites for new Fast Delivery Permanent Home developments for renters displaced by disasters. For example, a community could acquire such a site and keep it as open space. If a disaster strikes, prepared contracts for a pre-planned subdivision and development of the sites could be let immediately and plots could be made available at fair market value to eligible families.

iv. Conclusions

Preventive pre-disaster land use planning is primarily applicable for flood disasters and has become mandatory under the Flood Disaster Protection Act of 1973. A Fast Delivery Permanent Home program can benefit by the implementation of that act through the Federal Insurance Administration. Pre-disaster land use planning for renters, as yet unutilized, should be considered by communities where renters live in high-risk areas.

(b) Outline of a Proposed Complementary HUD Program for Fast Delivery Permanent Home Assistance

In the wake of a disaster, the time needed to build a house can be considerably longer than it would be normally. Therefore, the Fast Delivery Permanent Home approach would require that as many problems as possible be resolved in advance through a program defining the legal framework operating procedures, available housing models and responsibilities of all participants. The program should also include a system of updated call-contract agreements between the government and interested manufacturers of suitable housing systems.

Responsbility for developing and administering such a program should be part of the federal responsibility for providing immediate post-disaster housing assistance and should rest with HUD. Several factors relevant to such a program are discussed below.

i. Compatibility with the Disaster Relief Act of 1970

As discussed before, the Disaster Relief Act of 1970 as amended specifically authorized HUD to provide temporary housing assistance. Assistance for purchasing permanent housing is restricted to SBA and FmHA loans. On the other hand, if the legislation is more broadly interpreted, it would seem possible to provide a Fast Delivery Permanent Home that is more beneficial but no more costly on a per family basis, without violating the intent of the Act. This assumption is supported by the BRAB study.

Therefore, the first step in developing a Fast Delivery Permanent Home program is to clarify the existing legislative basis for it and to prepare necessary amendments. If it can be demonstrated that benefits of a Fast Delivery Permanent Home will exceed the benefits of temporary housing, at no extra cost to the taxpayer, any necessary legislative changes should be feasible.

ii. Coordination and Utilization of Existing HUD Operations

Two HUD agencies currently provide housing assistance to disaster victims:

- The Emergency Preparedness Staff (EPS) is HUD's arm for making temporary housing assistance available under the Disaster Relief Act of 1970;

- The Federal Insurance Administration (FIA) is responsible for implementing the Flood Disaster Protection Act of 1973.

A Fast Delivery Permanent Home program for disaster victims should be based partly on close coordination of both operations. The Federal Housing Administration (FHA), the HUD branch responsible for mortgage insurance and other assistance to privately owned housing, should also be actively involved.*

State FHA directors could determine in advance the extent to which available manufactured housing systems comply with FHA Minimum Property Standards and other applicable codes and standards. Updated information on manufacturers and their products could be maintained. Furthermore, pre-disaster arrangements could be made with manufacturers to reduce the lead time for delivery. Arrangements might be made in form of call-contracts for turnkey type delivery of the homes, ready to be signed immediately after a disaster strikes.

iii. Eligibility Requirements

To prevent misuse of a Fast Delivery Permanent Home program and to prevent increased federal spending for the program, clear and equitable eligibility requirements must be established. The following criteria are suggested:

- Eligibility of the applicant for temporary housing assistance.

- Participation and cooperation of state and local government in the Fast Delivery Permanent Home program before the disaster strikes. This includes a commitment by the state to share 20% of the payment in lieu of

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* EPS often uses FHA personnel from local insuring and area offices as field staff during the first phase of housing missions.

temporary housing assistance and adoption by the local government of all federally required pre-disaster land use controls.

- Documented willingness and ability of the applicant to provide his temporary housing without government assistance until the Fast Delivery Permanent Home is completed.

- A maximum income limit that might be set at 200% of the local exception income limits for FHA Section 236 housing.

- The applicant's ability to pay the total annual cost of the new home.

- The ratio of estimated repair costs to the damaged structure to the fair market value of the repaired structure should exceed 50% if the structure is not located in an area designated as flood prone or 10% if the structure is in a designated flood-prone area.

- A commitment by the owner to clear his damaged house from its site at his expense within a specified time period.

iv. Participation of the Manufactured Housing Industry

The following features are important for assuring the cooperation of the manufactured housing industry:

- Estimated Demand

The analysis of Volume 3 of this study (Report for Task I.B.1) shows that under the previously existing conditions close to 20 percent of all families displaced by major disasters find their homes have been damaged beyond repair. There will be approximately 15,000 such families during the next 10 years. Enforcement of the Flood Disaster

Protection Act of 1973 will increase this number, particularly if incentives to rebuild rather than rehabilitate are provided. Such incentives could be payment by FIA of more than the estimated damage cost to owners in flood-prone areas whose property damage is less than 50 percent value of improvements. Normally, these owners would be permitted to rehabilitate despite the risk of repeated flooding.

Assuming a 20 percent increase of families needing new homes under the Flood Disaster Protection Act, the total need for new, permanent housing would amount to 18,000 units over the 10-year period in the principal disaster regions. Subsequent discussion will show that if families have the option of obtaining a grant in lieu of temporary housing assistance in the amount normally paid for a year rent-free in a mobile home ($8,000 in 1974 dollars), a majority of families, including renters, will be able to purchase a Fast Delivery Permanent Home without needing further cash equity. In other words, much of the need for permanent housing could become a market demand for Fast Delivery Permanent Homes.

- Downpayments - An Important Incentive

Modular housing manufacturers often have trouble because they normally are not paid by their customers until the home is delivered. The best incentive for a manufacturer to give priority to an order of Fast Delivery Permanent Homes might be to offer a sizeable downpayment when a purchase order is placed.

- Established Marketing Patterns

As pointed out earlier in this report, modular manufacturers usually sell their product to builder/dealer/developers who are responsible for preparing sites, building foundations, providing utility connections and selling the completed product. The manufacturer's own crew usually erects the manufactured home on prepared foundations but this work may also be performed by builder/dealer/developers. In other words, the manufacturer normally acts as a supplier, not a general contractor.

On the other hand, disaster relief missions require the assignment of clear and unambiguous responsibilities to as few parties as possible. Therefore, the contract with a manufacturer for a Fast Delivery Permanent Home program should cover all phases of construction up to turnkey completion and delivery of the unit to the owner. Contrary to the normal procedure, builder/dealer/developers would act as subcontractors to the manufacturer, who would serve as general contractor. This concept should be worked out jointly by HUD/FHA and interested manufacturers, along with the National Association of Building Manufacturers.

v. Outline of the Suggested Procedure of the Fast Delivery Permanent Home Program

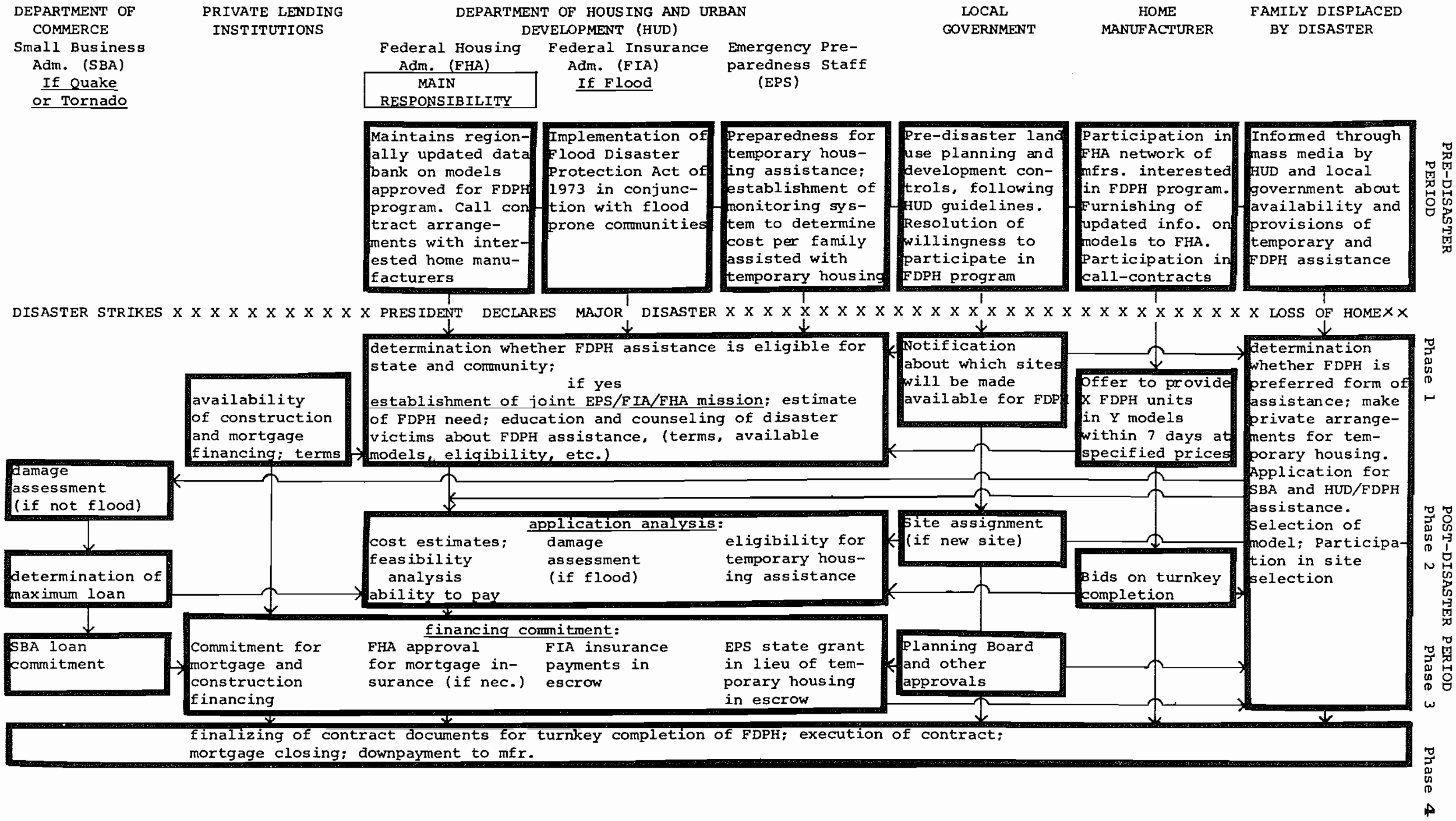
Figure 27 presents a schematic description of the participants and major steps in the Fast Delivery Permanent Home program.

Four major steps are envisioned for the period between declaration of a major disaster and execution of a contract for turnkey completion of Fast Delivery Permanent Homes.

Phase I is the establishment of a joint disaster relief mission by the three HUD agencies involved: EPS, FIA (in the case of flood disasters) and FHA as the proposed coordinator of the Fast Delivery Permanent Home program. During this phase the need for Fast Delivery Permanent Homes must be tentatively estimated,

FIGURE 24

PARTICIPANTS AND MAJOR STEPS OF THE FAST DELIVERY PERMANENT HOME (FDPH) PROGRAM DURING PRE-DISASTER AND POST-DISASTER PERIOD



the population must be informed and counseled about the program and contacts with the local government, interested manufacturers and lending institutions must be developed.

During the second phase, applications for Fast Delivery Permanent Homes are processed along with applications for temporary housing assistance. As a prerequisite, EPS determines the applicant's eligibility for temporary housing assistance.

FHA estimators review bids from manufacturers for turnkey completion of pre-approved models on specific sites. Where applicable, the amount of insurance payments available as equity and the amount of SBA low-interest loans are determined.* Based on the estimated cost per unit, the available equity and the applicant's ability to pay the resulting annual housing costs, FHA decides whether to approve the application. The minimum available equity is the proposed EPS payment in lieu of temporary housing assistance.

The third phase is the commitment for Fast Delivery Permanent Home assistance. During this phase, the insurance payments available as equity, the portion of the Small Business Disaster Loan available for new housing construction and the proposed EPS payment in lieu of temporary housing assistance are put in an escrow fund. If necessary, construction and mortgage financing must be committed by private lending institutions. Local approvals must be obtained.

After the financing commitment has been obtained, the contract documents for turnkey completion are finalized and executed in the fourth phase.

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* The eligibility and amount under provisions of P.L. 93-288 of "Individual and Family Grant Programs" must also be determined at this point.

With good pre-disaster planning, a small, efficient and experienced HUD staff specializing in Fast Delivery Permanent Home assistance and an average size relief mission (less than 30 homes destroyed in one community) these four phases should be completed within one month. If it takes another month to complete the new home, the applicant would not have to wait much longer than he would for imported temporary housing.

The following option should be built into the program: if an eligible applicant prefers to build a customized home, to purchase a manufactured home not included in the call-contract arrangements or to purchase an existing home, the proposed payment in lieu of temporary housing should still be put in escrow for him with the provision that he would forfeit the funds if closing of the mortgage on the new house and start of construction occur more than one year after the payment is approved.

b. Pre-Selection of Specific Manufactured Housing Systems for Use as Fast Delivery Permanent Homes and Feasibility Analysis

(1) Approach

As pointed out earlier, some 400 industrialized housing producers were contacted during the first phase of the study to reach a wide range of companies either already manufacturing or capable of producing temporary housing systems. They were told the purpose of the study and invited to submit information on their on their current products. Approximately 80 percent of these companies were marketing modular and/or packaged housing -- that is, permanent units, rather than temporary housing systems.*

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* For a list of companies surveyed, see Appendix II.

Nevertheless, as shown in Appendix II, approximately 7 percent of these permanent housing manufacturers expressed interest in the study and submitted information. Several manufacturers suggested using the advantages of permanent housing systems for disaster relief rather than focusing only on temporary systems.

This first series of contacts led to an important hypothesis: permanent housing manufacturers represent a major resource unutilized for disaster relief. They could play a major role in federal disaster relief missions, if the current emphasis on temporary housing assistance were complemented by a Fast Delivery Permanent Home approach.

To determine which manufactured housing systems are best suited for use as Fast Delivery Permanent Homes, the manufacturers who had responded to the initial request for information were contacted again, told about the concept and asked to complete a survey questionnaire and to submit plans and specifications on specific models.*

Thirteen of the 17 modular producers who had responded to the initial request for information participated in this Survey of Interested Manufacturers along with five of the seven interested packaged housing producers. Table 32 summarizes the rates of response in both phases.

(2) Pre-Selection of Specific Systems

Analysis of information on products marketed by companies participating in the Survey of Interested Manufacturers led to the following conclusion: the predominant system type is a detached one-story single-family home ranging from 700 to 1,300 sq. ft. for two- to four-bedroom models. There is a wide range of elevations, but the layout concepts do not vary much among different manufacturers.

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* For a copy of the questionnaire, see Appendix II-B.

TABLE 32

CONTACTS WITH MANUFACTURERS OF MODULAR AND PACKAGED HOUSING SUMMARY OF RESPONSES TO GENERAL SURVEY OF INDUSTRIALIZED HOUSING MANUFACTURERS AND SURVEY OF INTERESTED MANUFACTURERS

	Mfrs. of Modular Housing	Mfrs. of Packaged Housing
PHASE 1 (see Part II, Table 19)		
<u>General Survey of Industrialized Housing Mfrs.</u>		
TOTAL # OF COMPANIES CONTACTED BY LETTER	239	121
INTERESTED RESPONSE TO LETTER	17	7
PERCENT OF INTERESTED RESPONSE TO LETTER	7%	6%
PHASE 2		
<u>Survey of Interested Manufacturers</u>		
# OF COMPANIES SURVEYED	17	7
INTERESTED RESPONSE TO SURVEY	13	5
PERCENT OF PARTICIPATION IN SURVEY	76%	71%
PERCENT OF PARTICIPATION IN SURVEY FROM TOTAL # OF COMPANIES CONTACTED IN PHASE I	5%	4%

(a) The Two-Piece Modular/Sectional Home

Among manufactured detached single-family housing types, the modular/sectional home is the most standardized and widely available category. Eleven of the 13 modular manufacturers participating in the survey market this system. Typically, it is 90 percent factory completed and shipped in two 12-feet-wide modules (14 feet where permitted) from plant to prepared foundations where the two halves are connected, hooked up and finished out. As stated earlier, producers of these systems are considered the backbone of the modular housing industry.

Section c.(1) of this chapter contains abstracts of the survey information received from interested manufacturers, along with plans, elevations, outline specifications and FOB prices of typical three-bedroom models. The most striking conclusion to be drawn from this information is the similarity of products and prices.* This similarity appears to indicate the industry's growing sensitivity to market forces rather than a lack of design imagination. There is a demand for quality single-family homes at prices below conventional new construction. The two-piece modular/sectional home is a proven, viable and marketable response to this demand.

The 11 modular/sectional manufacturers participating in the survey range in size from the giant Boise Cascade Manufactured Housing Group (leading in estimated 1973 modular production) to typical small to medium-size producers such as Craftmark Homes (ranking 50th in estimated 1973 production). Together they operate 38 modular housing plants.

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* The companies do offer variations in elevations and optional features to avoid the image of uniformity.

Table 33 lists these plants in relation to the four demand areas defined in Volume 3 of this study (Report for Task I-B-1). The companies are identified by the same numbers used in the directories of manufacturers in Appendix III-B.

Map 4 shows the locations of these plants and indicates that all disaster-prone regions can be supplied with modular/sectional homes from the 11 interested companies.

Table 34 shows that the combined 1973 production was 10,640 units. Assuming only a 10 per cent volume increase from 1973 levels, these companies can be expected to soon have a combined annual production of 11,700 units. On the other hand, the nationwide average demand for Fast Delivery Permanent Homes has been estimated at 1,800 units annually, or 15 per cent of the estimated production of the 11 interested manufacturers. The 11 companies could absorb this demand among themselves. On the other hand, other manufacturers of modular/sectional homes may also want to participate in the Fast Delivery Permanent Home program once it has become a reality.

It was concluded that the two-piece modular/sectional home is particularly well suited for use in the proposed Fast Delivery Permanent Home program for the following principal reasons:

- The system is accepted by consumers throughout the country and clearly marketable.

- More than any other manufactured system, the two-piece modular/sectional home is readily available in all disaster-prone parts of the country as a standardized product within a comparable, competitive price range.

TABLE 33

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS
PLANTS OF INTERESTED MANUFACTURERS OF MODULAR/SECTIONAL HOMES WITHIN 300 MILES
FROM AREAS OF MAJOR DEMAND FOR TEMPORARY HOUSING

		1. WESTERN EARTHQUAKES		2. CENTRAL TORNADOES		3. SOUTHERN FLOODS AND HURRICANES		4. EASTERN TROPICAL STORMS	
ID #*	COMPANY NAME	Plant	Max.** Prod./Shift	Plant	Max.** Prod./Shift	Plant	Max.** Prod./Shift	Plant	Max.** Prod./Shift
M 3	BOISE-CASCADE MFRD. HOUSING WESTERN OPERATIONS	Boise,ID Denver,CO Pocatello,ID Post Falls,ID Salt Lake City,UT Spokane,WA	2 2 2 2 2 2						
M 3a	BOISE-CASCADE MRFD. HOUSING KINGSBERRY HOMES			Sigourney,IA	N.R.	Fort Payne,AL	N.R.	Emporia,VA Muncy,PA	N.R. N.R.
M 11	CRAFTMARK HOMES							Liverpool,NY Liverpool,NY	2 2
M 20	ENVIRONMENTAL COMMUNITIES	Corona,CA	1						
M 24	GLEN MANOR HOMES (POST COACH INC.)					Post Coach of SC	4	Danville,PA Wilkes-Barre,PA	4-6 4
M 26	GUERDON INDUSTRIES, INC.	Patterson,CA	4	Madison,SD	N.R.	Alexander City,AL	N.R.	Chambersburg,PA	N.R.
M 26a	INTRA AMERICAN HOMES					Vicksburg,MS	N.R.		
M 26b	LONERGAN CORP.					Ocala,FL	N.R.		
M 26c	MAGNOLIA HOMES MFRG. CORP.					Vicksburg,MS	N.R.		
M 35	MANUFACTURED HOMES, INC.					Elkhart,IN	1		
M 37	MOD-U-KRAF HOMES, INC.							Pulasky, VA. Rocky Mount, VA.	4 1½
M 38	MODULAGE/ALBEE HOMES, INC.							Niles,OH	N.R.
M 40	NBC MODULAR HOMES			Waukomis,OK	½	Lake Placid,FL Bishop,TX Clebourne,TX Waco,TX Temple,TX	½ ½ ½ ½ ½		
P 40	SCHOLZ HOMES, INLAND-SCHOLZ							Milan,MI	N.R.
M 60a	WEIL-McLAIN, CONTINENTAL HOMES							Boones Mill,VA Boones Mill,VA Malden,MO Nashua,NH	7 15 15 17

*The numbers identify the headquarters and plants on the opposite map. **Modular/Sectional only.
M refers to Appendix III-B-1, "The Leading Modular Home Manufacturers, Their Subsidiaries and Selected Smaller Manufacturers."
P refers to Appendix III-B-2, "The Leading Packaged Home Manufacturers, Their Subsidiaries and Selected Smaller Manufacturers."

Source: Directory/Census of Manufactured Housing, Section 2-6, 1973; Joint Venture's Survey, February, 1974.

TABLE 34

SURVEY OF INTERESTED MANUFACTURERS
ESTIMATED TOTAL 1973 PRODUCTION OF 11 MANUFACTURERS OF TWO-PIECE MODULAR/SECTIONAL HOMES

Company Name	Estimated # of Modular/Sectional Homes Produced, 1973
1. Boise Cascade Manufactured Housing	3,650*
2. Craftmark Homes	500*
3. Environmental Communities	300**
4. Glen Manor Homes	1,200**
5. Guerdon Industries	1,000*
6. Manufactured Homes, Inc.	500*
7. Mod-U-Kraf Homes, Inc.	300*
8. Modulage/Albee Homes, Inc.	800*
9. NBC Modular Homes	500*
10. Inland Scholz	300**
11. Weil McLain	1,590*
TOTAL INTERESTED MANUFACTURERS	10,640

* Appendix III-B-1, the Leading Modular Home Manufacturers, Their Subsidiaries and Selected Smaller Manufacturers.

**Estimates based on 1972 production.

- Minimal time is needed for site erection and the need to import skilled labor is negligible.

The two-piece modular/sectional home seems also ideally suited for an initial pilot experiment with the proposed Fast Delivery Permanent Home approach since it is designed for individual ownership and thereby avoids the added complexities of cooperative or condominium ownership.

(b) Other Single-Family Housing Systems Produced by Interested Manufacturers

Table 35 lists the seven manufacturers producing other modular or packaged single-family housing systems who also participated in the survey. Information on typical products of these companies is presented in section c.(1)(b) of this chapter.

The structural systems used by some of these manufacturers include steel, aluminum and plastic. In the context of the proposed Fast Delivery Permanent Home program, such special materials and structural systems may be disadvantageous since their use is limited to only a few specific manufacturers.

Five of the seven manufacturers in this group produce packaged housing systems, including such leading companies as National Homes and Weston Homes (a subsidiary of Wausau Homes). Packaged systems account for approximately 80 percent of all manufactured housing. Their advantages were discussed earlier. For the Fast Delivery Permanent Home program, however, packaged systems seem less suitable than the two-piece modular/sectional home because of the greater dependency on on-site labor. But the line between packaged and modular production is fluid: packaged housing producers can expand their product line to include modular/sectionals, provided such a decision is sound from a business standpoint.

TABLE 35

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS
PLANTS OF INTERESTED MANUFACTURERS OF MODULAR (NOT SECTIONAL) AND PACKAGED HOMES WITHIN 300 MILES
FROM AREAS OF MAJOR DEMAND FOR TEMPORARY HOUSING

		1. WESTERN EARTHQUAKES		2. CENTRAL TORNADOES		3. SOUTHERN FLOODS AND HURRICANES		4. EASTERN TROPICAL STORMS	
ID #*	COMPANY NAME	Plant	Max. Prod./Shift	Plant	Max. Prod./Shift	Plant	Max. Prod./Shift	Plant	Max. Prod./Shift
M 6	CARDINAL INDUSTRIES			Columbus,OH	N.R.				
M 8	COMMUNITY TECHNOLOGY (TRW)	Sacramento,CA	N.R.						
R 2.1	ENDURE PRODUCTS					Miami,FL	N.R.		
P 28	MAYHILL HOMES CORP.					Gainesville,GA	N.R.		
P 31	NATIONAL HOMES CORP.					Meridian,MS Thomson,GA Martinsville,VA Lafayette,IN Effingham,IL	10 15 12 24 10	Horseheads,NY	12
				Tyler,TX	10				
P 46	U.S. STEEL HOMES					New Albany,IN Orlando,FL	N.R. N.R.		
P 48a	WESTON HOMES			Rothschild,WI	8	Newnan,GA	4		

*The numbers serve to identify the headquarters and plants on the opposite map.
M refers to Appendix III-B-1, "The Leading Modular Home Manufacturers, Their Subsidiaries and Selected Smaller Manufacturers."
P refers to Appendix III-B-2, "The Leading Packaged Home Manufacturers, Their Subsidiaries and Selected Smaller Manufacturers."
R refers to Appendix III-C , "Relocatable Housing Manufacturers, Their Subsidiaries and Selected Smaller Manufacturers."

Source: Directory/Census of Manufactured Housing, Section 2-6, 1973;
Joint Venture's Survey, February, 1974.

(c) Townhouse and Garden Apartment Systems

Table 36 shows that many manufacturers have added attached, two-story, models to the more traditional detached one-story, single-family models. The distinction between townhouse and garden apartment models is often unclear. Often both consist of four 12-feet-wide, stack-on modules. But a great variety of special designs is available. Although these systems often permit individual ownership, they are usually referred to as multi-family housing. Despite well-publicized failures of modular multi-family systems, a substantial share of the growth of manufactured housing during the coming years could occur in this sector.

Townhouse and garden apartment systems can become an important additional part of the proposed Fast Delivery Permanent Home program. The possibility of higher densities and cooperative ownership could help to bring this housing within reach of families unable to afford single family homes. In urban areas, attached designs may be the only feasible option. However, use of these systems requires more sophisticated pre-disaster planning and relief mission management than detached single-family homes.

The following section will present a generalized feasibility analysis of the system recommended for initial application as Fast Delivery Permanent Housing: the two-piece modular/sectional home.

(3) Generalized Feasibility Analysis of the Use of Two-Piece Modular/Sectional Systems for Fast Delivery Permanent Home Assistance

Exhibits 1 through 8 show that the proposed optional payment in lieu of temporary housing assistance, in conjunction with the Flood Disaster Protection Act or SBA financing, would make Fast Delivery Permanent Homes available to any homeowner and most renters displaced by disasters.

TABLE 36

SURVEY OF INTERESTED MANUFACTURERS
COMPANIES PRODUCING WOOD FRAMED MODULAR, TOWNHOUSE AND GARDEN APARTMENT UNITS

		Townhouse	Garden Apt.
M3	BOISE CASCADE MFRD HOUSING WESTERN OPERATIONS	X	X
M6	CARDINAL INDUSTRIES		X
M24	GLEN MANOR HOMES	X	X
M37	MOD-U-KRAF HOMES	X	
M38	MODULAGE/ALBEE HOMES	X	X
M40	NBC MODULAR HOMES		X
P40	SCHOLZ HOMES, INLAND SCHOLZ	X	X
	TOTAL	5	6

The analysis is presented for one state in each of four areas of major demand.

The following sources of cost information were utilized:

- F.O.B. price of unit: manufacturer (Section c.(1))
- Site preparation and unit erection: estimates by McKee-Berger-Mansueto (Section c.(2))
- Median values of single-family homes and median incomes: U.S. Dept. of Commerce (Section c.(3))
- Miscellaneous (interest rates, property tax rates, etc.): Consultants' spot surveys and estimates.

The percentage of total net housing cost of the median family income per state (including utilities and considering income tax savings) was used to indicate feasibility. Exhibits show that even in the most precarious case -- renters in the northeast without equity capital -- the projected net housing cost does not exceed 25 percent of median family income. For homeowners the availability of insurance payments or SBA loans substantially improves this ratio.

Undoubtedly part of the displaced rental population has incomes substantially below the median income ranges. But the analysis shows that the proposed payment in lieu of temporary housing assistance in conjunction with the logistical assistance to be provided will enable most eligible disaster victims to afford a Fast Delivery Permanent Home.

EXHIBITS

HYPOTHETICAL DEVELOPMENT BUDGET FOR A FAST DELIVERY PERMANENT HOME

EXHIBIT 1

1. RELIEF SITUATION: WESTERN EARTHQUAKE
STATE SELECTED: CALIFORNIA

				TOTAL COST	
				ALT. 1 Old Site	ALT. 2 New Site Pr.Renter
TYPE OF HOME:	Mod./Sect., approx. 24'x44', 1,056 sq.ft., 3 BR, 1 bath.				
SPECIFICATIONS:	For typical examples, see Sect. 3 c (1), Documentation of Typical Systems;				
	ID # Company Name				
	M 3a Boise-Cascade Mfrd. Housing, Western Operations				
	M 20 Environmental Communities, Inc.				
	M 26 Guerdon Industries, Inc.				
SITE PREPARATION AND FOUNDATIONS:					
ALTERNATIVE 1 (Existing site, new perimeter foundations)	Site Clearance: ¼ acre site[4]		$ 161[2]		
	Perimeter Foundations (3' deep, excavation, footings, blocks, backfill)		1,657[2]		
	Total Cost for Site Preparation, Alternative 1			$ 1,818	
ALTERNATIVE 2 (Construction on new site)	Site Acquisition: ¼ acre lot		$ 3,528[2]		
	Perimeter Foundations (3' deep, excavation, footings, blocks, backfill)		1,657[2]		
	Total Cost for Site Preparation, Alternative 2				$ 5,185
UTILITY CONNECTIONS: ALTERNATIVE 2	Water: connection to main in street		$ 450[2]		
	Sewage: connection to sewer in street		299[2]		
	Electricity		150[2]		
	Telephone		94[2]		
	Total Cost for Utility Connections			$ 993	$ 993
MANUFACTURED HOME:	Sales price FOB plant for complete unit as specified in Sect. 3.c (1), including sales tax (example: Environmental Communities)		$14,025[1]		
	Transportation: 300 miles @ $1.70		510[1]		
	Total Cost for Home Delivered to the Site			$14,535	$14,535
SITE ERECTION:	Including utility hook-ups, ext. and int. finishing			1,216[2]	1,216[2]
SITE WORK:	Landscaping, walks; miscellaneous (fee, permits, etc.)			638[2]	638[2]
INDIRECT COSTS:	Interim financing, points and closing costs			1,200[4]	2,000[4]
TOTAL NET DEV. COST:				$20,400	$24,567
BUILDER'S PROFIT:	15%[1] of Total Net Development Cost			$ 3,060	$ 3,685
TOTAL TO CUSTOMER:				$23,460	$28,252
EQUITY:					
ALTERNATIVE 1 (Previous Home Owner)	Proposed optional grant in lieu of temporary housing assistance		$ 8,000[4]		
	SBA Loan:				
	Median value of single-family home, 1970 $23,100[3]				
	Est. median value,1974: x 1.27 (6% annual increase)	$29,300[3,4]			
	Est. median lot value (site acquisition)	-3,530[2]			
	Est. median value of structure	$25,770			
	Hypothetical damage 60 percent	15,460[4]	$15,460[4]		
	Hypothetical principal on previous mtg.	+9,540[4]			
	1% interest SBA Loan	25,000			
	Deduct $5,000 forgiveness	-5,000			
	SBA Loan 1% interest, 30 years	$20,000			
	Total Equity and SBA financing available for new home			$23,460	
ALTERNATIVE 2 (Previous Renter)	Proposed optional grant in lieu of temporary housing assistance				$ 8,000
MORTGAGE REQUIREMENT:				$ 0	$20,252
ROUNDED TO NEXT $500				$20,000 SBA	$20,500

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1) For source of cost information see Section 3.c (1), Documentation of Typical Systems.
2) For source of cost information see Section 3.c (2), Cost Estimates for Site Preparations.
3) For source of cost information see Section 3.c (3), Median Values (1970 Census of Population and Housing).
4) Hypothetical Assumption.

EXHIBIT 2

HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET FOR A FAST DELIVERY PERMANENT HOME

1. RELIEF SITUATION: WESTERN EARTHQUAKE
STATE SELECTED: CALIFORNIA

		ALTERNATIVE 1 (existing site, permission to rebuild)	ALTERNATIVE 2 (new site, previous renter)
HYPOTHETICAL MORTGAGE AMOUNT (EXHIBIT 1)		$20,000*	$20,500
1. ANNUAL DEBT SERVICE			
Estimated mortgage interest rate	8.25%		
FHA insurance premium	.25		
Constant (30 years) *	9.23		
SBA Constant* *	3.87%		
Annual Debt Service		$ 775*	$ 1,900
2. REAL ESTATE TAX			
Estimated assessed value at 100% valuation: $27,000			
Typical tax rate at 100% valuation: 33/1000			
Estimated Real Estate Tax		900	900
3. UTILITIES $75/ROOM/YEAR (5.5 ROOMS)		410	410
4. INSURANCE			
Homeowner's Policy		120	120
5. TOTAL HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET		$ 2,205	$ 3,330
6. TAX LOSSES, YEAR 1			
Interest		$ 200	$ 1,700
Real Estate Tax		900	900
Total loss available as income tax deduction		$ 1,100	$ 2,600
Estimated annual tax savings (assuming 20% tax bracket)		$ 220	$ 520
7. ESTIMATED NET ANNUAL HOUSING COST (ITEM 5 MINUS ITEM 6)		$ 1,985	$ 2,810
8. ESTIMATED NET ANNUAL HOUSING COST AS PERCENTAGE OF MEDIAN INCOME			
Median income, California 1970 = $10,700			
Estimated median income, California 1974: $10,700 x 1.27 (assuming 6% annual increase) = $13,600			
Percent of Estimated Median Income		15%	21%

* For commercial mortgage.

* *30-year SBA loan at 1% interest.

EXHIBIT 3

HYPOTHETICAL DEVELOPMENT BUDGET FOR A FAST DELIVERY PERMANENT HOME

2. RELIEF SITUATION: CENTRAL TORNADOES
STATE SELECTED: KANSAS

				TOTAL COST	
				ALT. 1 Old Site w/Util.& Basement	ALT. 2 New Site Previous Renter
TYPE OF HOME:	Mod./Sect., approx. 24'x44', 1,056 sq.ft., 3 BR, 1 bath.				
SPECIFICATIONS:	For typical examples, see Sect. 3.c (1), Documentation of Typical Systems; ID# Company Name M 3a Boise-Cascade Mfrd. Housing, Kingsberry Homes M 26 Guerdon Industries M 40 NBC Modular Homes M 60a Weil McLain, Continental Homes				
SITE PREPARATION AND FOUNDATIONS:					
ALTERNATIVE 1 (Existing site, reusable basement)	Site Clearance: ¼ acre site[4]		$ 162[2]		
	Total Cost for Site Preparation, Alternative 1			$ 162	
ALTERNATIVE 2 (Construction on new site)	Site Acquisition: ¼ acre lot		$ 3,560[2]		
	Foundations and Basement		3,310[2]		
	Total Cost for Site Preparation, Alternative 2				$ 6,870
UTILITY CONNECTIONS: ALTERNATIVE 2	Water: connection to main in street		$ 454[2]		
	Sewage: connection to sewer in street		303[2]		
	Electricity		151[2]		
	Telephone		94[2]		
	Total Cost for Utility Connections			-	$ 1,002
MANUFACTURED HOME:	Sales price FOB plant for complete unit as specified in Sect. 3.c (1), including sales tax (example: Kingsberry Homes)		$10,500[1]		
	Transportation: 300 miles @ $2.25		675[1]		
	Total Cost for Home Delivered to the Site			$11,175	$11,175
SITE ERECTION:	Including utility hook-ups, ext. and int. finishings			1,213[2]	1,213[2]
SITE WORK:	Landscaping, walks; miscellaneous (fee, permits, etc.)			643[2]	643[2]
INDIRECT COSTS:	Interim financing, points and closing costs			1,000[4]	2,000[4]
TOTAL NET DEV. COST:				$14,193	$22,909
BUILDER'S PROFIT:	15%[1] of Total Net Development Cost			$ 2,130	$ 3,435
TOTAL TO CUSTOMER:				$16,323	$19,474
EQUITY:					
ALTERNATIVE 1 (Previous Home Owner)	Proposed optional grant in lieu of temporary housing assistance		$ 8,000[4]		
	SBA Loan:				
	Median value of single-family home, 1970 $12,000[3]				
	Est. median value,1974: x 1.27 (6% annual increase)	$15,240[3,4]			
	Est. median lot value (site acquisition above)	-3,560			
	Est. median value of structure	$11,680			
	Hypothetical damage 70 percent	8,180[4]	$ 8,180[4]		
	Hypothetical principal on previous mtg.	+4,000[4]			
	1% interest SBA Loan	12,180			
	Deduct $5,000 forgiveness	-5,000			
	SBA Loan 1% interest, 30 years	$ 7,180			
	Total Equity and SBA financing available for new home			$16,180	
ALTERNATIVE 2 (Previous Renter)	Proposed optional grant in lieu of temporary housing assistance				$ 8,000
MORTGAGE REQUIREMENT:				$ 143	$11,474
ROUNDED TO NEXT $500				$ 7,500 SBA	$11,500

1) For source of cost information see Section 3.c.(1), Documentation of Typical Systems.
2) For source of cost information see Section 3.c.(2), Cost Estimates for Site Preparations.
3) For source of cost information see Section 3.c.(3), Median Values (1970 Census of Population and Housing).
4) Hypothetical Assumption.

EXHIBIT 4

HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET FOR A FAST DELIVERY PERMANENT HOME

2. RELIEF SITUATION: CENTRAL TORNADOES
STATE SELECTED: KANSAS

		ALTERNATIVE 1 (existing site, permission to rebuild)	ALTERNATIVE 2 (new site, previous home owner)
HYPOTHETICAL MORTGAGE AMOUNT (EXHIBIT 3)		$7,500*	$11,500
1. ANNUAL DEBT SERVICE			
Estimated mortgage interest rate	8.25%		
FHA insurance premium	.25		
Constant (30 years) *	9.23		
SBA Constant**	3.87		
Annual Debt Service		$ 290*	$ 1,060
2. REAL ESTATE TAX			
Estimated assessed value at 100% valuation: $19,500			
Typical tax rate at 100% valuation: 10/1000			
Estimated Real Estate Tax		195	195
3. UTILITIES $75/ROOM/YEAR (5.5 ROOMS)		410	410
4. INSURANCE			
Homeowner's Policy		120	120
5. TOTAL HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET		$1,015	$ 1,785
6. TAX LOSSES, YEAR 1			
Interest		$ 75	$ 950
Real Estate Tax		195	195
Total loss available as income tax deduction		$ 270	$ 1,145
Estimated annual tax savings (assuming 20% tax bracket)		$ 50	$ 230
7. ESTIMATED NET ANNUAL HOUSING COST (ITEM 5 MINUS ITEM 6)		$ 965	$ 1,555
8. ESTIMATED NET ANNUAL HOUSING COST AS PERCENTAGE OF MEDIAN INCOME			
Median income, Kansas 1970 = $8,700			
Estimated median income, Kansas 1974: $8,700 x 1.27 (assuming 6% annual increase) = $11,050			
Percent of Estimated Median Income		9%	14%

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*For commercial mortgage.

* *30-year SBA loan at 1% interest.

HYPOTHETICAL DEVELOPMENT BUDGET FOR A FAST DELIVERY PERMANENT HOME

EXHIBIT 5

3. RELIEF SITUATION: SOUTHERN HURRICANES AND FLOODS
STATE SELECTED: LOUISIANA

				TOTAL COST		
				ALT. 1 Old Site w/Util.	ALT. 2a New Site Pr.Owner	ALT.2b New Site Pr.Renter
TYPE OF HOME:	Mod./Sect., approx. 24'x44', 1,056 sq.ft., 3 BR, 1 bath.					
SPECIFICATIONS:	For typical examples, see Sect. 3.c. (1), Documentation of Typical Systems;					
	ID # Company Name					
	M 3a Boise-Cascade Mfrd. Housing, Kingsberry Homes					
	M 24 Glen Manor Homes, (Post Coach of SC)					
	M 26 Guerdon Industries					
	M 40 NBC Modular Homes					
FLOOD PROOFING AND FOUNDATIONS: ALTERNATIVE 1 (Permission to build on existing site of destroyed home)	Site Clearance: ¼ acre site[4]		$ 131[2]			
	Flood Proofing of Existing Site: New minimum level of lowest living floor: 1' above 100 year flood level; Assumption: 10' high stilt system with stairs[4]		1,203[2]			
	Total Cost for Flood Proofing, Alternative 1			$ 1,334		
ALTERNATIVE 2 (Construction on new site outside flood prone area)	Site Acquisition: ¼ acre lot		$ 2,880[2]			
	Perimeter Foundations (3' deep, excavation, footings, blocks, backfill)		1,349[2]			
	Total Cost for Flood Proofing & Foundations, Alt. 2				$ 4,229	$ 4,229
UTILITY CONNECTIONS: ALTERNATIVE 2	Water: connection to main in street		$ 367[2]			
	Sewage: connection to sewer in street		194[2]			
	Electricity		122[2]			
	Telephone		77[2]			
	Total Cost for Utility Connections			-	$ 760	$ 760
MANUFACTURED HOME:	Sales price FOB plant for compl. unit as specified in Sect. 3.c. (1), incl. sales tax (ex. Kingsberry Homes)		$10,500[1]			
	Transportation: 300 miles @ $2.25		675[1]			
	Total Cost for Home Delivered to the Site			$11,175	$11,175	$11,175
SITE ERECTION:	Including utility hook-ups, ext. and int. finishing					
ALTERNATIVE 1	Stilt Foundations			1,146[2]		
ALTERNATIVE 2	Perimeter Foundations				988[2]	988[2]
SITE WORK:	Landscaping, walks; misc. (fee, permits, etc.)			520[2]	520[2]	520[2]
INDIRECT COSTS:	Interim financing, points and closing costs			1,500[4]	1,750[4]	2,000[4]
TOTAL NET DEV. COST:				$15,675	$19,422	$19,672
BUILDER'S PROFIT:	15%[1] of Total Net Development Cost			$ 2,350	$ 2,910	$ 2,950
TOTAL TO CUSTOMER:				$18,025	$22,332	$22,622
EQUITY: ALTERNATIVE 1	Proposed optional grant in lieu of temp. hsg. assistance		$ 8,000[4]			
	Insurance Payment:					
	Median value of single-family home, 1970	$14,600[3]				
	Est. median value,1974:x 1.27(6% ann. incr.)	$18,540[3,4]				
	Est. median lot value (site acquis. above)	-2,880[2]				
	Est. median value of structure	$15,660				
	Hypothetical damage 60 percent	9,400[4]				
	Hypothetical principal on previous mtg.	-6,000[4]				
	Fed. flood ins. payment avail. for new home, assmg. prop. was insd. up to repl. value		$ 3,400			
	Total Equity available from above payments			$11,400		
ALTERNATIVE 2	a. Previous home owner: same as Alt. 1	$11,400				
	+ compensation for site in flood prone area	2,880			$14,280	
	b. Previous renter: proposed optional grant in lieu of temporary housing assistance			———	———	$ 8,000
MORTGAGE REQUIREMENT:				$ 6,625	$ 8,052	$14,622
ROUNDED TO NEXT $500				$ 7,000	8,500	15,000

1) For source of cost information see Section 3.c.(1), Documentation of Typical Systems.
2) For source of cost information see Section 3.c.(2), Cost Estimates for Site Preparations.
3) For source of cost information see Section 3.c.(3), Median Values (1970 Census of Population and Housing).
4) Hypothetical Assumption.

EXHIBIT 6

HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET FOR A FAST DELIVERY PERMANENT HOME

3. RELIEF SITUATION: SOUTHERN HURRICANES AND FLOODS
STATE SELECTED: LOUISIANA

		ALTERNATIVE 1 (existing site, permission to rebuild)	ALTERNATIVE 2a (new site, previous home owner)	ALTERNATIVE 2b (new site, previous renter)
HYPOTHETICAL MORTGAGE AMOUNT (EXHIBIT 5)		$7,000	$8,500	$15,000
1. ANNUAL DEBT SERVICE				
Estimated mortgage interest rate	8.25%			
FHA insurance premium	.25			
Constant (30 years)	9.23			
Annual Debt Service		$ 650	$ 780	$ 1,380
2. REAL ESTATE TAX				
Estimated assessed value at 100% valuation: $22,000				
Typical tax rate at 100% valuation: 10/1000				
Estimated Real Estate Tax		220	220	220
3. UTILITIES $75/ROOM/YEAR (5.5 ROOMS)		410	410	410
4. INSURANCE				
Alternative 1 Flood Insurance = (¢25/$100 for $22,000)		55		
Alternatives 1 and 2: Homeowner's Policy		120	120	120
5. TOTAL HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET		$1,455	$1,530	$ 2,130
6. TAX LOSSES, YEAR 1				
Interest		$ 580	$ 700	$ 1,240
Real Estate Tax		220	220	220
Total loss available as income tax deduction		$ 800	$ 920	$ 1,460
Estimated annual tax savings (assuming 20% tax bracket)		$ 160	$ 180	$ 300
7. ESTIMATED NET ANNUAL HOUSING COST (ITEM 5 MINUS ITEM 6)		$1,295	$1,350	$ 1,830
8. ESTIMATED NET ANNUAL HOUSING COST AS PERCENTAGE OF MEDIAN INCOME				
Median income, Louisiana 1970 = $7,500				
Estimated median income, Louisiana 1974: $7,500 x 1.27 (assuming 6% annual increase) = $9,500				
Percent of Estimated Median Income		13%	14%	19%

HYPOTHETICAL DEVELOPMENT BUDGET FOR A FAST DELIVERY PERMANENT HOME

EXHIBIT 7

4. RELIEF SITUATION: EASTERN TROPICAL STORM
STATE SELECTED: PENNSYLVANIA

			TOTAL COST		
			ALT. 1 Old Site w/Util.	ALT. 2a New Site Pr.Owner	ALT. 2b New Site Pr.Renter
TYPE OF HOME:	Mod./Sect., approx. 24'x44', 1,056 sq.ft., 3 BR, 1 bath.				
SPECIFICATIONS:	For typical examples, see Sect. 3.c. (1), Documentation of Typical Systems; ID # Company Name M 3a Boise-Cascade Mfrd. Housing, Kingsberry Homes M 11 Craftmark Homes M 24 Glen Manor Homes, (Post Coach, Inc.) M 38 Modulage/Albee P 40 Scholz Homes, Inland-Scholz M 60a Weil-McLain, Continental Homes				
FLOOD PROOFING AND FOUNDATIONS: ALTERNATIVE 1 (Permission to build on existing site of destroyed home)	Site Clearance: ¼ acre site[4]	$ 166[2]			
	Flood Proofing of Existing Site: New minimum level of lowest living floor: 1' above 100 year flood level; Assumption: 10' high stilt system with stairs[4]	1,522[2]			
	Total Cost for Flood Proofing, Alternative 1		$ 1,688		
ALTERNATIVE 2 (Construction on new site outside flood prone area)	Site Acquisition: ¼ acre lot	$ 3,644[2]			
	Perimeter Foundations (3' deep; excavation, footings, blocks, backfill)	1,708[2]			
	Total Cost for Flood Proofing & Foundations, Alt. 2			$ 5,352	$ 5,352
UTILITY CONNECTIONS: ALTERNATIVE 2	Water: connection to main in street	$ 465[2]			
	Sewage: connection to sewer in street	309[2]			
	Electricity	156[2]			
	Telephone	97[2]			
	Total Cost for Utility Connections		-	$ 1,027	$ 1,027
MANUFACTURED HOME:	Sales price FOB plant for compl. unit as specified in Sect. 3.c.(1), incl. sales tax (ex. Glen Manor Homes)	$12,900[1]			
	Transportation: 300 miles @ $2.50	750[1]			
	Total Cost for Home Delivered to the Site		$13,650	$13,650	$13,650
SITE ERECTION:	Including utility hook-ups, ext. and int. finishings				
ALTERNATIVE 1	Stilt Foundations		1,350[2]		
ALTERNATIVE 2	Perimeter Foundations			1,250[2]	1,250[2]
SITE WORK:	Landscaping, walks; misc. (fee, permits, etc.)		657[2]	657[2]	657[2]
INDIRECT COSTS:	Interim financing, points and closing costs		1,500[4]	1,750[4]	2,000[4]
TOTAL NET DEV. COST:			$18,845	$23,686	$23,936
BUILDER'S PROFIT:	15%[1] of Total Net Development Cost		$ 2,830	$ 3,550	$ 3,590
TOTAL TO CUSTOMER:			$21,675	$27,236	$27,526
EQUITY: ALTERNATIVE 1	Proposed optional grant in lieu of temp. hsg. assistance	$ 8,000[4]			
	Insurance Payment: Median value of single-family home, 1970 $13,600[3] Est. median value,1974:x1.27(6% ann. incr.) $17,150[3,4] Est. median lot value (site acquis. above) -3,640[2] Est. median value of structure $13,510 Hypothetical damage 60 percent 8,100[4] Hypothetical principal on previous mtg. -6,000[4]				
	Fed. flood ins. payment avail. for new home, assmg. prop. was insd. up to repl. value	$ 2,100			
	Total Equity available from above payments		$10,100		
ALTERNATIVE 2	a. Previous home owner: same as Alt. 1 $10,100 + compensation for site in flood prone area 3,640			$13,740	
	b. Previous renter: proposed optional grant in lieu of temporary housing assistance		___	___	$ 8,000
MORTGAGE REQUIREMENT:			$11,575	$13,496	$19,526
ROUNDED TO NEXT $500			$12,000	$13,500	$19,500

1) For source of cost information see Section 3.c.(1), Documentation of Typical Systems.
2) For source of cost information see Section 3.c.(2), Cost Estimates for Site Preparations.
3) For source of cost information see Section 3.c.(3), Median Values (1970 Census of Population and Housing).
4) Hypothetical Assumption.

EXHIBIT 8

HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET FOR A FAST DELIVERY PERMANENT HOME

4. RELIEF SITUATION: EASTERN TROPICAL STORM
STATE SELECTED: PENNSYLVANIA

		ALTERNATIVE 1 (existing site, permission to rebuild)	ALTERNATIVE 2a (new site, previous home owner)	ALTERNATIVE 2b (new site, previous renter)
HYPOTHETICAL MORTGAGE AMOUNT (EXHIBIT 7)		$12,000	$13,500	$19,500
1. ANNUAL DEBT SERVICE				
Estimated mortgage interest rate	8.25%			
FHA insurance premium	.25			
Constant (30 years)	9.23			
Annual Debt Service		$ 1,100	$ 1,250	$ 1,800
2. REAL ESTATE TAX				
Estimated assessed value at 100% valuation: $26,000				
Typical tax rate at 100% valuation: 40/1000				
Estimated Real Estate Tax		1,040	1,040	1,040
3. UTILITIES $100/ROOM/YEAR (5.5 ROOMS)		550	550	550
4. INSURANCE				
Alternative 1 Flood Insurance = (¢25/$100 for $26,000)		65		
Alternatives 1 and 2: Homeowner's Policy		120	120	120
5. TOTAL HYPOTHETICAL ANNUAL DEBT SERVICE AND OPERATING BUDGET		$ 2,875	$ 2,960	$ 3,510
6. TAX LOSSES, YEAR 1				
Interest		$ 990	$ 1,110	$ 1,610
Real Estate Tax		1,040	1,040	1,040
Total loss available as income tax deduction		$ 2,030	$ 2,150	$ 2,650
Estimated annual tax savings (assuming 20% tax bracket)		$ 400	$ 430	$ 530
7. ESTIMATED NET ANNUAL HOUSING COST (ITEM 5 MINUS ITEM 6)		$ 2,475	$ 2,530	$ 2,980
8. ESTIMATED NET ANNUAL HOUSING COST AS PERCENTAGE OF MEDIAN INCOME				
Median income, Pennsylvania 1970 = $9,600				
Estimated median income, Pennsylvania 1974: $9,600 x 1.27 (assuming 6% annual increase) = $12,200				
Percent of Estimated Median Income		20%	21%	24%

c. Documentation

(1) Systems Descriptions

(a) Two-Piece Modular/Sectional Homes

- Boise Cascade Mfrd. Housing, Western Operations
- Boise Cascade Mfrd. Housing, Kingsberry Homes
- Craftmark Homes
- Environmental Communities Industrialized Housing
- Glen Manor Homes
- Guerdon Industries
- Manufactured Homes
- Mod-U-Kraf Homes
- Modulage Homes
- NBC Modular Homes
- Scholz Homes
- Weil McLain, Continental Homes

Buy a better home for your money . . .

Quality Lumber Products

- Only the **BEST** lumber is selected for use in Boise Cascade Homes
- After sorting and grading, lumber is kiln-dried for strength and dimensional stability at Boise Cascade mills

Special Construction Techniques

- Full-length headers over all doors and windows
- Exterior sheathing over wall studs — nailed **AND** glued for extra strength
- Insulation in walls and ceilings (floor insulation in electrically heated homes)
- Interior walls are smooth, conventional, painted sheetrock
- Warp-resistant, weather-stripped doors and aluminum-framed windows
- From start to finish, each phase of construction is closely inspected to maintain highest quality control
- Construction is not affected by adverse weather conditions. House is completely framed in and weather tight before it goes outside for interior finishing

A Completely Finished Home

- All appliances and fixtures installed
- All carpeting, with foam pad, and linoleum installed
- Electrical wiring, gas outlets and plumbing fixtures all installed and ready for hook-up
- All interior and exterior painting and staining is done
- You select your own color scheme throughout

"Standard" Specifications

- All lumber kiln-dried
- ½" Plywood sub-floor, glued and nailed to joists
- Underlayment, 5/8" particleboard; throughout
- Plywood sub siding, glued and nailed to studs under lap siding
- Engineered roof trusses
- Wall insulation, R-11 (3" nominal) with vapor barrier
- Ceiling insulation, R-29 (10" nominal)
- Floor insulation, R-19 (6" nominal)
- Insulated metal exterior doors
- Sliding aluminum windows, dual glazed with screens
- 2 Freeze-proof exterior hose faucets
- Radiant ceiling panel heat
- Plastic and copper plumbing
- Fiberglas tub and shower combination (w/rod)
- Glass-lined, electric 52 gallon water heater
- Stainless steel kitchen sink
- Ceiling of light in kitchen
- Vent-a-matic attic fan
- Heat/light/fan in each bathroom
- Built in electric range, hood and fan
- Electrical receptacle for clothes dryer (non basement models)
- Plumbing rough-in for washer (non basement models)
- Adjustable linen shelving
- Wardrobe doors, Bi-Fold
- Vanity mirrors and medicine cabinets
- Carpet in living room, hall, bedrooms, dining and family rooms
- Resilient floor covering in kitchen, baths, storage and utility rooms
- Off-white interior paint, semi-gloss latex enamel
- Exterior latex paint or stain
- Textured drywall interior
- Door chimes
- One year warranty

"Standard" Options

- Forced air, gas heat
- Gas water heater
- Roof design for heavy snow load
- Outside weather-proof electrical receptacle
- Hand split shake roof
- Fireplace
- Refrigerator,* disposal, dishwasher, washer, dryer

Boise Cascade Homes

Boise Cascade reserves the right to change specifications and options, alter floor plans and exterior designs and adjust prices without notice.

*The F.O.B. prices below include the following optional items in addition to the standard specifications above:

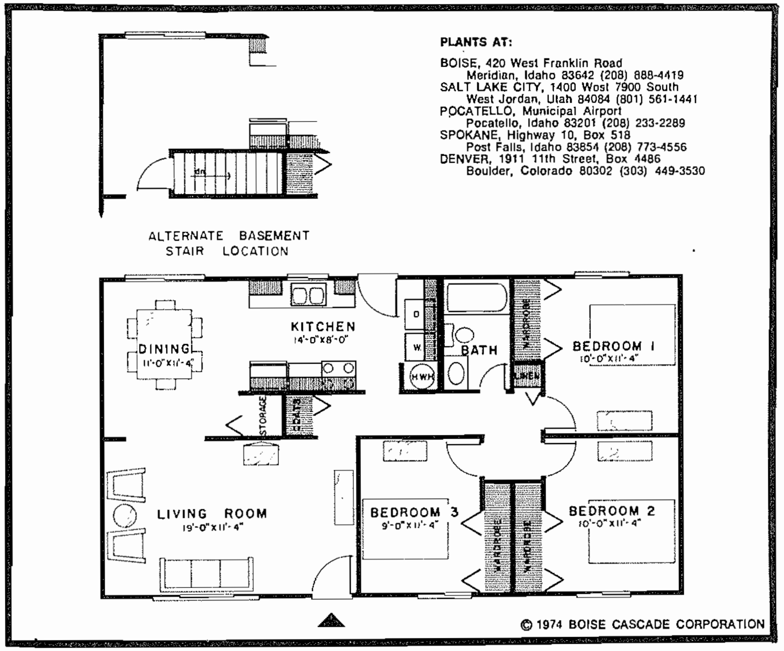
Refrigerator, 14 cubic feet (Prices supplied by manufacturer)	$200

Boise Cascade Homes

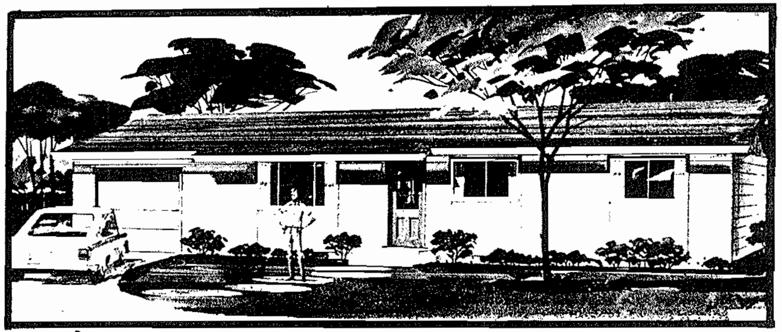
the Sunnydale

23'9"x44'

1045 SQ. FT.
3 BEDROOMS
1 BATH



PLANTS AT:
BOISE, 420 West Franklin Road
Meridian, Idaho 83642 (208) 888-4419
SALT LAKE CITY, 1400 West 7900 South
West Jordan, Utah 84084 (801) 561-1441
POCATELLO, Municipal Airport
Pocatello, Idaho 83201 (208) 233-2289
SPOKANE, Highway 10, Box 518
Post Falls, Idaho 83854 (208) 773-4556
DENVER, 1911 11th Street, Box 4486
Boulder, Colorado 80302 (303) 449-3530



DESIGN **A**

SYSTEMS DESCRIPTION 1

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 3
A. CURRENT PROD. RANGE	Single-family detached, semi-detached and townhouse; garden apts., comm./indust. units, schools, others -	Boise Cascade Manufactured Housing, Western Operations One Jefferson Square Boise, Idaho 83728 (208) 384-6460 Attn: John T. Daly
B. YRS. OF IND.BLDG EXP	9 years	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular/Sectional	
E. NUMBER OF PLANTS	6 (1. Boise, ID; 2. Denver, CO; 3. Pocatello, ID; 4. Post Falls, ID; 5. Salt Lake City, UT; 6. Spokane, WA)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA / **III. COST INFORMATION**

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A. $ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.	Oakdale/Brentwood (duplex)	1/1	23'9" x 34' 27'5" x 56'	807/1,535	12x34/14x56	1. 1	HI, AK, WA,	$11,045	$11,045
b. 2BR-TOWNHOUSE	Cascade	2	24'2" x 34'	1,643	12 x 34	2. 2	OR, NC, ID,	11,488	11,488
c. 3BR-DET.	Sunnydale	1	23'9" x 44'	1,045	12 x 44	3. 1	UT, NV, No.	12,970	12,970
d. 3BR-TOWNHOUSE						4. 2	AZ, MT, WY,		
e. 4BR-DET.	Stonybrook	1	27'5" x 44'	1,206	14 x 44	5. 2	CO, No.NM,	15,350	15,350
f. 4BR-TOWNHOUSE						6. 2	W.NE, W.KS		

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Truck - Rail	Company owned, leased commercial	300 miles±	Truck limit is 60 miles, rail shipment unlimited	Approx. $4/ mile (one way) by truck		300 miles @ $4.00	$1,200

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
a. EXTERIOR b. INTERIOR	Yes	ESTIMATED COST $ - ESTIMATED COST $ -		$ -

1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS

D. SITE ERECTION	SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
a. COMPANY			X				Skid beam system or crane for many units - spreader bars	1. FOUNDATIONS (PERIMETER)	$ NR
b. DEALER	X	X		X	X	X		2. ERECTION (EXT.& INT. FINISH INC.)	$ NR
c. SUBCONTRACTOR									
d. OTHER									
	3. CLOSE-IN	a. DAYS b. MAN-HRS.	2 24	4. FINISHING	a. DAYS b. MAN-HRS.	3 48			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	Typically one year on labor and material.	OF TOTAL DEVELOPMENT COST	10-12%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	Production takes about 20 working days. The backlog, however, will determine when a unit can be put into production. Currently this is 35-40 days. Backlog is generally shorter in winter and longer in summer.	Generally preliminary plan approval and paperwork consumes a great deal of time. If this could be worked out in advance with only final price left blank much time could be saved getting the program into operation at the time of the disaster. HUD could be kept aware of current price changes so they were always ready to go.	

SPECIFICATIONS:

1. *Framing*

   Floor Framing — 2" x 8" #2 SYP with 5/8" T&G underlayment grade plywood, glue-nailed to floor framing.

   Exterior Walls — 2" x 4" studs (16" o.c.) kiln-dried Western species or stud grade yellow pine. Sheathing, 5/16" shoathing grade plywood glued and nailed or Thermoply Stormbrace.

   Interior Partitions — 2" x 4" studs (16" o.c.) kiln-dried Western species or kiln-dried yellow pine, stud grade.

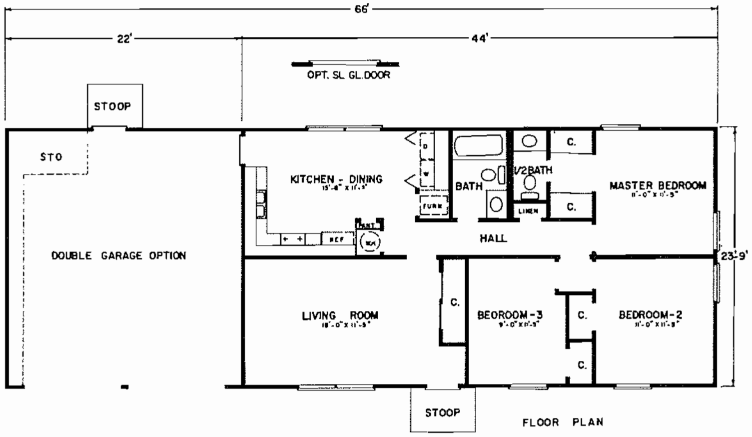
   Roof System — 2" x 6" precut rafters (24" o.c.) with a supporting knee-wall, 3/8" plywood sheething (to be installed by builder).

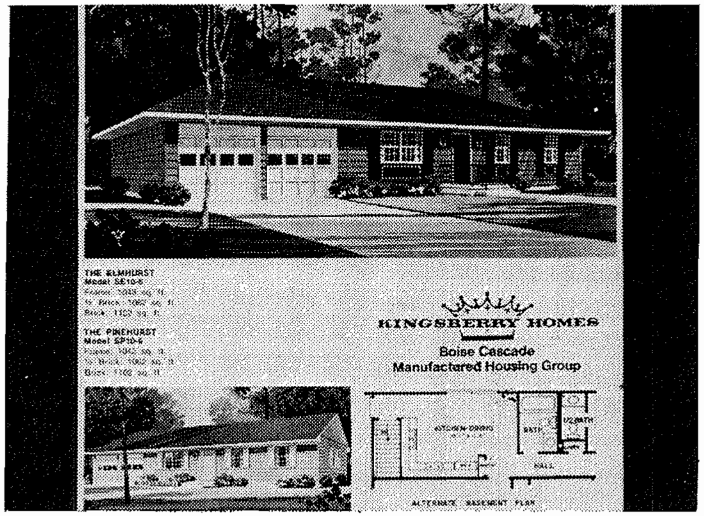
   Exterior Trim — includes facia, soffits, rake assemblies, window shutters, colonial window panels. Consult drawings and price lists for each particular model to find which trim items are included or are optional extra.
2. *Siding* — esch house is offered with full siding, part siding and part brick or full brick. Siding is factory applied where possible, brick is supplied by the builder.
3. *Exterior finish* — all exposed wood surfaces have one coat of latex paint over oil base primer. Paint for one edditional exterior coat is furnished.
4. *Roofing materials* — 15 pound felt, roofing nails and 235 pound Class C, self-sealing shingles furnished for builder application.
5. *Interior finish* — Ceiling finish is 1/2" gypsum wallboard. Sidewall finish is 1/2" gypsum wallboard or 1/4" plywood paneling (glue-nailed). Gypsum walls and ceilings are completely finished with two coats of off-white latex wall peint. Interior trim painted with semi-gloss enamel.
6. *Windows* — wood double hung (take-out sash) or aluminum single hung.
7. *Heating System* — forced air, 75,000 btu input, gas, with partially installed duct package or ductless, self contained.
8. *Flooring* — Congoleum cushioned vinyl throughout the house.
9. *Insulation* — sidewall 3" thick (R-11) installed. Ceiling insulation is 3" thick (R-13) installed.
10. *Interior doors* — flush pre-finished lauan hollow core or painted louvered doors.
11. *Exterior door* — 6 panel or flush hollow core per plan.
12. *Kitchen Cabinets* — factory pre-finished with backs and include post formed laminated plastic countertop, double bowl sink, strainers, faucet and spray.
13. *Range* — Electric combination oven/range.
14. *Range hood* — furnished with light end two-speed fan.
15. *Light Fixtures* — Decorator styled, fixtures factory installed.
16. *Plumbing* — Fiberglass reinforced bathtub with shower, china lavatories and siphon jet, china water closets. Copper or ABS drain, waste and vent and copper water supply. Cast iron underground pipe is furnished for builder installation. Water heaters are 40 gal. natural or L.P. gas, glass lined.
17. *Electrical* — Wiring factory installed from 200 amp circuit breaker panel to outlets and appliances.
18. *Optional items* — Single or double garage (panelized), garage door, crawl or basement floor system, 1/2" plywood roof sheathing, rake assemblies, storm sash, snap-in window muntins, screen door, Pease metal doors, electric heating and water heater, dishwisher, garbage disposer, marble top bath vanities, rain cover, and 100% continuous filament nylon carpet and pad conforming to FHA requirements in living room, or living room, hall end bedrooms.

The F.O.B. prices below include the following optional items in addition to the standard specifications above:

Vinyl wall covering in bath and kitchen	$350
Refrigerator, 14 cubic feet	$300

(Prices supplied by manufacturer)





SYSTEMS DESCRIPTION 2

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 3a
A. CURRENT PROD. RANGE	Single-family detached	Boise Cascade Manufactured Housing (Kingsberry Homes) 61 Perimeter Park Atlanta, Georgia 30341 (404) 458-9411 Attn: Michael Goss
B. YRS. OF IND.BLDG EXP	4 years	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular/Sectional	
E. NUMBER OF PLANTS	4 (1. Emporia, VA; 2. Fort Payne, AL; 3. Muncy, PA; 4. Sigourney, IA)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.							Tenn, Ky,		
b. 2BR-TOWNHOUSE							Ala, Ga, Fla		
c. 3BR-DET.	Cedarhurst (SC9-11)	1	23'9" x 40'	950	12 x 40	3-4 Day	So.Car., Va,	$10,094	$10,094
d. 3BR-DET.	Pinehurst (SP10-6)	1	24' x 44'	1,056	12 x 44		Ill., Ind.;	10,500	10,500
e. 4BR-DET.							expect No.		
f. 4BR-TOWNHOUSE							Car. soon		

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Tractors Trailers - special design	Tractors are leased but drivers are co. employees Trailers - co. owned.	300 miles	800 miles	$2.25		300 miles @ $2.25	$625

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR		ESTIMATED COST $ -	
b. INTERIOR	Yes	ESTIMATED COST $ -	$ -

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3BR. DETACHED)	
a. COMPANY							35-40 ton crane with 60 foot boom is usually sufficient. Handling equipment (spreader bars, cables, etc.) are provided by U.S.	1. FOUNDATIONS (PERIMETER)	$1,000*
b. DEALER	X	X	X	X	X	X		2. ERECTION (EXT.& INT. FINISH INC.)	$1,000*
c. SUBCONTRACTOR									
d. OTHER									
	3. CLOSE-IN	a. DAYS	1	4. FINISHING	a. DAYS	4-10			
		b. MAN-HRS.	40		b. MAN-HRS.	175			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	90 days parts and labor.	OF TOTAL DEVELOPMENT COST	5-8%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	Four to six weeks.		*Rough estimates.

CRAFTMARK HOMES INC.- GENERAL DESCRIPTION OF MATERIALS -LUXURY LINE

8/13/73
PAGE 10

FLOOR CONSTRUCTION

Sill Sealer
2 x 6 Mud Sill
Adjustable Jack Posts as required
2 x 8 Floor Joist
2 x 10 Double Box Sill
1 x 3 Wood Bridging
5 x 8" T & G Plywood Subfloor
Vinyl Finish on Bath and Kitchen
Carpeting in remaining living areas
2 x 10 Un-cut Stair Stringer w/Pre-cut Treads
2 x 4 Handrail and post material

EXTERIOR WALLS

2 x 4 Studs @ 16" O.C.
7'7" Ceiling Height
3/8" Plywood Sheathing
Andersen Narroline Perma Shield windows w/insulated glass and screens
1/2" Gypsum dry wall paint finish

INTERIOR WALLS

2 x 4 Studs @ 16" O.C.
2 x 3 Studs @ 16" O.C. Common Wall
1/2" Gypsum dry wall paint finish
Paneling accent on dining room wall

ROOF SYSTEM

2 x 4 Trusses @ 24" O.C. hinged 4/12
3/8" Plywood sheathing w/clips
Pre-finished Hardboard Soffit Material
Aluminum Drip Edge and Fascia Material
1/2" Gypsum dry wall - Sandfloat Finish - ceiling

EXTERIOR DOORS

Front Door - insulated steel - furnished by design with aluminum sill, threshold and weatherstripped
Secondary Doors - insulated steel - 1 lite with aluminum sill, threshold and weatherstripped
6/0 x 6/8 Aluminum insulated glass sliding doors where shown

INSULATION

Wall - 3½" (R-11) with vapor barrier
Ceiling - 6" (R-19) with vapor barrier
Floor - 3 5/8" (R-13) friction fit (shipped loose)

SIDING AND TRIM

Pre-finished 12" Hardboard Color-Side lap siding with accessories

INTERIOR DOORS AND TRIM

Pre-finished flush passage doors w/pre-finished jambs, stop casing, and baseboard
Pre-finished metal louvered closet doors
Pre-finished metal closet shelves and rods

BATH FIXTURES

Fiberglass tub enclosure
Moonglow vanity cabinet with simulated marble - top with integral bowl - single lever hardware
3 piece medicine cabinet
China water closet

KITCHEN FIXTURES

Scheirich Garden Court Cabinets w/roll formed top
Double Bowl Stainless Steel Sink and single lever faucet
30" Vented Range Hood
30" Electric Range
12.5 cu.ft. Refrigerator
24" Built-in Dishwasher (basic where shown)

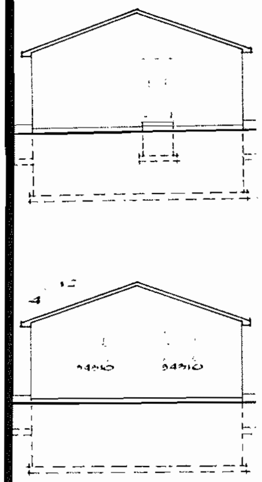
PLUMBING

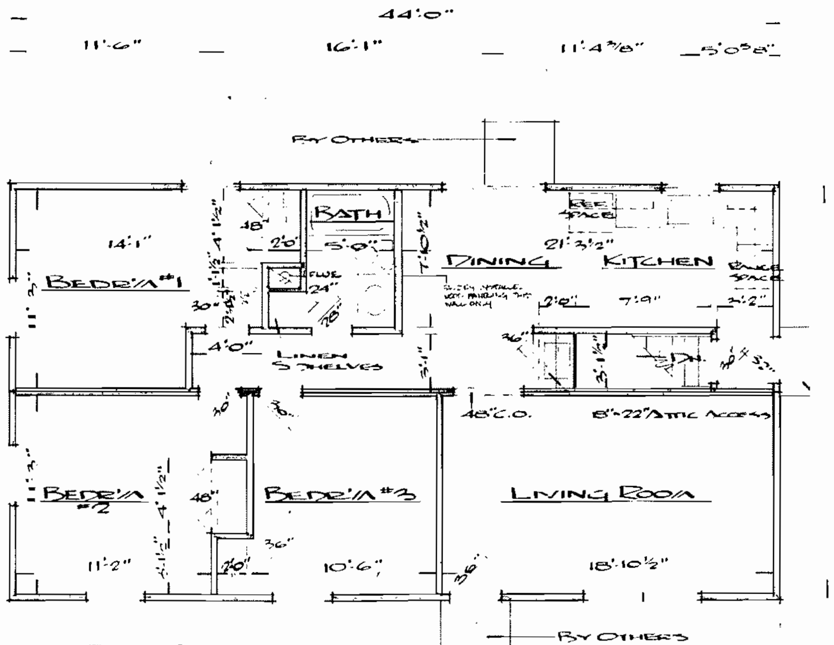
Copper supply lines
ABS Waste lines
52 Gallon Electric Water Heater

HEATING

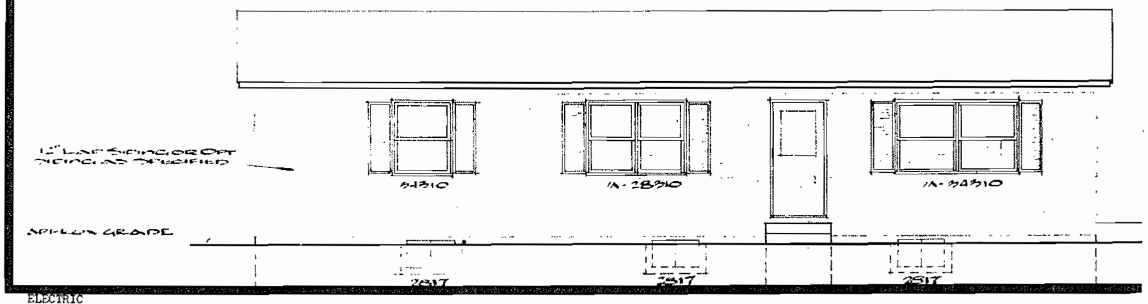
Electric baseboard w/individual room thermostats (main level only)

Craftmark homes inc.





MODEL NO R 2448



ELECTRIC

Electric 200 AMP service panel - all required convenience outlets and switches
Light fixtures for kitchen, dining area, hall, bath and each entry
Door chime for front door

MISCELLANEOUS ASSEMBLY PARTS

Nails and hardware as required for installation

INTERIOR WALLS

Simulated wood beams as per plans
Paneling accent on livingroom wall

INTERIOR DOORS AND TRIM

Finish assembled stairs w/trim and W.I. railings

LOWER LEVEL MATERIAL (WHERE SHOWN)

Loose studs and plates around stair area
Passage door to basement
Foyer platform
2 x 8 window buck material
Windows per elevation
Paneling finish for foyer area

SYSTEMS DESCRIPTION 3

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 11
A. CURRENT PROD. RANGE	Single-family detached; panelized	Craftmark Homes, Inc. 4595 Morgan Place Liverpool, New York 13088 (315) 457-8900 Attn: John Bauer
B. YRS. OF IND.BLDG EXP	4 years	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular Sectional; open panel	
E. NUMBER OF PLANTS	2 (1. Liverpool, NY; 2. Liverpool, NY)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA | **III. COST INFORMATION**

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.							All New		
b. 2BR-TOWNHOUSE						2 Houses-Mod.	England,	2440=$13,085	2440=$13,085
c. 3BR-DET.	R Series 2440, 2444	R = 1	24x40, 24x44	960, 1,056	12x40, 12x44	2 Houses-Pan.	N.Y., Pa.,	2444= 13,517	2444= 13,517
d. 3BR-TOWNHOUSE							N.J.		
e. 4BR-DET.									
f. 4BR-TOWNHOUSE									

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Trucks and Trailers	Company owned and leased	200 miles	250 miles	$3.50 per unit		300 miles @ $3.50	$1,050

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	Yes	ESTIMATED COST $ -	$ -
b. INTERIOR		ESTIMATED COST $ -	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS: SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
a. COMPANY			X				Modular - Crane or roll-on equipment Panelized - Manpower or crane	1. FOUNDATIONS (PERIMETER)	$ NR
b. DEALER	X	X	X	X	X	X		2. ERECTION (EXT.&INT. FINISH INC.)	$ NR
c. SUBCONTRACTOR									
d. OTHER									

3. CLOSE-IN		4. FINISHING	
a. DAYS	Mod. - 1 Pan. - 2	a. DAYS	Mod. - 2-3 Pan. - 17
b. MAN-HRS.	Mod. - 40 Pan. - 148	b. MAN-HRS.	Mod. - 80 Pan. - 352

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	No warranties	OF TOTAL DEVELOPMENT COST	15%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	4-9 weeks for modular, depending on system 6-12 weeks panelized, depends on dealer		

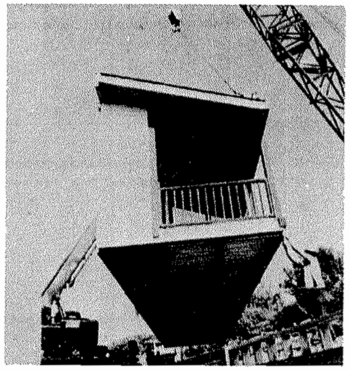
ECIH *PRESENTS*

A Modular Home For Every Use

Environmental Communities Industrialized Housing Inc. produces modular homes of various size and design on a production line in its Corona, California manufacturing complex.

These homes are 90% complete before they are delivered to the customer and all of these structures are VA and FHA approved. 95% financing is available through mortgage guarantee companies, for up to 30 years. The purchaser of an E.C.I.H. home has a choice of many elevations, floor plans, and finish materials, which gives them a custom built home.

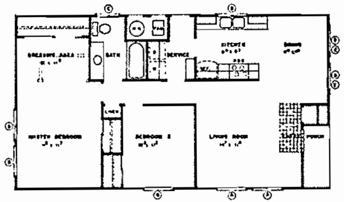
E.C.I.H. homes are now being marketed in 7 western states. They are sold by realtors in scattered lot progression. Developers are using them as models from which to sell entire subdivisions and of course they are used frequently for second homes in resort communities.



Parade of E.C.I. Mobile Homes

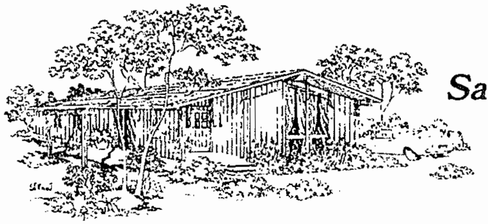
AND OF F.C.I. MODULAR/SECTIONAL HOMES

LEGEND
- Ⓐ 4060
- Ⓑ 4030
- Ⓒ 3020
- Ⓓ 30 CATHEDRAL
- Ⓔ 3016
- Ⓕ 6036
- Ⓖ 6068 SLIDER



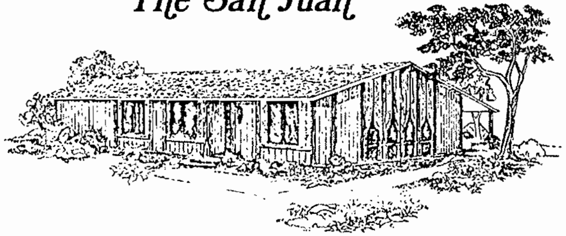
1000C 24 x 44

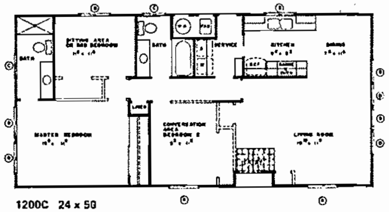
The "San Mateo" will be welcomed by those who have limited lot space and those who prefer a mobile/modular in the economy price range. This compact home has most of the features included in the larger E.C.I. Homes. A spacious dressing room off the master bedroom is standard in this model, or as an option you may have a second bath in this area. Handsome floor to ceiling cathedral windows and cedar shake roofs are standard, even in this lower price range.



The San Mateo

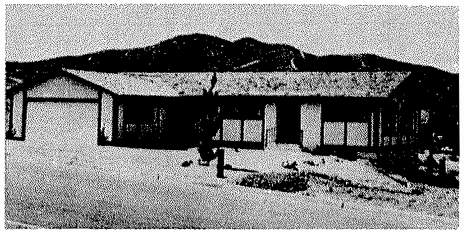
The San Juan

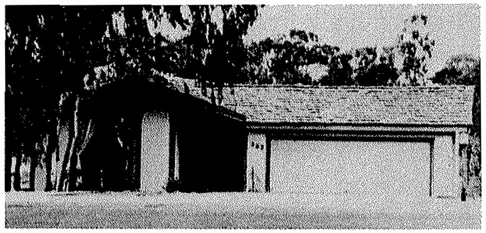


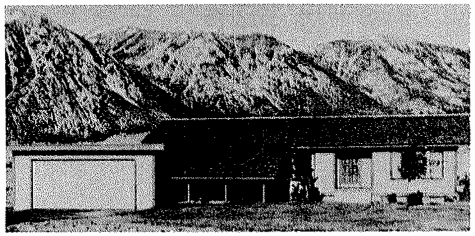


1200C 24 x 50

The San Juan is the mid-size house in the E.C.I. Family of fine homes. This model is large enough for a small family, but is also suitable for the couple who demand more living space than the average apartment. It is available with two or three bedrooms and two baths are standard. The San Juan, like all E.C.I. homes, was designed for carefree living with low maintenance.







SYSTEMS DESCRIPTION 4

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 20
A. CURRENT PROD. RANGE	Single-family detached, double-wide mobile homes, motels, commercial units.	Environmental Communities Industrialized Housing, Inc. 14296 E. Sixth Street P.O. Box 1700 Corona, Ca. 91720 (714) 734-1010 Attn: Charles Rea, II
B. YRS. OF IND.BLDG EXP.	3½	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular/Sectional (The modular/sectional line is directly developed out of the double-wide mobile home line with all changes necessary for code compliance).	
E. NUMBER OF PLANTS	1 (Corona, CA)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A. $ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.	San Mateo (Model 1000)	1	24 x 44	1,056	12 x 44		CA, TX,	$14,025*	
b. 2BR-DET.	San Juan (Model 1200)	1	24 x 50	1,200	12 x 50		UT, WA	15,580**	discount for
c. 3BR-DET.	San Mateo (Model 1000)	1	24 x 44	1,056	12 x 44	1 Unit		14,025	bulk order
d. 3BR-DET.	San Juan (Model 1200)	1	24 x 50	1,200	12 x 50			15,580	available
e. 4BR-DET.	Monterrey (Model 1400)	1	24 x 60	1,440	12 x 60			N.R.	
f. 4BR-TOWNHOUSE									

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Truck, Barge possible	Company leased and commercial carriers	200 miles	800 miles	$1.70		300 miles @ $1.70	$ 510

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
a. EXTERIOR	No	ESTIMATED COST $ 400		$ 400
b. INTERIOR	Yes	ESTIMATED COST $ -		

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV.	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
a. COMPANY	X	X	X	X	X	X	Roll-off equipment (crane normally not required)	1. FOUNDATIONS (PERIMETER)	$ NR
b. DEALER									
c. SUBCONTRACTOR	X	X	X	X	X	X		2. ERECTION (EXT.& INT. FINISH INC.)	$ NR
d. OTHER	The company plans to carry out all phases of the operation on its own.								
	3. CLOSE-IN a. DAYS		1	4. FINISHING a. DAYS		1			
	b. MAN-HRS.		24	b. MAN-HRS.		24			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	One year warranty on labor and material.	OF TOTAL DEVELOPMENT COST	10%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	15 to 30 days.	"We would suggest a system of distribution points each of which would stockpile say 5-6 units. These distribution points would be located in different areas of the country which are more prone to disasters, e.g. gulf coast, eastern seaboard, along the Mississippi River, etc."

FOOTNOTES

*	F.O.B.	$13,750
	Sales Tax	275
		$14,025
**	F.O.B.	$15,275
	Sales Tax	305
		$15,580

STANDARD SPECIFICATIONS FOR GRANDE AND SM SERIES HOMES

Stainless Steel, Double bowl sink
40 Gallon Electric Hot Water Heater
Electric Baseboard Heat
200 AMP Service Panel
3" sidewall; 6" ceiling; 3" Floor (Loose) Insulation
Linoleum roll goods, Kitchen and Bath(s), installed

Half Bath, All Models, except 912, 1296, and Grande 54 x 24
Storage room in 912
Two full Baths in 1296 and Grande 54 x 24
Wood Windows w/Storms and screens (No Grilles)
Vented Aluminum Soffit and Facia
Front and Rear Exterior Door Lights
Metal Insulated Exterior Doors
"L" Copper water lines; ABS Plastic Vents and Waste Lines
Delux Kitchen Cabinets
Latex Painted Walls, White
Texture Painted Ceilings, White
3/4" Plywood tongue and groove, Sub-Floor
3/8" Plywood Roof Sheathing
1/2" Celotex Sheathing w/1/2" Plywood Corner Bracing, Ends & Sidewalls
1/2" Drywall Sidewalls and Ceilings, glued and nailed to studs
2 x 8 Floor Joists, 16" on center.

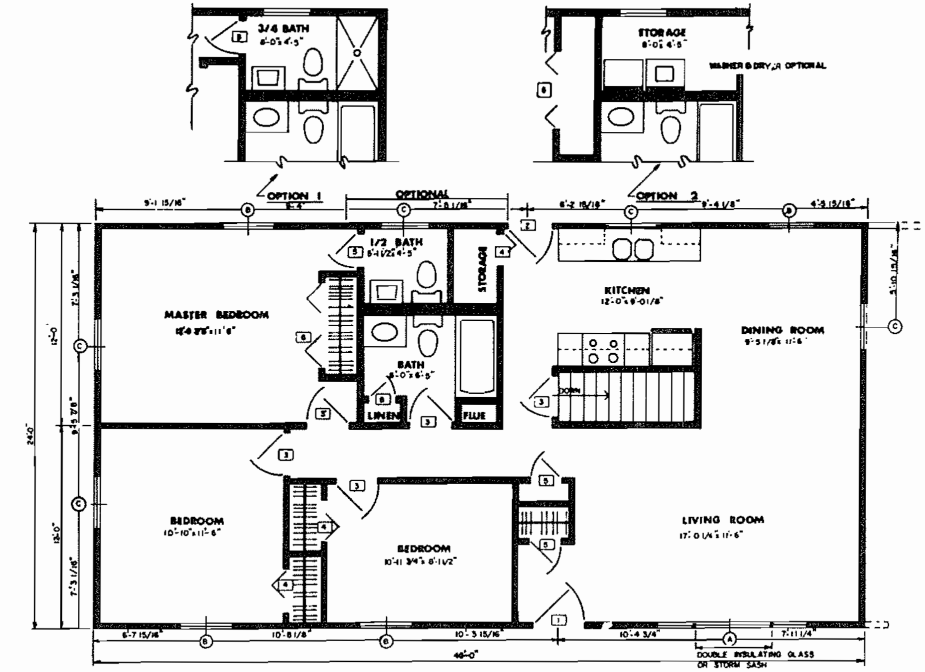
NOTE: Grande and SM Series Floorplans are the same. The difference in these two homes is the Roof Style.

GRANDE: 3/12 Fixed Roof built onto house in plant, with felt, shingles, soffit and facia installed. 2 x 4 Truss System, 16" o.c.

SM Series: (A, B, C, or D Design) 6/12 Roof Materials supplied. Assembled same as conventional Roof. Material Package includes Pre-Cut Rafters, Gables, Rakes, 4 x 8 Plywood Sheathing, Felt Paper, Soffit, and facia. NO SHINGLES SUPPLIED WITH THIS ROOF DUE TO WEIGHT.

**OPTIONAL HINGED ROOF: 4.5/12 Roof w/10" Overhang. Completed in plant, except for row of shingles and capping; soffit and facia to be installed at ends where two sections meet. Lift knee wall and brace on site.

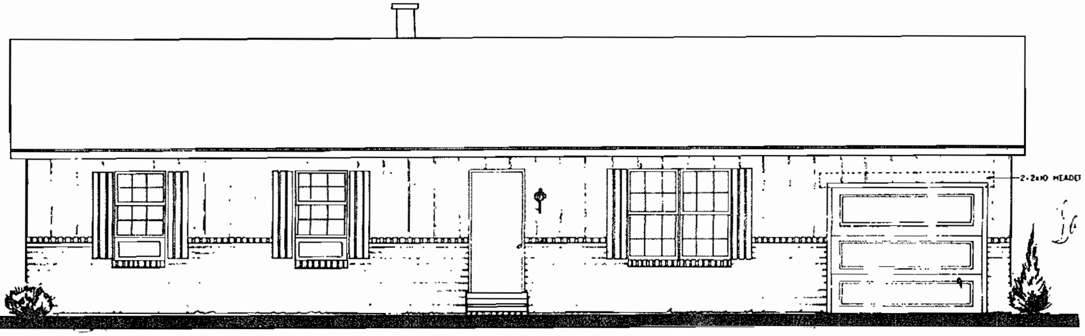
**Cost: In addition to Grande Pricing:
46x24: +$200; 50x24: +$225; 54x24: +$250



Glen Manor Homes MODEL #1104 GALLEY KITCHEN

The F.O.B. prices below include the following optional items in addition to the standard specifications above:

Floor covering	$500
Refrigerator, 14 cubic feet	200
Kitchen sink	200
(Prices supplied by manufacturer)	



SYSTEMS DESCRIPTION 5

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 24
A. CURRENT PROD. RANGE	Single-family detached, semi-detached, townhouses; garden apts.; commercial/industrial; medical clinics	Glen Manor Homes, Glenwood Housing Corp. (Post Coach, Inc.) Danville, Pa. 17821 (717) 437-2044 Attn: Robert E. Paterson
B. YRS. OF IND.BLDG EXP	5 years (under other names)	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular	
E. NUMBER OF PLANTS	3 (1. Glenwood Hsg. Co., Danville, PA; 2. Glenmanor Homes, Danville, PA; 3. Post Coach of South Carolina, Orangeburg, SC)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA | **III. COST INFORMATION**

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.						1. 2 Towhses.	VA, OH, MD,		
b. 2BR-TOWNHOUSE	2-T-846	2	18' x 23'6"	846	36' x 11'9"	2. 2 Sin.Fam.	NY, NJ, CT,	$11,049	$11,049
c. 3BR-DET.	1104	1	24' x 46'	1,104	12' x 46'	3. 1 Sin.Fam.	MA, RI, UT,	12,900	12,900
d. 3BR-TOWNHOUSE	3-T-1128	2	24' x 23'6"	1,128	24' x 11'9"		NH, ME	13,717	13,717
e. 4BR-DET.									
f. 4BR-TOWNHOUSE	4-T-1316	2	28' x 23'6"	1,316	28' x 11'9"			16,480	16,480

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Standard module transporters (trailers)	Company-owned and leased	150 miles	Truck - 300 miles Rail - any distance	$2.50		300 miles @ $2.50	$750

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	Yes	ESTIMATED COST $ -	$ -
b. INTERIOR		ESTIMATED COST $ -	
		Not recommended because of inherent dampness penetration and entrapment when packaged.	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
a. COMPANY							Crane or roll-off equipment.	1. FOUNDATIONS (PERIMETER)	$ NR
b. DEALER	X	X	X	X	X	X		2. ERECTION (EXT.& INT. FINISH INC.)	$ NR
c. SUBCONTRACTOR	X	X	X	X	X	X			
d. OTHER									
	3. CLOSE-IN	a. DAYS	1	4. FINISHING	a. DAYS	2			
		b. MAN-HRS.	32		b. MAN-HRS.	64			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	One year builder's warranty.	OF TOTAL DEVELOPMENT COST	12%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	6 weeks to 6 months depending upon availability of materials.	Government diversion of materials to expedite availability.	

Guerdon Industries

(No illustrations or specifications available.)

SYSTEMS DESCRIPTION 6

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM

A. CURRENT PROD. RANGE	Permanent: Single-family detached; Mobile Homes: single-wide, double-wide, fold-out.
B. YRS. OF IND.BLDG EXP	California plant has 2 years of experience in permanent home production.
C. MAIN STRUCT. SYSTEM	Wood
D. BASIC CONFIGURATION	Modular/Sectional
E. NUMBER OF PLANTS (MODULAR ONLY)	7 (1. Alexander City, AL; 2. Chambersburg, PA; 3. Madison, SD; 4. Patterson, CA; 5. Intra America Homes, Vicksburg, MS; 6. Lonergan Corp., Ocala, FL; 7. Magnolia Homes Mfrg. Corp., Vicksburg, MS)

THE MANUFACTURER M 26

Guerdon Industries, Inc.
P.O. Box 1259
Louisville, KY 40201
(502) 583-3931
Attn:*

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET.	40-I-2	1	24 x 40	960	12 x 40	1.,2.,3.,NR	Patterson Plant; entire West Coast
b. 2BR-DET.	48-I-2	1	24 x 48	1,052	12 x 48	4. 4 units	
c. 3BR-DET.	40-I-3 FMHA	1	24 x 40	960	12 x 40	5.,6.,7.,NR	
d. 3BR-DET.	40-I-3	1	24 x 48	1,052	12 x 48		
e. 3BR-DET.	48-I-3 FMHA	1	24 x 48	1,052	12 x 48		
f. 4BR-DET.	56-UM-4	1	24 x 56	1,344	12 x 56		

III. COST INFORMATION

A.$ PER UNIT F.O.B. PLANT

20 UNITS	50+ UNITS
$12,250	All prices include $305 for refrigerator and 5% sales tax on 40% of F.O.B. invoice
14,330	
11,690	
13,310	
13,750	
16,270	

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS
	Units are delivered on own wheels like mobile homes and hauled by mobile home toters; wheels are removed at site erection.	Company owned and common carrier	300 miles	entire west coast	$1.40	

B. $ PER UNIT PER AVERAGE SHIPMENT

300 miles @ $1.40	$420

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	Yes	ESTIMATED COST $ -
b. INTERIOR	Yes	ESTIMATED COST $ -

C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)

$ -

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED
a. COMPANY							
b. DEALER	X	X	X	X	X	X	None; cranes are needed at slope sites.
c. SUBCONTRACTOR	X	X	X	X	X	X	
d. OTHER							
	3. CLOSE-IN	a. DAYS	1	4. FINISHING	a. DAYS	2	
		b. MAN-HRS.	24		b. MAN-HRS.	48	

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)

1. FOUNDATIONS (PERIMETER)	$ NR
2. ERECTION (EXT.& INT. FINISH INC.)	$ NR

E. MAINTENANCE	
Warranty	1 year warranty.

E. BUILDER'S PROFIT

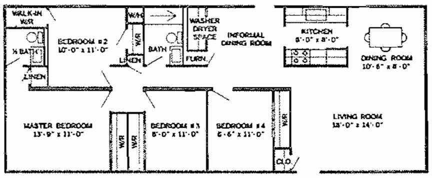
OF TOTAL DEVELOPMENT COST	NR

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	3-7 weeks	

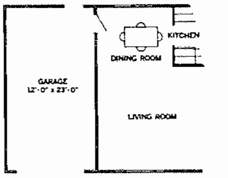
FOOTNOTES

*Information obtained from:
Guerdon Industries
P.O. Box 135
Patterson, CA 95363
(209) 892-6241
Mr. Larry Davis

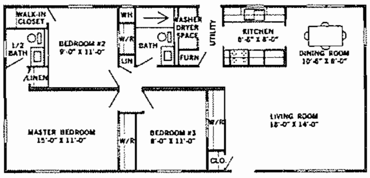
PREFERRED FLOOR PLANS



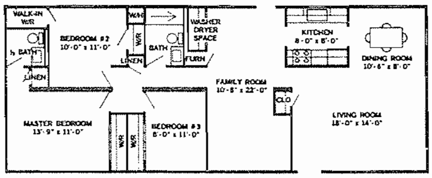
2456—4 BEDROOM, 1½ BATHS



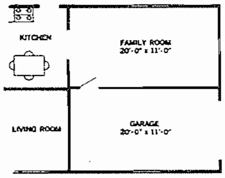
GARAGE OR FAMILY ROOM ADDITION
ADAPTABLE TO PLANS 2436, 2440,
2444 AND 2448



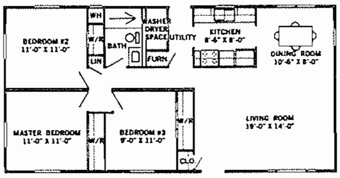
2448—3 BEDROOM, 1½ BATHS



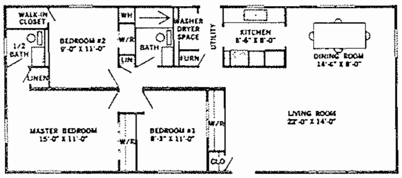
2456F—3 BEDROOM, FAMILY ROOM, 1½ BATHS



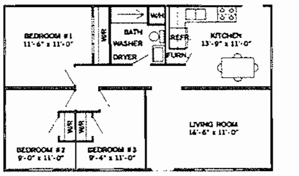
GARAGE/FAMILY ROOM ADDITION
ADAPTABLE TO PLANS 2436 AND 2440



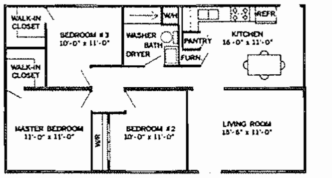
2444—3 BEDROOM, SINGLE BATH



2452—3 BEDROOM, 1½ BATHS

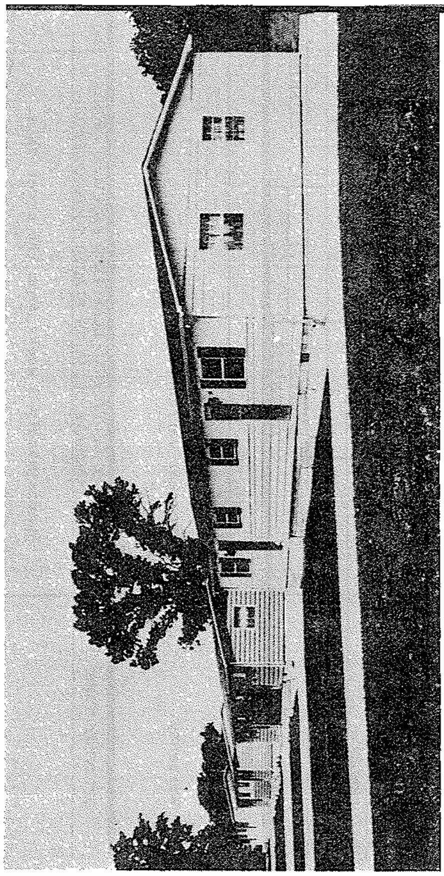


2436—3 BEDROOM, SINGLE BATH



2440—3 BEDROOM, SINGLE BATH

All Floor Plans Shown Also Available In Reverse Arrangement.



STANDARD SPECIFICATIONS

- 8" Aluminum Lap Siding (Custom Application)
- Gable Roof—Rated 40 lbs. sq. ft. Loading—(Code Vented)
- Asphalt Shingles, #240 (3 in 1 Strip, Seal Down)
- Wood Single Hung Windows, With Storms and Screens
- Muntin Design—All Windows
- Wood Door With Storm (Front and Rear)
- Shutters—Front Side
- Exterior Porch Lights (Front)
- Gutters and Downspouts
- 90" Ceiling Throughout
- Plank-Style Ceiling Board
- Cross-Bridged Basement Type Floor Rated 40 lbs. (live load)
- On-Site Construction Designed Frame
- Detachable Hitches
- 4" Side Walls With 1/4" Paneling
- Code Plumbing, Heating, Wiring
- 54" Tub With Shower
- 30 Gal. Gas or Electric Water Heater
- 12 cu. ft. Single Door Refrigerator
- Standard 30" Gas Range
- Range Hood With Light, With Sidewall Vent
- Customized Kitchen Cabinetry
- Tailored Curtains Throughout
- Sculptured Nylon Carpeting in Living Room
- Fully Insulated With Aluminum Board Complement
- Lined Wardrobes
- Code Approved B. T. U. Gas Furnace

Specifications and appointments subject to change without prior written notice

MANUFACTURED HOMES, INC.

3011 Phillips Street ELKHART, INDIANA 46514 Phone (219) 264-0661

SYSTEMS DESCRIPTION 7

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 35
A. CURRENT PROD. RANGE	Single-family detached, semi-detached, single-wide mobile homes, double-wide mobile homes.	Manufactured Homes, Inc. 926 E. Jackson Elkhart, IN 46514 (219) 294-5463 Attn: Robert Willard
B. YRS. OF IND.BLDG EXP	5	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular/Sectional	
E. NUMBER OF PLANTS	3 (all at Elkhart, IN)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA — **III. COST INFORMATION**

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.							IN, IL, MI,		
b. 2BR-TOWNHOUSE						Plant 1: 3	OH, KY, WV,		
c. 3BR-DET.	2444 CK-3	1	22'8" x 44'	997	11'4" x 44'	Plant 2: 6	WI (part)	$11,240	$11,045
d. 3BR-TOWNHOUSE						Plant 3: 3			
e. 4BR-DET.	2456-4-1½	1	22'8" x 56'	1,269	11'4" x 56'			12,895	12,645
f. 4BR-TOWNHOUSE									

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Truck - trailer	Commercial carrier, trailer toter	400 miles	1,000 miles	$2.00	All units include an almost finished out home.	300 miles @ $2.00	$600

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	Yes	ESTIMATED COST $ -	$ -
b. INTERIOR	Yes	ESTIMATED COST $ -	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
a. COMPANY							Cranes or telescopic pipe and roller system	1. FOUNDATIONS (PERIMETER)	$ NR
b. DEALER	X	X	X	X	X	X			
c. SUBCONTRACTOR	X	X	X	X	X	X		2. ERECTION (EXT.& INT. FINISH INC.)	$ NR
d. OTHER									
	3. CLOSE-IN	a. DAYS	1.5	4. FINISHING	a. DAYS	1.5			
		b. MAN-HRS.	30		b. MAN-HRS.	30			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	One year warranty.	OF TOTAL DEVELOPMENT COST	15%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	Approximately 3 weeks from the order date.		

MOD-U-KRAF HOMES, INC.
MODULAR SPECIFICATIONS
(DELUXE AND STANDARD LINES)

1. EXTERIOR WALLS: (1) Framing: Southern or Lodge Pole Pine (Company Option) stud size 2 x 4, spaced 16" o.c. (2) Sheathing: 3/8" x 4' x 8' Interior plywood with exterior glue conforming to U.S. Product Standards, or complying to American Society for Testing Materials, (Company Option). (3) Siding (if ordered): Cedar Shakes * or horizontal hardboard lap siding. Brick or other masonry not available as part of the unit.

2. FLOOR FRAMING AND SUBFLOOR: (1) Girders: Southern Pine, No. 2C, 2 layers of 3/8" plywood. 4 ea. 2 x 8, S4S, with joist hanger at girder. (2) Floor joist: 2 x 8, No. 2C, Southern Pine, S4S, 16" o.c.; Headers: 2 ea. 2 x 8, S4S. (3) Subflooring: 5/8" x 4' x 8' plywood conforming to U.S. Product Standards.

3. PARTITION FRAMING: (1) Studs: Southern or Lodge Pole Pine (Company Option) 2 x 4's, 16" o.c. (2) Sole: 2 x 4, S4S. (3) Plates doubled. (4) Lintels-(Headers with flitch plate for large openings. See plans.)

4. ROOF: (1) Sheathing: 1/2" x 4' x 8' Interior plywood with exterior glue conforming to U.S. Product Standards. (2) Shingles: Asphalt 235 lb., seal tab, size 12" x 36". (3) Underlayment: 2 layers of 15 lb. asphalt felt. (4) Roof Trusses: 24" o.c.

5. INTERIOR WALLS AND CEILING: (1) Gypsum Board (Drywall): 1/2" x 4' x 12' overhead, 1/2" sidewalls (Factory finished). (2) Paneling: Walls for kitchen-dining, hall and front center bedroom. (3) Wall finish: Paneling pre-finished; drywall, two to three coats of Latex base paint.

6. DOORS, WINDOWS AND MILLWORK: (1) Door Units: 2 1/4" casing, jambs and trim, B & Btr. Pine, doors flush Mahogany. (2) Windows: Double hung, Ponderosa Pine; Trim: B & Btr.; Glass: S. S. B. unless other types shown. (3) Screens: Aluminum wire and frame with windows. (Storm windows & doors with extruded aluminum frames available*). (4) Base: Western Pine. (5) Closet Shelves: 12" Particle Board with attached hanger.

7. ENTRANCE DOORS AND EXTERIOR MILLWORK: (1) Entrance doors: Mahogany or Douglas Fir, 1 3/4" thick. (2) Other outside doors: 1 3/4" thick. (3) Door frames: Rabbeted jambs 1 1/2" thick. (4) Weatherstripping: Aluminum type; 3 1/2" aluminum thresholds. (5) Screen doors: 1 1/8" thick, aluminum wire and guard. (6) Ventilation: Gables, 8 mesh galvanized wire behind, see plans. (7) Exterior Millwork: B & Btr. Pine or Western woods (Company Option).

8. CABINETS AND INTERIOR DETAIL: (1) Cabinets: Wood, factory built with Birch finish, wall shelf 12", base shelf 24". (2) Countertop: Laminated plastic top and edging; plastic backsplash. (3) Lavinette, main bath: Factory built and finished, laminated plastic top, with basin installed. (4) Dining Area: Accent wall, wainscot with decorative wall paper or fabric above. (5) Living Room: Large mural depicting International Style of home. (6) Other millwork as per detail.

9. STAIRWAYS: Basement stairway, where shown. Treads 1 1/8" Southern Pine; Handrail: Southern Pine; Carriage: 2 x 10's Southern Pine*.

10. BATH ACCESSORIES: (1) Ceramic - 6 per full bath. (2) Full Length mirror in main bath. (3) Tub enclosure for main bath.

11. PLUMBING: (1) Steel sink: Size 32" x 21" double compartment with single lever mixer, swing faucet, spray and strainers. (2) Lavatory: in white. (3) Water Closet: In white with seat. (4) Bath tub: Porcelain enameled steel in white with faucets, shower, trip lever waste and overflow. (5) Hot water heater: 52 gal., electric, quick recovery. Other fixtures and plumbing as shown. *Colored fixtures available.

12. HEATING: (1) Baseboard electric complying with National Electric Manufacturers Association (NEMA) and Underwriters Laboratories Incorporated (UL) complete with a full length thermal disconnect and calrod element as mfgd. by Electromode Division of The Singer Company or equal. Each room thermostatically controlled with a double pole thermostat. (2) *Forced air heat with prefab flue, thermostat, and baseboard diffusers.

13. ELECTRIC WIRING AND FIXTURES: (1) All switches (silent type) G. E. or equal, convenience outlets and light fixtures. (2) All rough wiring including the main panel. (3) Chimes: front and service door.

14. PAINTING AND DECORATING: (1) Exterior: Factory applied non-chalking latex base. (2) Interior: Factory finished work.

15. INSULATION: 6" in ceiling, 3 1/2" in exterior walls and 2 1/4" under floor; (If forced air heat: 3 1/2" in ceiling and 2 1/4" in exterior walls).

16. ROUGH HARDWARE: (1) Nails and staples of the proper size and specification for a complete job. Galvanized nails for all exterior exposed nailing. Galvanized staples and nails for roofing.

17. FINISH HARDWARE: (1) Locks: Exterior doors with exterior cylindrical locksets. Inside doors with interior cylindrical locksets and latchsets. (2) Other: All finish hardware for a complete job; Polished Brass Finish.

18. FLOORING: 25/32", prefinished oak flooring or 1/2" Parquet flooring (Company Option) or carpet with pad. Kitchen-Dining and bath (s) See Tile.

19. TILE: (1) Kitchen Floor: Sheet vinyl as manufactured by the Armstrong Company or equal. (2) Bath Floor: Ceramic. (3) Bath Walls: 4 1/4" x 4 1/4" Ceramic tile permanently glazed surface.

20. MEDICINE CABINETS: Large, picture frame mirror door with deluxe hang down light fixture.

21. These specifications are intended to include labor in manufacturing of the house and materials for the house above the foundation sill plate. Purchaser to provide two men to assist in the erection of the house onto the foundation. Labor and materials for the foundation, termite shield, sill plate, stairway erection, masonry materials, hook-up of electrical, plumbing and furnace, if any, (oil tank or gas piping) or labor for field completion and items related thereto are not included.

22. Split Foyers include only the windows and shutters for the front on the lower level.

23. Specifications subject to change without notice.

* Extra Charge

NOTE: The Standard Line includes the items as listed above for the Deluxe Line except:

1. Sheet vinyl for dining, hall, bath, and rear corner bedroom (entire rear half of home).
2. Cabinets with flush style doors (fewer cabinets than Deluxe, complies with Minimum Property Standards).
3. Paneling in lieu of decorative accent wall in dining area.
4. Ceramic tile at tub area only.
5. Wall hung lavatory in lieu of bath lavinette.
6. No full length mirror in bath.
7. Curtain rod for main bath in lieu of tub enclosure.
8. Bath fan in lieu of bath window (Main bath).
9. Paneling for all rooms included except bath in lieu of paneling and gypsum board.
10. Painted or stained trim (Company Option).
11. Limited Selection of light fixtures.
12. No spray at kitchen sink.
13. No door chimes.
14. Mural in living room eliminated.

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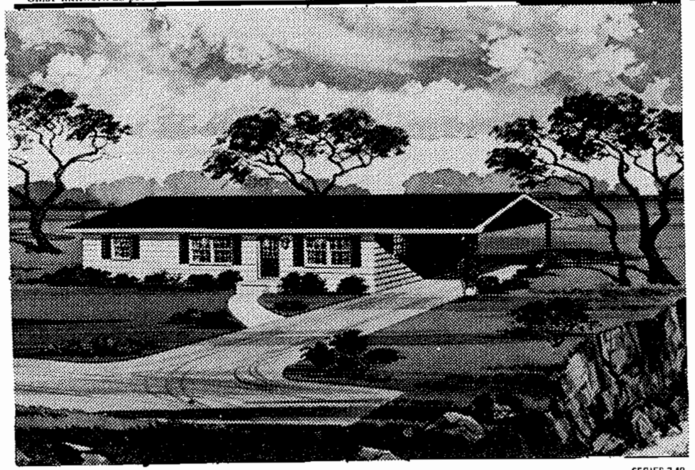
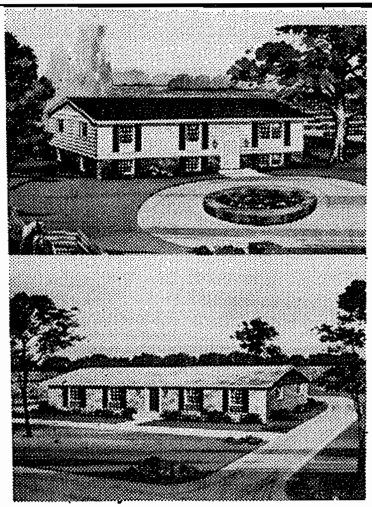


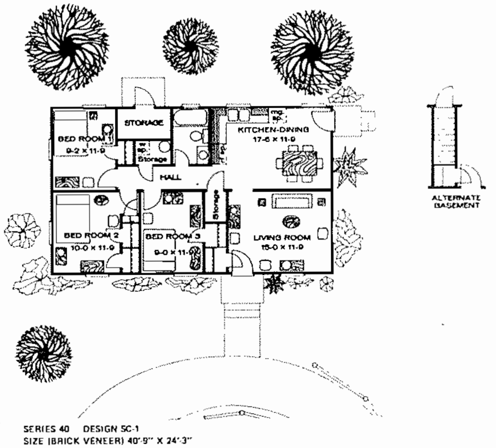
SERIES 240

Baltic Bungalo

THE
INTERNATIONAL
COLLECTION

MOD-U-KRAF HOMES INC.
Rocky Mount, Virginia 24151, Phone (703) 483-0291





SERIES 40 DESIGN SC-1
SIZE (BRICK VENEER) 40'-9" X 24'-3"
LIVABLE AREA WITH BRICK VENEER 988 SQ. FT.

MOD-U-KRAF HOMES INC.
Rocky Mount, Virginia 24151, Phone (703) 483-0291

These artist illustrations and inkings are for sales use only.
For actual dimensions, refer to working drawings
Furniture and furnishings not included

SYSTEMS DESCRIPTION 8

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM

A.	CURRENT PROD. RANGE	Single-family detached, semi-detached and townhouse; commercial/industrial and schools
B.	YRS. OF IND.BLDG EXP.	3 years
C.	MAIN STRUCT. SYSTEM	Wood
D.	BASIC CONFIGURATION	Modular, modular/sectional
E.	NUMBER OF PLANTS	2 (1. Rocky Mount, Va.; 2. Pulaski, Va.)

THE MANUFACTURER M37

Mod-U-Kraf Homes, Inc.
P.O. Box 573
Rocky Mount, Va. 24151
(703) 483-0291
Attn: E.T. Lawson

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA (INS. WALLS)	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET./SEMI-DET.						1. 1.5	All south-
b. 2BR-TOWNHOUSE	The Winchester	2	24' x 42'	1,008	12' x 42'	2. 4	eastern
c. 3BR-DET./SEMI-DET.	Series 40, Design SC-1	1	24'3"x 40'9"	998	12' x 40'9"		states
d. 3BR-TOWNHOUSE							
e. 4BR-DET./SEMI-DET.	Series 44, Design VC-1	1	24'3"x 44'9"	1,085	12' x 44'9"		
f. 4BR-TOWNHOUSE							

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS
	Solid three axle trailer	Company owned	100 - 200 miles	1,000 miles	Included in F.O.B. cost	

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	Yes	ESTIMATED COST $ -
b. INTERIOR	Yes	ESTIMATED COST $ -

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH
a. COMPANY			X			
b. DEALER	X	X		X	X	X
c. SUBCONTRACTOR						
d. OTHER						

3. CLOSE-IN a. DAYS 1 b. MAN-HRS. 20

4. FINISHING a. DAYS 2 b. MAN-HRS. 32

2. SPECIAL EQUIPMENT REQUIRED
Company owned roll-off equipment; use of crane on rough terrain only

E. MAINTENANCE	
Warranty	One year warranty

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	One month	"There isn't any system any more efficient than our single-family homes. (A quality modular home - better materials than conventional construction). Foundations could be erected in advance. Cranes could be used for expeditious erection."

III. COST INFORMATION

A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
$10,500*	discount
$11,000*	available

B.$ PER UNIT PER AVERAGE SHIPMENT	
	-*

C.$ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
	$-

D.$ PER UNIT FOR SITE ERECTION	(3 BR, DETACHED)
1.FOUNDATIONS (PERIMETER)	$ NR
2.ERECTION	$ NR

E. BUILDER'S PROFIT	
OF TOTAL DEVELOPMENT COST	NR

FOOTNOTES

*Includes transportation and erection costs.

Specifications

JUST A FEW OF THE UNMATCHED QUALITIES INCORPORATED IN YOUR MODULAGE HOME

Quality plumbing and wiring (UL approved) throughout, meets or surpasses strictest building codes.

Triple hinged exterior and interior doors, steel-clad insulated front door.

Special "screw-nails", gluing and bolting used throughout for added strength and sound conditioning.

Prefinished trim and mouldings throughout.

Wall to wall cushioned carpeting, vinyl floor covering in kitchen and bath.

Built-in decorator kitchen appliances, quality crafted cabinets, custom Formica counter tops, double stainless steel sink.

Easy to clean ceramic tile baths, custom Formica vanities.

The latest architectural designs, just off the drawing boards.

Only first quality, dried lumber used throughout with ribbon boards for added strength.

Full 1/2" drywall on ceilings and walls, glued and nailed on ribbon boards.

Double wall center construction for added strength, insulation and soundproofing.

First quality wood and metal windows with matching trim.

Sub floor joints glued, nailed, filled and sanded.

Fully insulated walls, ceilings and roof for lower heat bills.

Special steel strapping on floors and roof for added rigidity.

Double 2"x10" perimeter boxing, glued and nailed for super-strong construction.

Complete home wrapped in durable plywood for added strength and insulation.

MAIN OFFICE:

Rt. 422 Across from the Eastwood Mall
Phone 652-1733

LAKEWODD:

Morningside Rd. off North Rd.
Phone 652-0644

NORTH PARK ESTATES:

On 5th Ave Extension off Churchill Rd.
Phone 759-1274

FERNWAY HEIGHTS:

Niles–Corver Road in Weathersfield Township

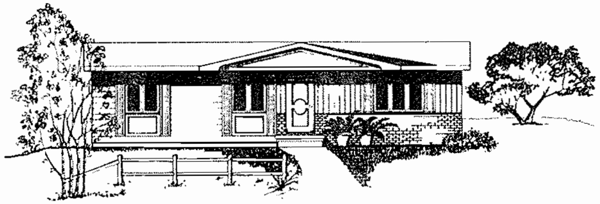
WAVERLY KNOLLS:

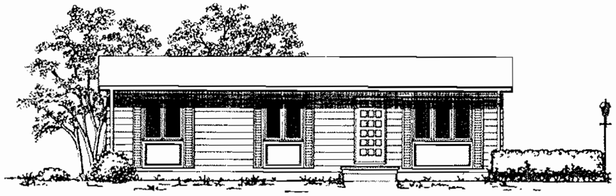
Marshall and Bond Streets off Mahoning Avenue in Champion Township.

OR YOUR OWN LOT ANYWHERE IN THIS AREA, CITY OR COUNTRY

you're living in the MODULAGE

Ranch Homes

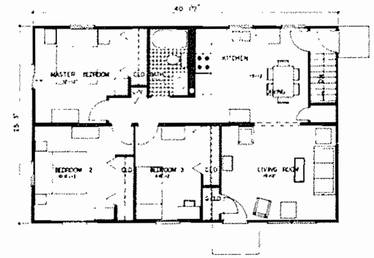




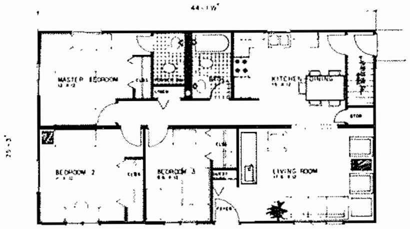
Spacious Well Planned design . . . yet compact enough for economy. Modulage ranch plans are fully carpeted throughout and feature Decorator kitchens with built in oven and range tiled baths, formica counters and vanities, Hot Water Heat and many other fine features for comfortable family living.

* garages and porches optional

Elevation styles are interchangeable on all ranches. Gables, porches and other decorations are optional.



you're living in the MODULAGE



SYSTEMS DESCRIPTION 9

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 38
A. CURRENT PROD. RANGE	Single-family detached, townhouse, garden apartments, commercial and industrial units	Modulage Homes
B. YRS. OF IND.BLDG EXP.	6 years	Modulage/Albee
C. MAIN STRUCT. SYSTEM	Wood	931 Summit Street
D. BASIC CONFIGURATION	Modular Sectional	Niles, Ohio 44446
E. NUMBER OF PLANTS	1 (Niles, OH)	(317) 447-3131
		Attn: Mr. James Wilson

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A. $ PER UNIT F.O.B.* PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.							N.J., N.Y.,		
b. 2BR-TOWNHOUSE	1340	2	12'6" x 40'	1,000	12'6" x 40'		Va., Mo.,	$ 6,296	$ 6,296
c. 3BR-DET.	2444	1	24' x 44'	1,056	12' x 44'	2 units	Ohio, Pa.,	12,046	12,046
d. 3BR-TOWNHOUSE	4426 Royal Mall (2 units)	2	25'3" x 44'	1,115	12'6" x 44'		W.Va., Mich.	12,666	12,666
e. 4BR-DET.	4826	1	25'3" x 48'	1,212	12'6" x 48'		Md.	13,803	13,803
f. 4BR-TOWNHOUSE	5624 (2 units)	2	23'9" x 56'	1,330	11'10" x 56'			15,133	15,133

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Tractors and Trailers	Company	300 miles	Depends on size of contract. Now 600 miles for USAF	$3.00 per unit		300 miles @ $3.00	$900

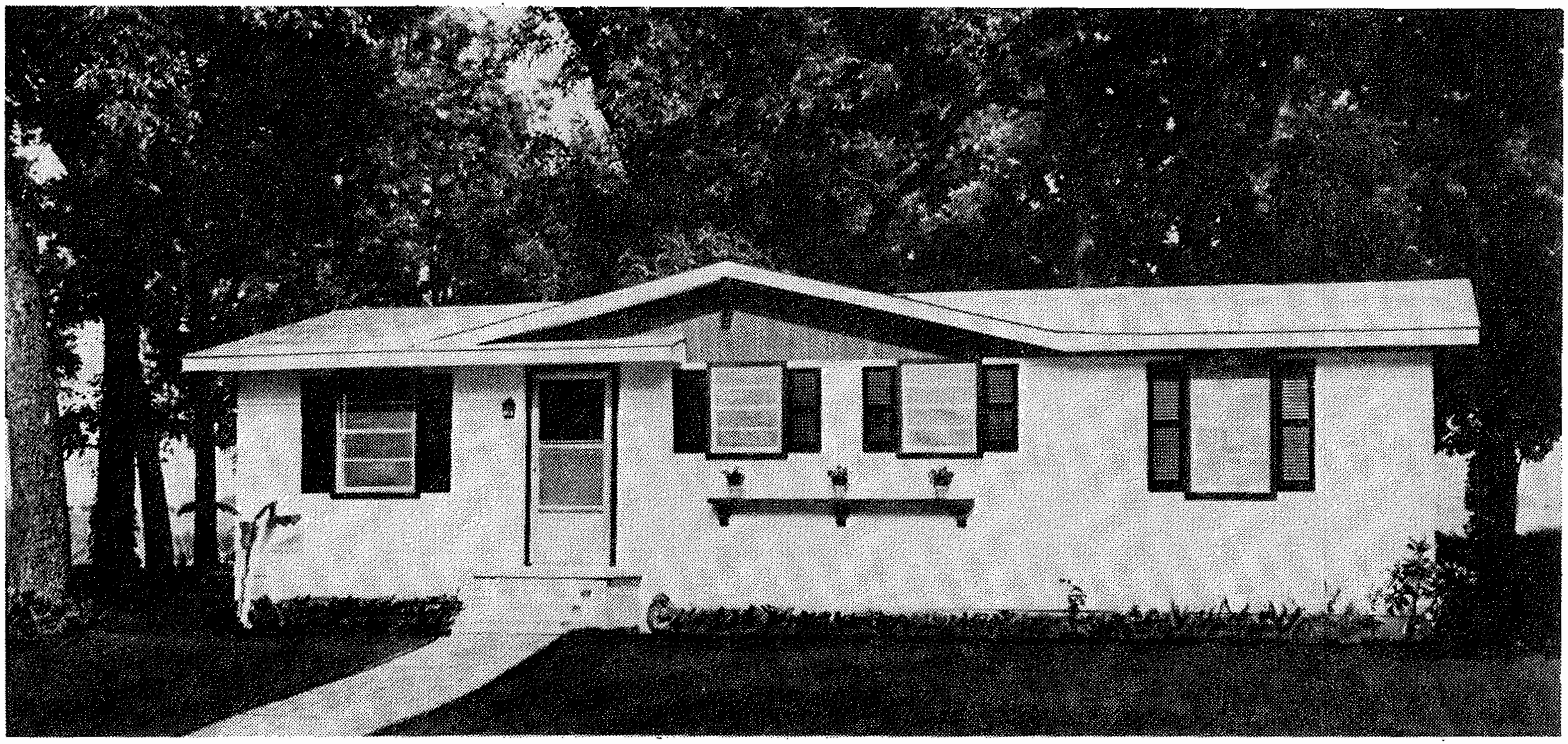
C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	Yes	ESTIMATED COST $ -	$ -
b. INTERIOR		ESTIMATED COST $ -	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV.	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED
a. COMPANY			X				
b. DEALER	X	X		X	X	X	45 ton crane (hydraulic) with spreader beam
c. SUBCONTRACTOR			X				
d. OTHER							
	3. CLOSE-IN	a. DAYS	5-7	4. FINISHING	a. DAYS	14	
		b. MAN-HRS.	180-200		b. MAN-HRS.	-	

D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ NR
2. ERECTION (EXT.&INT. FINISH INC.)	$ NR

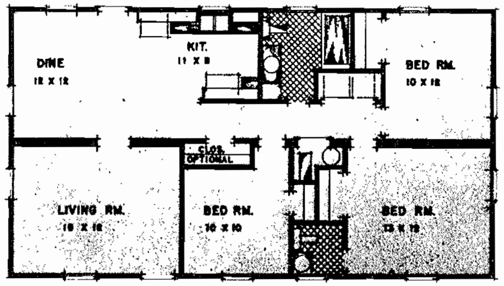
E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	Standard one year on all materials.	OF TOTAL DEVELOPMENT COST	15%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	90 days.		*4% sales tax on 60% net F.O.B. included in these prices.



Greenwich

PLAN 3-4424 - This larger three-bedroom, 1-1/2 bath has good size bedrooms and a large family room for every day living. Carport or garage optional.



3-4424
Frame Area = 1056 sq. ft.
Brick Area = 1114 sq. ft.

NATIONAL BUILDING CENTERS, INCORPORATED
NBC MODULAR HOME DIVISION

SYSTEMS DESCRIPTION 10

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM

A. CURRENT PROD. RANGE	Single-family detached, garden apartments
B. YRS. OF IND.BLDG EXP	2½ years
C. MAIN STRUCT. SYSTEM	Wood
D. BASIC CONFIGURATION	Modular/Sectional
E. NUMBER OF PLANTS	5 (1. Bishop, TX; 2. Temple, TX; 3. Clebourne, TX; 4. Waukomis, OK; 5. Lake Placid, FL)

THE MANUFACTURER M 40

NBC Modular Homes
P.O. Box 1069
Waco, TX 76703
(817) 772-3010
Attn: Mr. Cates

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET.	2-3024 (1 bath)	1	24 x 30	720	12 x 30	1. ½	TX, OK,
b. 2BR-DET.	2-3624 (1 bath)	1	24 x 36	864	12 x 36	2. ½	LA, FL
c. 3BR-DET.	3-4024 (1 bath)	1	24 x 40	960	12 x 40	3. ½	
d. 3BR-DET.	3-4424 (1½ bath)	1	24 x 44	1,056	12 x 44	4. ½	
e. 4BR-DET.	3-4824 (2 baths)	1	24 x 48	1,152	12 x 48	5. ½	
f. 4BR-DET.	4-5024 (2 baths)	1	24 x 50	1,200	12 x 50	6. ½	

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS
	Truck	Company owned	150 miles	300 miles	$2.50	

C. STORABILITY

	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	Yes	ESTIMATED COST $ -
b. INTERIOR	Yes	ESTIMATED COST $ -

D. SITE ERECTION

1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS

	SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH
a. COMPANY			X	X	X	X
b. DEALER	X	X		X		
c. SUBCONTRACTOR						
d. OTHER						

3. CLOSE-IN a. DAYS 2
b. MAN-HRS. 80

4. FINISHING a. DAYS 1
b. MAN-HRS. 40

2. SPECIAL EQUIPMENT REQUIRED

Roll-off system
(Binkley)

E. MAINTENANCE

Warranty 1 Year.

F. DELIVERY TIME

1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION

2. MISCELLANEOUS SUGGESTIONS

III. COST INFORMATION

A. $ PER UNIT F.O.B. PLANT

20 UNITS	50+ UNITS
$ 8,995	
10,300	5% discount
11,570	for bulk
12,610	order
14,175	
14,640	

B. $ PER UNIT PER AVERAGE SHIPMENT

300 miles @ $2.50 — $750

C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)

$ -

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)

1. FOUNDATIONS (PERIMETER) $1,000
2. ERECTION (EXT.& INT. FINISH INC.) $ 500

E. BUILDER'S PROFIT

OF TOTAL DEVELOPMENT COST 10-12%

FOOTNOTES

Specifications

CEILING AND ROOF SYSTEM: Trusses 24" O.C. • ½" CDX plywood glued then nailed to sheathing • 4:12 pitch roof • Shingles are 36" strips, 235 pound self-sealing asphalt with 15 pound felt paper • Shingles are 85% plant applied • 6" rakes and 12" overhang are an integral part of the roof.

DOORS: Metal clad thermal exterior doors. 1¾" polyurethane core, primed interior coat, with all hardware and molding installed • Sliding doors are aluminum framed mill finished with ⅝" tempered insulated glass, weather stripping, complete with sliding screen and lock-set • Interior doors are 1⅜" hardboard with vinylwood finish.

INSULATION: Wall insulation is 3½" blanket type glass fiber with vapor barriers on warm side (R-11 rating) • Ceiling is 6" of insulation with vapor barrier on warm side (R-19 rating).

WINDOWS: All units are single glazed, pre-finished with screens included.

INTERIOR WALLS AND CEILINGS: ½" gypsum board applied on all walls and ceilings • Factory finished with off-white latex paint.

FLOORING: Floors are filled and sanded ready to receive optional floor tile or carpeting by builder.

KITCHENS: Built-in kitchen cabinets with ⅝" flush self-closing doors • Laminated plastic counter tops – double bowled self-rimming stainless steel sink • Ducted range hood with light and fan • Sliding soffit doors afford storage above cabinets.

BATHROOMS: Recessed medicine cabinet with swinging door • Wall mirror over lavatory counter top • Porcelain steel tub with shower head and ceramic tile surround • Paper holder, soap dish, towel bars included • Water closet is white vitreous china • Ceiling mounted exhaust fan.

FLOOR SYSTEM: Constructed of 10", 10 gauge galvanized steel channel perimeter beams and 6", 19 gauge galvanized steel floor joists • 16" O.C. spot welded • Subfloor of ⅝" plywood.

INTERIOR PARTITIONS: Load bearing wall 2"x4" frame, 16" O.C. doubled where required • All major openings are reinforced with ½" plywood.

EXTERIOR WALLS: ½" asphalt fiberboard sheathing • 2"x4" top and bottom plate, 2"x4" studs, 16" O.C. (kiln dried) • Walls are fastened to floors and into steel rim beams with self-tapping screws.

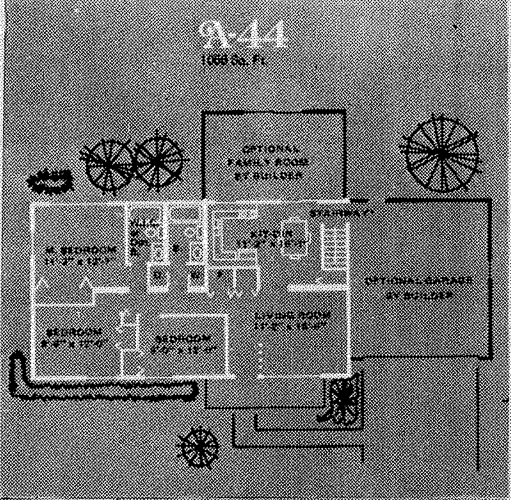
HEATING: Forced warm air system, gas-fired counterflow • Galvanized steel ductwork, registers, grills, thermostat.

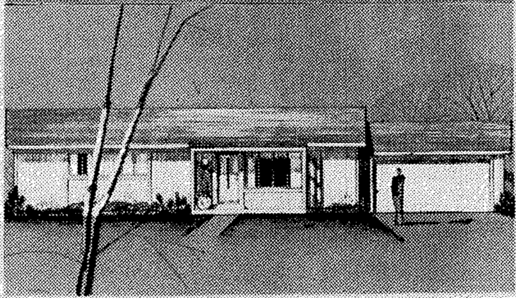
PLUMBING: Drain, waste and vent lines are PVC piping, schedule 40 with approved fittings • Water heater is automatic electric, glass lined 40 gal. capacity • Washer and dryer hook-up available on 1st floor.

ELECTRICAL: Fully pre-wired including switches, wall plates, fixtures, panels and breakers in a 200 amp. service panel—all U.L. approved • Kitchens are wired for electric range.

INLAND-SCHOLZ HOUSING SYSTEMS
800 County Street
Milan, Michigan 48160

DESIGN 401 exceeds the requirements of
FHA Structural Engineering Bulletin 737.
BOCA RR #73-46





DESIGN 401 MODEL A-44

The F.O.B. price includes the following additional items:

Range/oven	$ 140
Range hood	45
Refrigerator, 14 cubic feet, cycle defrosting	215
Carpeting in living room and bedrooms	385
Vinyl wall covering in bath and kitchen	90
Sheet vinyl floor covering in bath	12
Carpeting in kitchen	86
Horizontal siding	495

DESIGN 401

221-513

SYSTEMS DESCRIPTION 11

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER P 40
A. CURRENT PROD. RANGE	Single-family detached, semi-detached and townhouse; garden apartments.	Scholz Homes* Inland Scholz Housing Systems 800 County Street Milan, Michigan 48160 (313) 439-1511 Attn: Mr. M.H. Caminer
B. YRS. OF IND.BLDG EXP.	3 years	
C. MAIN STRUCT. SYSTEM	Primarily wood with steel floors.	
D. BASIC CONFIGURATION	Modular Sectional	
E. NUMBER OF PLANTS	1 (Milan, MI)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA								III. COST INFORMATION	
A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A. $ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.							Ohio, Ind.,		
b. 2BR-TOWNHOUSE	1000	2	24x36 for 2 units	864	12 x 36	For singles:	Mich.,	$11,500	$11,500
c. 3BR-DET.	401-A44	1	24x44	1,056	12 x 44	now 5; but		13,500	13,500
d. 3BR-TOWNHOUSE	1000	2	24x48 for 2 units	1,152	12 x 48	expect to	Ill.,	12,500	12,500
e. 4BR-DET.						produce 8 by	Wisc., Pa.,		
f. 4BR-TOWNHOUSE	1000	2	24x56 for 2 units	1,344	12 x 56	Spring '74.	Ky. & W.Va.	14,500	14,500

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Trucks	To: Builder company-owned trailers - hauled by hired transporters	300 miles	800 miles	$2.50		300 miles @ $2.50	$750

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	Units are not now intended to be stored for all-weather conditions - Cannot estimate cost of package.	ESTIMATED COST $ NR	$ NR
b. INTERIOR		ESTIMATED COST $ NR	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV.	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
a. COMPANY							Need crane or roll-off system on site.	1. FOUNDATIONS (PERIMETER)	$1,000
b. DEALER		X	X	X	X	X			
c. SUBCONTRACTOR	X	X	X	X	X	X		2. ERECTION (EXT. & INT FINISH INC.)	$ 950
d. OTHER									
	3. CLOSE-IN a. DAYS		1 for SF unit	4. FINISHING	a. DAYS	7			
	b. MAN-HRS.		40		b. MAN-HRS.	no estimate			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	90 day warranty.	OF TOTAL DEVELOPMENT COST	15%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	60 days - not including site preparation.		*The headquarters of Scholz Homes (Subsidiary of Inland Steel) is located at: 2001 N. Westwood Ave. Toledo, OH 43607 (419) 531-1601 (Pkged.Homes)

Item No.:

1. EXTERIOR WALLS: (1) Framing: Standard & better or stud grade (factory option) stud size 2 x 4, S4S, spaced 16" o.c. (2) Sheathing: 3/8" x 4' x 8' moisture resistant plywood conforming to U.S. Product Standard, P.S. 1-66. (All exposed joints caulked or made weather tight.) (3) Siding (If ordered: Georgia Pacific primed siding, cedar shakes* or aluminum with baked-on enamel and insulated back*). (Siding for ends to be supplied by Manufacturer and installed by Customer.) Brick or other masonry not available, as part of the unit.

2. FLOOR FRAMING & SUBFLOOR: (1) Girders: No. 2, 2 layers of 3/8" plywood, 2-2x8, S4S, and 2-2x6, S4S, laminated. (2) Floor Joist: 2 x 8, No. 2, S4S, 16" o.c.; Headers; 2 x 6, S4S, laminated to 2 x 8, S4S, and one layer of 3/8" plywood. (3) Subflooring: 5/8" x 4' x 8' T & G moisture resistant plywood conforming to U.S. Product Standard, P.S. 1-66. (4) Underlayment for Tile: 3/8" exterior plywood conforming to U.S. Product Standard, P.S. 1-66 or 3/8" particle board complying to Commercial Standard, US 236-66 (factory option).

3. PARTITION FRAMING: (1) Studs: Standard & better or stud grade, (factory option) 2 x 4, 16" o.c. (2) Sole: 2 x 4, S4S. (3) Plates doubled. (4) Lintels (headers): See plans.

4. ROOF: (1) Sheathing: 1/2" x 4' x 8' moisture resistant plywood conforming to U.S. Product Standard, P.S. 1-66. (2) Shingles: Asphalt 235 lb., seal tab, size 12" x 36". (3) Underlayment: 15 lb. asphalt felt, doubled. (4) Roof Trusses: 24" o.c.

5. INTERIOR WALLS AND CEILING: (1) Walls of prefinished paneling. (2) Gypsum Board: 1/2" x 4' x 12' ceiling. (3) Bath walls to have vinyl wall fabric.

6. ADHESIVE: B. F. Goodrich, PL-400 Adhesive or equal applied to: (1) Storm sheathing. (Full height of studs.) (2) Subfloor. (3) Underlayment. (4) Gypsum board. (5) Paneling.

7. DOORS, WINDOWS AND MILLWORK: (1) Door Unit: 2¼" casing, jambs and trim, B & Btr. Southern Pine; Doors: flush mahogany. (2) Windows: Double hung, Ponderosa Pine; Trim: B & Btr. Pine or Hardwood; Glass S.S.B. unless otherwise shown. (3) Screens: Aluminum wire and frame. (Self storing white aluminum storm windows and doors with extruded frames available*.) (4) Base: 1 member, factory finished hardwood. (5) Closet Rods: Wood or metal (factory option). (Inside trim hardwood factory finished - flush doors factory finished.)

8. ENTRANCE DOORS AND EXTERIOR MILLWORK: (1) Entrance doors: Mahogany, 1-3/4" thick. (2) Other outside doors: 1-3/4" thick. (3) All exterior doors to have adjustable sweep. (4) Door frames: Rabbeted jambs 1-1/16" thick. (5) Weatherstripping: Aluminum or vinyl type; 7" aluminum sill. (6) Screen doors: 1" thick, aluminum wire and guard. (White aluminum frame.) (7) Ventilation: Gables, 08 mesh galvanized wire behind, see plans. (8) Exterior Millwork: B & Btr.

9. CABINETS AND INTERIOR DETAILS: (1) Cabinets: Hardwood, factory built with dark birch finish, wall shelf 12". (2) Countertop: Laminated plastic top and edging; plastic backsplash.

10. STAIRWAYS: Basement stairway, where shown, Treads: 1-3/3"; Handrail; Carriage: 2 x 10's pre-engineered and rabbeted to receive treads.

11. BATH ACCESSORIES: (1) Ceramic - 6 per full bath. (2) Ceramic - 4 per 1/2 bath.

12. PLUMBING: (1) Steel Sink: Size 32" x 21" double compartment with swing faucet, spray and strainers. (2) Lavatory: In white. (3) Water Closet: In white with seat. (4) Bathtub: Enameled steel in white with faucets, shower, trip lever waste, overflow, and curtain rod. Other fixtures and plumbing as shown.

13. HEATING: (1) Baseboard electric complying with National Electrical Manufacturers Association (NEMA) and Underwriters' Laboratories, Inc. (UL) complete with a full length thermal disconnect and calrod element as mfgd. by Berko Electric Mfg. Corporation or equal. Each room thermostatically controlled with a double pole thermostat.

14. ELECTRIC WIRING AND FIXTURES: (1) All switches (silent type) Bryant or equal, convenience outlets and light fixtures. (2) All rough wiring including the main panel is installed in accordance to the National Electrical Code.

15. WATER HEATER: Electric, 52 gallon, Quick Recovery, glass lined.

16. PAINTING AND DECORATING: (1) Exterior: Factory applied latex base paint as mfgd. by the Glidden Company or equal. After delivery, an additional coat may be necessary by the Customer. (2) Interior: Factory finished work.

ITEM	FACTORY FINISH
1. White Oak Paneling	Photographed
2. Base	Prefinished (Factory finished)
3. Gypsum Board	Tape & joint system-plus smooth or sand finish roll on latex base paint (Off white only)
4. Bathroom Walls	Vinyl wall fabric and ceramic tile at tub
5. Kitchen Cabinets	Spray-stain & lacquer
6. Interior Doors & Trim	Prefinished (Factory finished)
7. Ceiling Cornice	Prefinished (Factory finished)
8. Living Room Accent Wall	Vinyl Wall Fabric

17. INSULATION: (1) Ceilings: R-19. (2) Sidewalls: R-11. (3) Floor: R-11 mineral wood or fiberglas.

18. MECHANICAL FASTENERS: (1) Fasteners of the proper size and specification for a complete job. Galvanized fasteners to be used on the roof and exterior exposed fasteners.

19. FINISH HARDWARE: (1) Locks: Exterior doors with exterior cylindrical locksets. Inside doors with interior cylindrical locksets and latchsets. (2) Other: All finish hardware for a complete job; Polished brass finish.

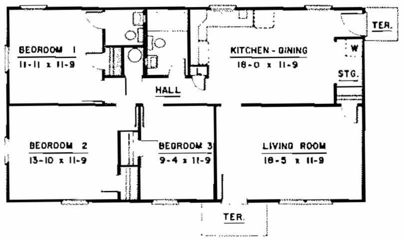
20. FLOORING: (1) Vinyl floor covering in kitchen, bath, hall, bedroom 01, and continuous filament nylon carpet with padding in living room, bedroom 02, and bedroom 03.

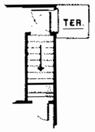
21. TILE: (1) Bath Walls: 4¼" x 4¼" ceramic tile at tub only with waterproof adhesive.

22. MEDICINE CABINETS: Single mirror door cabinet with light fixture above.

23. These specifications are intended to include labor in manufacturing of the house and materials for the house above the foundation sill plate. Purchaser to provide two mechanics to assist in the erection of the house onto the foundation. Labor and materials for the foundation, termite shield, sill plate, stairway erection, masonry materials, hook-up of electrical and plumbing or labor for field completion and items related thereto are not included.

24. Specifications subject to change without notice.





Alternate Basement

mach VII

Designed for the ultimate
in beauty and
convenience. Meets or
exceeds FHA, VA and
BOCA standards

Series US M44B
Design 1 C-1
Livable area (frame)
1036 square feet
Dimensions (frame)
44'-1" x 23'-6"
Refer to working
drawings for more
exact dimensions.

Continental Homes

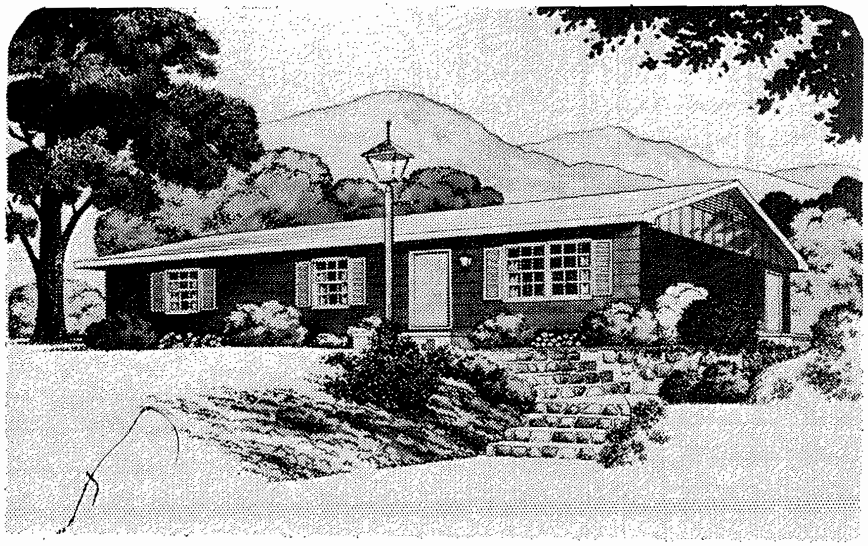
P.O. Box 1800 Roanoke Virginia 24008
Telephone 703 334 5000
Home Office Boones Mill Virginia
Plants Boones Mill Virginia Malden
Missouri

A division of Weil-McLain

mach VII

series US M44B / design 1 C-1 / color scheme — mach VII

Continental Homes



SYSTEMS DESCRIPTION 12

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM	
A. CURRENT PROD. RANGE	Single-family detached, commercial/industrial, schools
B. YRS. OF IND.BLDG EXP	12 years
C. MAIN STRUCT. SYSTEM	Wood
D. BASIC CONFIGURATION	Modular sectional
× E. NUMBER OF PLANTS 4	(Plant 2 - Boones Mill, Va.; Plant 6 - Boones Mill, Va.; Plant 7 - Malden, Mo.; Continental Homes of New England - Nashua, N.H.)

THE MANUFACTURER M 60a

Weil McLain
Continental Homes
P.O. Box 1800
Roanoke, Virginia 24008
(703) 334-5000
Attn: Robert L. Cooper

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET.	Uni-Structure-The Whitney Series US-38	1	38'1"x23'6"	895	38'1"x11'9"	Plant 2 - 7	Ark, Ala, Del,
b. 2BR-TOWNHOUSE						Plant 6 - 15	Conn, Ga, Ill,
c. 3BR-DET.	Mach II Series M-40A	1	40'1"x23'6"	942	40'1"x11'9"	Plant 7 - 15	Ind, Iowa, Ky,
d. 3BR-DET.	Mach VII	1	44'1"x23'6"	1,036	44'1"x11'9"	Cont'l. 17	Md, Mass, Mich
e. 4BR-DET.	Mach VI Series M-44A	1	44'1"x23'6"	1,036	44'1"x11'9"	Homes	Minn, Mo, NH,
f. 4BR-TOWNHOUSE							Okla, Tenn,

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	
	Trailer	Leased	300 miles	1,000 miles	N.R.		W.Va, Wisc, Soon Fla.

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	Yes	ESTIMATED COST $ -
b. INTERIOR		ESTIMATED COST $ -

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED
a. COMPANY			X				
b. DEALER	X	X		X			
c. SUBCONTRACTOR							
d. OTHER					Customer	Customer	
	3. CLOSE-IN	a. DAYS	1	4. FINISHING	a. DAYS	7	
		b. MAN-HRS.	32 (4 men)		b. MAN-HRS.	96 (4 men)	

E. MAINTENANCE	
Warranty	One year warranty for replacement of faulty parts.

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	1st Quarter - 3 weeks 2nd Quarter - 4 weeks 3rd Quarter - 6 weeks 4th Quarter - 6 weeks	Use pressurized wood foundations to speed foundation installation time.

III. COST INFORMATION

A. $ PER UNIT F.O.B. PLANT 20 UNITS*	50+ UNITS*
$14,770	$14,770
15,522	14,580
17,026	15,990
17,026	15,990

B. $ PER UNIT PER AVERAGE SHIPMENT	
300 miles @ $3.50**	$1,050

C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
	$ -

D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ 850
2. ERECTION (EXT. & INT. FINISH INC.)	$1,125

E. BUILDER'S PROFIT	
OF TOTAL DEVELOPMENT COST	10% South 15% North of Va.

FOOTNOTES

*Discounts for cash in advance are available.

**Estimate.

(b) Other Modular and Packaged Housing Systems

- Cardinal Industries
- Community Technology (TRW)
- Endure Products
- Mayhill Homes
- National Homes
- U.S. Steel Homes
- Weston Homes

GENERAL SPECIFICATIONS

All materials used in the manufacture of the Cardinal Industries Series 100 apartment unit are of recognized quality and come from nationally known suppliers. Cardinal Industries reserves the right to change brands and suppliers at its discretion. Note that the following specifications are general outline specifications and detailed specifications are contained in the architectural drawings and architectural specifications.

STRUCTURAL

Lumber - all kiln dried, association graded with certified grade mark.
Plywood - association graded with certified grade mark and lifetime guarantee
Beams - West Coast Douglas fir, #2 and better.
Floor Joists - 2" × 8" yellow pine, kiln dried, #2 and better.
Sub Floor - ¾" tongue and groove 5-ply underlay with fortified resin glue (Potlatch Forests, Inc.)
Wall Framing - 2" × 3" and 2" × 4" West Coast HEM/FIR or Douglas fir, construction grade allowing 20-25% standard.
Ceiling Framing - 2" × 6" West Coast HEM/FIR or Douglas fir, #2 and better
Roof Framing - 2" × 4" and 2" × 6" West Coast hemlock or Douglas fir, #2 and better
Roof Sheathing - ½" CD grade 3-ply with fortified resin glue. (Potlatch Forests, Inc.)
Wall Sheathing - ½" gypsum fire/sheath with water-repellent core and paper (National Gypsum Company)
Fastening - All structural members are fastened with approved nails in accordance with all applicable building codes and manufacturers' recommendations. In addition to standard nailing procedures, all framing members, plywood, wall sheathing, siding, are glued using recognized construction adhesives

INSULATION

Floor - R-13 rated mineral wool batts
Backerboard - asphalt impregnated (Simplex Paper Company)
Exterior Walls - R-11 rated mineral wool batts
Party Walls - R-11 rated mineral wool batts
Ceiling - R-20 rated mineral wool batts

EXTERIOR MILLWORK & SIDING

Siding - textured hardboard, pre-stained. (Weyerhaeuser Corporation)
Batten Strips - 1" × 2" rough sawn cedar, pre-stained.
Soffit - perforated aluminum with baked enamel finish. (Alcoa Products)
Fascia - aluminum with baked enamel finish. (Alcoa Products)

Shutters - pre-finished polymer. (Home Comfort)
Cupola - white pine with metal roof, pre-finished. (Cardinal Industries)
Patio Fencing - 1" × 8" rough sawn cedar with 2" × 4" cedar runners and 4" × 4" cedar post, all pre-stained with fence sections assembled and posts cut to length.

WINDOWS, STORM DOOR & EXTERIOR DOOR

Windows - aluminum with baked enamel finish, full insulating glass with screens. (Glouster Aluminum.)
Combination Storm & Screen Door - aluminum with baked enamel finish with screen and tempered storm panel, chain guard and all hardware (Hayes Aluminum)
Exterior Door - 3' × 6'8" × 1¾" pre-finished hardboard with pre-finished white pine jamb.

INTERIOR WALLBOARD

½" Gypsum - (National Gypsum Company)
Joint Tape - (National Gypsum Company)
Finish Compound - (National Gypsum Company)

INTERIOR WALL FINISHES

Paneling - vinyl covered walnut finish (U.S. Plywood Corp.)
Wall Covering - Wall-Tex, acrylic coated fabric. (Columbus Coated Fabrics)
Tub Enclosure - Deke-Board (U.S. Plywood Corporation)

FINISH HARDWARE

Bi Folding Door Track - (Great Lakes Hardware)
Door Knocker - with brass finish. (Safe Hardware Corporation)
Mail Box - cast aluminum. (Safe Hardware Corporation)
Door Stops - brass or bronze (Safe Hardware Corporation)
Coat Hooks - brass or bronze. (Safe Hardware Corporation)
Closet Rods - tubular steel with bright finish. (Palmer Manufacturing)
Shower Rod - tubular aluminum with bright finish. (Palmer Manufacturing)
Bath Accessories - (soap dish, grab, towel bars) - chrome. (Miami Carey)
Carpet Thresholds - aluminum (B & T Metals Company)
Traverse Rods - (Newell Companies)
Medicine Cabinet - (Miami Carey)
Bookcase Pulls - cast bronze (Liberty Hardware)
Exterior Lock, Handle, Escutcheon - (Westlock Company)
Interior Passage & Privacy Sets - (Westlock Company)
Interior Door Butts - 1'. pair per door (Stanley Works)
Exterior Door Butts - 4 × 4, 1½ pair per door (Stanley Works)

RDOFING

Roofing - 240# asphalt Sealdown (Logan-Long Company)
Underlayment - Seamless, asphalt saturated felt (Mannington Mills)

INTERIOR MILLWORK

Base - 2½", walnut finish, vinyl covered. (Empire Moulding)
Casing - 2¼", walnut finish, vinyl covered. (Empire Moulding)
Jambs - ½" by various widths, walnut finish, vinyl covered. (Empire Moulding)
Stops - 1¼", walnut finish, vinyl covered. (Empire Moulding)
Ceiling Mould - 1¼", walnut finish, vinyl covered. (Empire Moulding)
Corner Moulds - 1", walnut finish, vinyl covered. (Empire Moulding)
Window Jambs - ¾" × 3", walnut finish, vinyl covered. (Empire Moulding)
Hook Strip - ¾" white pine
Shelving - ⅝" particle board, painted (Weyerhaeuser and Georgia Pacific)
Interior Doors - 1⅜" × 2'8" × 6'8", finished walnut
Disappearing Stairway - southern pine. (Mellwood Products)

CABINETRY

Kitchen Cabinets, Vanity & Bookcase - high pressure laminated plastic (Micarta and Nevamar) with self-closing doors and postformed counter tops with backsplash (Formitex Plastic Fabricators)

APPLIANCES

Refrigerator - Model #J235 (General Electric)
Range - Model #42AX42 (Sunray Stove)
Disposal - Model #BB30 (Bus Boy of California)
Hot Water Heater - electric fast recovery, Model #CR8T-30-2 (State Stove)
Range Hood - Model #116-25-21 (Aubrey Manufacturing Company)
Bath Exhaust Fan - Model #562. (Aubrey Manufacturing Company)

FLOOR COVERINGS

Carpeting - high pile, with Class D 30 ounce medium density back. (Walter Carpet Mills)
Floor Tile - standard gauge, vinyl asbestos. (Flintkote Company)

ROUGH PLUMBING

Water Lines - copper, Type L
Plumbing Waste & Vent Stack - ABS plastic, Schedule 40

FINISH PLUMBING

Kitchen Sink - Stainless steel, 25" × 22" (Polar Manufacturing Company)
Vanity Top & Bowl - Simulated acrylic marble. (Lawndale Corporation)
Bath Tub - porcelainized steel (Lawndale Corporation)
Water Closet - porcelain (Gerber Manufacturing)
Faucets - chrome, "Valley," single lever (Eastman Central)

ROUGH HARDWARE

Anchoring Devices - 3/16" steel. (Cardinal Industries)
Foundation Vents - aluminum 6" × 16". (Harris Manufacturing)
Nails & Staples - all per manufacturers' recommendations
Joist Hangers - 2" × 8" galvanized steel. (Atlas Steel Products)
Roof Ventilators - aluminum (Vent-a-Ridge Corporation)

ROUGH ELECTRIC

Circuit Breaker Panel - (General Electric)
Wiring - plastic sheathed cable
Switch - ivory finish, silent throw

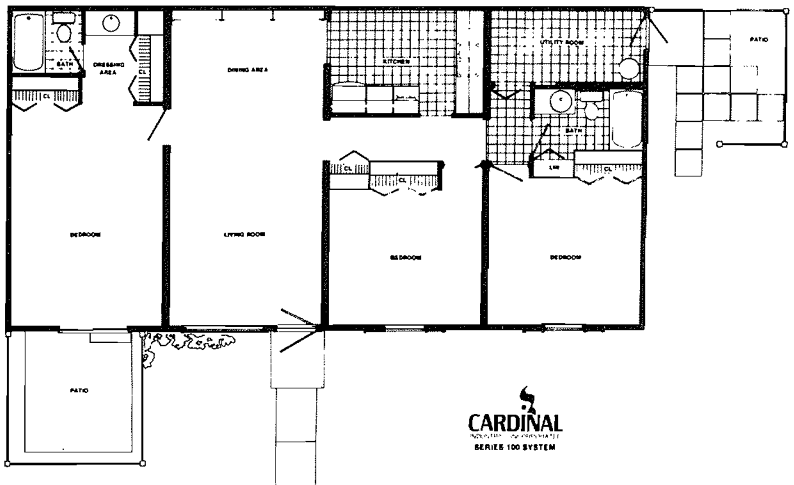
FINISH ELECTRIC

Switch & Outlet Plates - ivory finish plastic
Porch Light - cast aluminum, Model #6403 (Dinico)
Dining Area Chandelier - Model #T-604 (Timely)
Kitchen Ceiling Fixture - Model T-2695 BR (Timely)
Bath Light - Model T-446 BR (Timely)
Hall Light - Model T-2604 - BR (Timely)

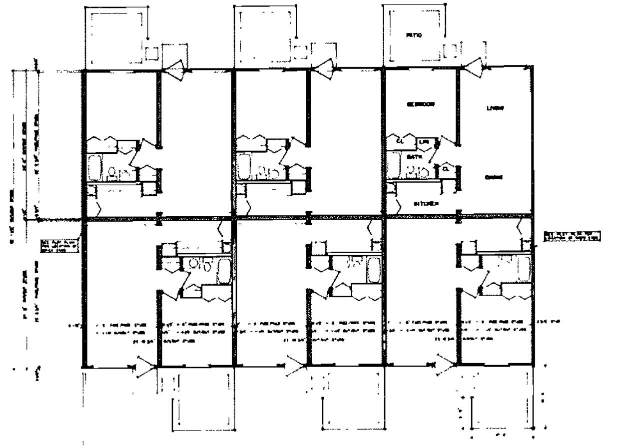
HEATING & COOLING

Furnace - forced air electric, with cooling coil (Stewart-Warner Corporation)
Heat Ducts - flexible insulated airduct (Flexible Tubing Corporation)
Plenum & Register Boots - insulated galvanized sheet metal (Buckeye Sheet Metal)
Registers - adjustable steel diffusers (Hart & Cooley Manufacturing)
Air Conditioning Condenser - (Stewart-Warner Corporation)
Thermostat - Model T-834-C with separate fan control (Stewart-Warner Corporation)

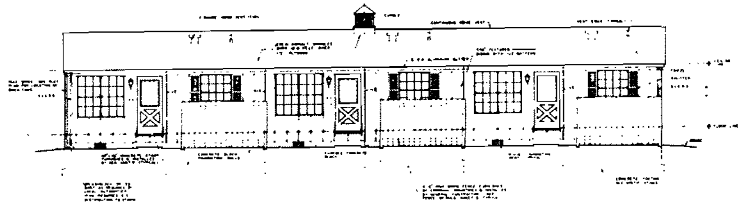
All materials contained in these outline specifications are completely installed in the apartment unit at the factory with the exception of the patio fence, aluminum soffit and fascia, foundation vents and anchors, Vent-a-Ridge, integor connecting jambs, cupola, air conditioning condenser, pre-charged refrigerant lines with charging valves, and connecting roofing (See Cardinal Industries Installation Manual for use of on-site materials and work required.)



CARDINAL
SERIES 100 SYSTEM



PLAN



TYPICAL ELEVATION

SYSTEMS DESCRIPTION 13

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 6
A. CURRENT PROD. RANGE	Garden apartments	Cardinal Industries 2040 S. Hamilton Rd. Columbus, OH 43227 (614) 861-3211 Attn: Austin Guirlinger
B. YRS. OF IND.BLDG EXP	20 (System 100, 4th year)	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Modular	
E. NUMBER OF PLANTS	1 (Columbus, OH; additional plants planned in Orlando, FL and Columbus, OH)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET.							
b. 2BR-TOWNHOUSE	Series 100 - 2BR	1	24 x 36		24 x 12	16 modules	OH, future FL
c. 3BR-DET.							
d. 3BR-TOWNHOUSE	Series 100 - 3BR	1	24 x 48		24 x 12		
e. 4BR-DET.							
f. 4BR-TOWNHOUSE							

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS
	Cardinal-designed trailer pulled by tractor	Company owned	125 miles	500 miles	over 50 miles $1/mile/cube 2BR = 3 cubes 3BR = 4 cubes	

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	Yes	ESTIMATED COST $ -
b. INTERIOR	Yes	ESTIMATED COST $ -
	Weather-proofed system, have been stored for more than 6 months.	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH
a. COMPANY	X		X	X	X (in factory)	
b. DEALER						
c. SUBCONTRACTOR	X	X	X	X		X
d. OTHER						

3. CLOSE-IN a. DAYS 1 b. MAN-HRS. 16

4. FINISHING a. DAYS b. MAN-HRS.

2. SPECIAL EQUIPMENT REQUIRED: Minimum 35 ton crane; specially designed Cardinal lifting frame tractor for removal of hauling trailers

E. MAINTENANCE	
Warranty	1 year for workmanship and materials.

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	1 week	

III. COST INFORMATION

A.$ PER UNIT F.O.B. PLANT	20 UNITS	50+ UNITS
b.	$10,000	
d.	13,000	

B. $ PER UNIT PER AVERAGE SHIPMENT	
300 miles (4 cubes) @ $4.00 per mile	$1,200

C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
	$ -

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ NR
2. ERECTION (EXT.& INT. FINISH INC.)	$ NR

E. BUILDER'S PROFIT	
Manufacturer's supervision	$200 NR %

FOOTNOTES

Community Technology (TRW)

(No illustrations or specifications available.)

SYSTEMS DESCRIPTION 14

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER M 8
A. CURRENT PROD. RANGE	Single-family detached (panelized); garden apartments (modular)	Community Technology Corp. 1 Space Park Building El Redondo Beach, CA 90278 (213) 536-2233 Attn: Mr. Aldrage
B. YRS. OF IND.BLDG EXP	4	
C. MAIN STRUCT. SYSTEM	TRW System (fiberglass - honeycomb panels)	
D. BASIC CONFIGURATION	Modular and Panelized	
E. NUMBER OF PLANTS	1 (Sacramento, CA)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.	14-204	1	28 x 40	1,120	NR	NR	Modulars:	$14,000	Final retail
b. 2BR-TOWNHOUSE	14-206	2	28(l), 32(u) x 14	840	NR		CA only;		price to cus-
c. 3BR-DET.	14-302	1	28 x 42	1,176	NR		Panelized:	16,000	tomers in Al-
d. 3BR-TOWNHOUSE	14-304	2	32(l), 40(u) x 14	1,008	NR		CA, NM		buquerque,NM
e. 4BR-DET.	14-402	1	42 x 42	1,764	NR			19,200	excluding land
f. 4BR-TOWNHOUSE									acquisition

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT
	Truck	Any	For panelized units, 900 miles	900 miles	NR		$ NR

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	NR	ESTIMATED COST $ NR	$ NR
b. INTERIOR		ESTIMATED COST $ NR	

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED
a. COMPANY							Small crane (telescopic)
b. DEALER							
c. SUBCONTRACTOR	X	X	X	X	X	X	
d. OTHER							
	3. CLOSE-IN	a. DAYS b. MAN-HRS.		4. FINISHING	a. DAYS b. MAN-HRS.		

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ included in FOB above
2. ERECTION (EXT.& INT. FINISH INC.)	$ included in FOB above

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	On panel	OF TOTAL DEVELOPMENT COST	NR

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	N.R.		

ENDURE A LIFETIME

Form #7038B
Rev. 4/73
Page 1 of 2

SHORT FORM SPECIFICATIONS
PRE-BILT CONSTRUCTION
COMMERCIAL - RESIDENTIAL BUILDINGS

GENERAL: Each building shall be constructed of modular pre-fabricated structural aluminum skin honeycomb core panels, as designed and manufactured by ENDURE-A-LIFETIME PRODUCTS, INC. These panels shall be of the sizes and types as noted on the plans and in accordance with all ENDURE specifications.

MATERIALS AND WORKMANSHIP: All materials used shall conform to ENDURE-A-LIFETIME PRODUCTS, INC., quality control standards and certifications of suppliers.

A. Except as noted, aluminum extrusions shall be 6063 Alloy mill finish, aluminum sheet shall be 3105 Alloy, finish as noted on plans.

B. All panel assemblies shall have all plies heat-bonded to core with a neoprene-resin reaction type adhesive.

C. All structural panels shall have a core of 3/4" cell, 11% resin, 99# impregnated Kraft honeycomb, continuously expanded and cured.

D. All panel fabrication shall be performed on automatic machinery to assure uniformity of honeycomb expansion, lamination, and size.

EXTERIOR WALL PANELS: All panels for exterior walls shall be 3" thick laminated honeycomb core sections, interlocking and structurally independent. Exterior facing shall be .025 stucco-embossed aluminum pre-painted in accordance to ENDURE standards; interior facing shall be as noted on plans. 4 ply, or 5 ply as noted on plans.

PARTITION PANELS: All partition panels for interior walls shall be 3" thick 3 ply laminated honeycomb core sections, structurally independent. Faces shall be as noted on plans.

ROOF PANELS: Roof panels shall be 3" or 4" 3 ply laminated honeycomb core sections, interlocking and structurally independent. Both faces are pre-painted .025 aluminum. Eaves shall be as shown on drawing.

PANEL CONNECTIONS: All contiguous panels whether interior or exterior shall be locked in such a way that they will form a continuous surface. Exterior panels shall have a "T" cleat to connect panels and act as a concealed water drain. Interior panel connections shall be compatible with system used. When completed, there shall be no exposed honeycomb at any panel edge.

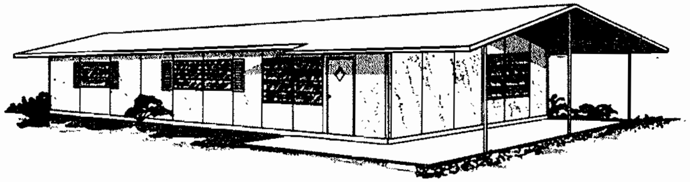
STRUCTURAL CONNECTIONS: Shall be extruded aluminum members. Base channel, corner posts, eave channels, end wall channels, ridge beam, etc., as indicated by plan.

FASTENINGS: All fastenings required for complete assembly in accordance with ENDURE standards shall be provided. Fastenings shall be non-corrosive type.

MOLDINGS: Snap-in place trim; slip-in place trim; or other moldings shall be furnished as needed. To be field cut and fitted to suit building conditions.

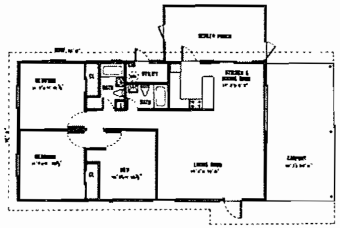
EXTERIOR DOORS AND FRAMES: All exterior doors shall be pre-hung standard ENDURE-A-DORS, aluminum faced honeycomb core construction in vinyl weather-stripped frames, 1-1/2 pr. of 4-1/2" anodized aluminum hinges; each leaf .171 thick; with nylon bushings; stainless steel non removable pins, Endure type.

INTERIOR DOORS AND FRAMES: All interior doors to be of hollow core wood construction in pre-hung frame, except closet doors which shall be a folding plastic or wood. One pair 3 x 3 hinges and privacy lock shall be standard with swing door.



The Mars

3 BEDROOMS - TWO BATHS
1090 SQUARE FEET



The car-or-boat port and screen porch off the kitchen-dining area are optional (and also available on the other models). The Mars has two bedrooms and a third bedroom nicely convertible into a den, and the two bathrooms are complete.

Accoustical white fiberglass ceiling.

ENDURE-A-LIFETIME PRODUCTS
BY PRE-BUILT STRUCTURES, INC.
7500 N. W. 72nd Avenue, Miami, Florida 33166, Phone (305) 885-9901

WINDOWS: All exterior windows shall be as shown on plan; one or more of the following: (a) Aluminum Awning type, complete with aluminum weather-stripped frame, glass, screen and operator. Maximum 4' wide. (b) Jalousie type, complete with weather-stripped frame, 4" glass slats, screen and operator. Maximum 3' wide. (c) Single-Hung type complete with wool pile weather-stripped frame, glass and screen. 2/2 unless noted otherwise. Maximum 4' wide. (d) Picture Windows, extruded aluminum frames with vinyl receiving channel; 7/32" thick glass, fixed non-opening windows.

All glass furnished in clear unless otherwise specified. All units except picture windows to have screens of 14/18 mesh aluminum wire, operators with encased plated steel gear, and handles.

ELECTRICAL SYSTEM: (1) Wall panels shall contain flush-mounted outlet boxes and concealed electrical race-ways, or (2) All electric surface-mounted.

PLUMBING: Shall be surface-mounted. No special preparation required.

KITCHEN: Shall be surface-mounted. No special preparation required.

CEILING: Suspended grid-type. No special preparation required.

AIR CONDITIONING AND HEATING: As required.

FINISH: If not shown on plans standard shall be as follows: Exterior panels shall be standard ENDURE white; Interior panels shall be standard ENDURE white; Fascia shall be trimmed in color choice of ENDURENAMEL; Interior doors shall be sealed with clear varnish; Kitchen cabinet doors and counters shall be a light formica pattern; plumbing fixtures white

The right is reserved to change these specifications. Substitutions shall be made only with the approval of ENDURE-A-LIFETIME PRODUCTS, INC., and all optional or substituted items shal conform to ENDURE-A-LIFETIME PRODUCTS, INC., quality control standards.

NOTE: All plans and specifications submitted for quotation are normally for a complete installation. A general description of the items to be furnished by ENDURE shall be enumerated for each individual Quotation. Anything in the specifications or in the plans notwithstanding, only those items enumerated shall be included as part of the ENDURE package. It shall be the customer's responsibility to advise the local building code requirements, if any.

SYSTEMS DESCRIPTION 15

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM

A. CURRENT PROD. RANGE	Single-family detached, semi-detached, townhouse; commercial/industrial units; schools; mobile offices
B. YRS. OF IND.BLDG EXP	27 years
C. MAIN STRUCT. SYSTEM	Aluminum; multi-ply sandwich panels utilizing a phenol impregnated honeycomb core with aluminum exterior facings and several types of interior facings.
D. BASIC CONFIGURATION	Structural load bearing panels in standard sizes.
E. NUMBER OF PLANTS	1 (Miami, FL)

THE MANUFACTURER R 2.1

Endure Products, Inc.
7500 N.W. 72nd Avenue
P.O. Box 666
Miami, FL 33166
(305) 885-9901
Attn: Arthur A. Kimmel

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET.	Saturn II	1	20'6"x36'7"	750	50"x47"x12'		
b. 2BR-TOWNHOUSE	The Townhouse	1	24'4"x33'9"	821	50"x44"x14'		All 48
c. 3BR-DET.	Apollo	1	20'6"x40'6"	830	50"x52"x12'	2	
d. 3BR-DET.	Mars	1	24'6"x44'6"	1,090	50"x52"x12'		States
e. 4BR-DET.	Aquarius	1	24'6"x47'7"	1,166	50"x52"x14'		
f. 4BR-TOWNHOUSE							

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS
	Truck trailer or rail	Commercial carrier or leased truck	1,500 miles	3,500 miles	NR	

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	No	ESTIMATED COST $ 300-400
b. INTERIOR	Yes	ESTIMATED COST $ -

D. SITE ERECTION	SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH
a. COMPANY			X		X	X
b. DEALER		X	X	X		
c. SUBCONTRACTOR		X	X	X		
d. OTHER	Buyer	X				

1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS

2. SPECIAL EQUIPMENT REQUIRED: Fork lift

3. CLOSE-IN a. DAYS 5-6 b. MAN-HRS. 160-192

4. FINISHING a. DAYS 5-6 additional b. MAN-HRS. 120-144 additional

E. MAINTENANCE	
Warranty	One year (per FHA requirements). No formal warranty issued.

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	8 weeks for first unit - thereafter 2 units per week minimum.	It would be more efficient to purchase and package ancillary equipment such as fixtures, cabinets, appliances and furnishings separately. This would facilitate increased rate of manufacture and simplify shipping and storage.

III. COST INFORMATION

A. $ PER UNIT F.O.B. *PLANT 20 UNITS*	50+ UNITS*
$ 7,360	5% discount
8,069	
8,314	
11,983	
10,982	

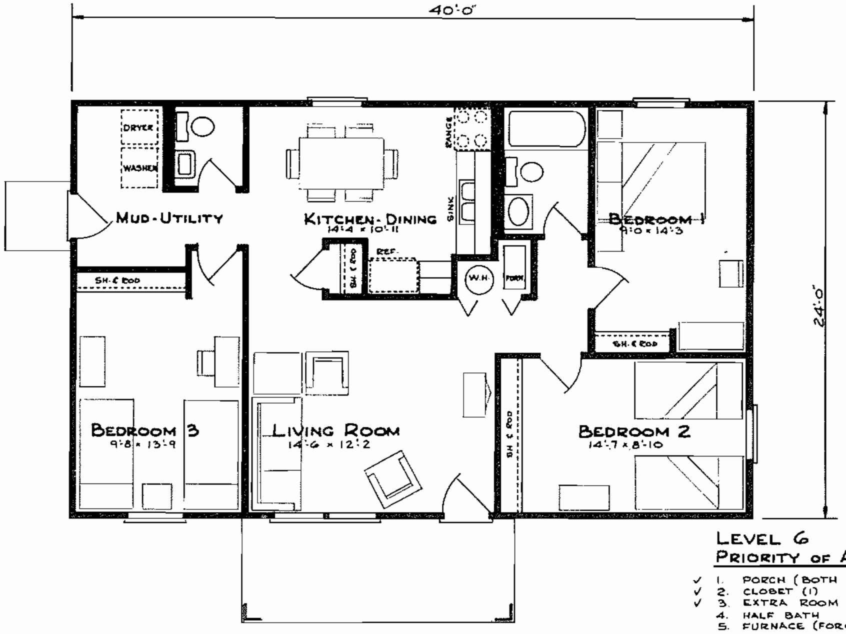
B. $ PER UNIT PER AVERAGE SHIPMENT: NR

C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB): $300-$400

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ NR
2. ERECTION (EXT.& INT. FINISH INC.)	$ NR

FOOTNOTES

*Not incl. in FOB price are: bath & kitchen packages, elec. package & fixtures, floor & base covering. Prices are wholesale to contractor; final price to consumer, approx. 200-220% of FOB, land excl. FOB prices incl. 4-ply ext. walls, 3-ply int. walls, roof panels, ext. doors, int. wood doors, closet doors, closet shelves, elec. preparation, drop ceiling.



FURNITURE SCHEMATIC

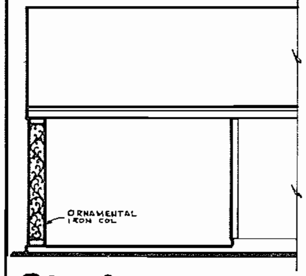
SCALE 1/4" = 1'0"

LEVEL 6
PRIORITY OF AMENITY CHOICES

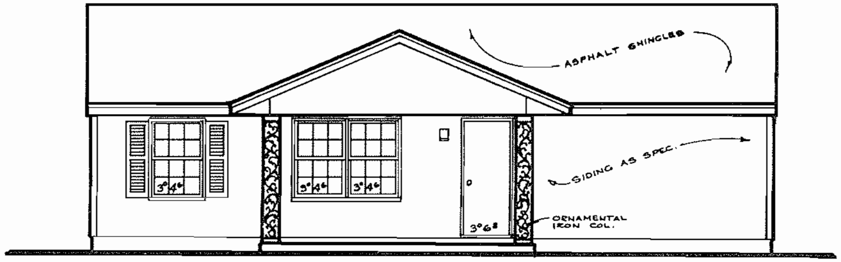
✓ 1. PORCH (BOTH KINDS)
✓ 2. CLOSET (1)
✓ 3. EXTRA ROOM (1)
4. HALF BATH
5. FURNACE (FORCED AIR)
6. BASEMENT
7. CAR STORAGE
✓ 8. EXTRA ROOM
9. MUD ROOM
✓ 10. CLOSET (2)
✓ 11. CLOSET (3)
✓ 12. CLOSET (4)
✓ AMENITIES INCORPORATED IN THIS PLAN

FURN. SCHEM.	
MODEL	V
SIDING	
ADDS	± FT. L.R. ± FT. B.R.
AREA	960 SQ. FT.
BATHS	1 1/2
BED ROOMS	THREE
CAR STORAGE	OPTIONAL
EXT. STORAGE	
INT. STORAGE	
ATTIC VENT	
DRAWN BY	G.H.C.
DATE	1 MAR 74

MAYHILL HOMES



OPT. CARPORT



FRONT ELEVATION

ELEVATIONS	
MODEL	V
SIDING	FRAME
ADDS	± FT. L.R. ± FT. B.R.
AREA	
BATHS	
BED ROOMS	
CAR STORAGE	
EXT. STORAGE	
INT. STORAGE	
ATTIC VENT	1384 SQ. IN.
DRAWN	G.H.C.

SYSTEMS DESCRIPTION 16

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER P 28
A. CURRENT PROD. RANGE	Single-family detached, semi-detached, townhouse, garden apartment	Mayhill Homes Corp.
B. YRS. OF IND.BLDG EXP.	2½	P.O. Box 1778
C. MAIN STRUCT. SYSTEM	Wood	Gainesville, GA 30501
D. BASIC CONFIGURATION	Mechanical cores and open panels	(404) 536-9871
E. NUMBER OF PLANTS	1 (Gainesville, GA)	Attn: John Odegaard

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.	Model II	1	24 x 30	720	All units		GA, AL,FL,	$ 9,000*	$ 9,000*
b. 2BR-TOWNHOUSE					fit on		NC, SC,TE		
c. 3BR-DET.	Model III	1	24 x 32	768	single			9,600*	9,600*
d. 3BR-DET.	Model IV	1	24 x 40	960	8' x 40'			11,000*	11,000*
e. 4BR-DET.	Model VI	1	24 x 42	1,008	semi-trailer			11,600*	11,600*
f. 4BR-TOWNHOUSE									

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Semi-trailers (flat bed units with a special rack welded to them to support wall panels and trusses).	Leased	150 miles	615 miles (actual recent shipment)	$0.50		300 miles @ $0.50	$150

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)
a. EXTERIOR	No	ESTIMATED COST $ NR	
b. INTERIOR		ESTIMATED COST $ NR	$ NR

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED
a. COMPANY							
b. DEALER	X	X	X	X	X	X	None
c. SUBCONTRACTOR							
d. OTHER							

3. CLOSE-IN		4. FINISHING	
a. DAYS	1 (7 hrs)	a. DAYS	10
b. MAN-HRS.	42	b. MAN-HRS.	160

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ NR
2. ERECTION (EXT.& INT. FINISH INC.)	$ included in FOB price

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	NR	OF TOTAL DEVELOPMENT COST	NR

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	30 days.		*in place cost, (land acquisition excluded).

GOOD REASON FOR JOINING NATIONAL NOW:

The Total Line of Single Family Housing.

The widest range of single family homes in the business. National offers you a choice of over 300 great designs for marketing in your area. They're market-right in size, style, architecture, price. No matter who your prospects are, they can come to you and get the specific homes they want and need.

GOOD REASON FOR JOINING NATIONAL NOW:

The Total Line of Multi-Family Housing.

National keeps you on top of this ever-increasing market. Our special, full-scale Multi-Family Dwelling Program offers exciting new concepts and new thinking in townhomes, duplexes, tri-plexes, garden apartments, quadrominiums. National's designs and programs are capturing the attention of buyers and builders throughout the industry.

GOOD REASON FOR JOINING NATIONAL NOW:

Marketing Support All Year 'Round.

National Homes provides its builders with full scale marketing programs several times yearly. Newspaper ads, radio and TV, billboards, road ads, and model signs. Incentive programs for your sales force. All of it professionally prepared, dramatic, sales producing.

EQUAL HOUSING OPPORTUNITIES

National HOMES
THE GROWTH SHELTER COMPANY

MORE FAMILIES LIVE IN NATIONAL HOMES THAN ANY OTHER HOMES IN THE WORLD.

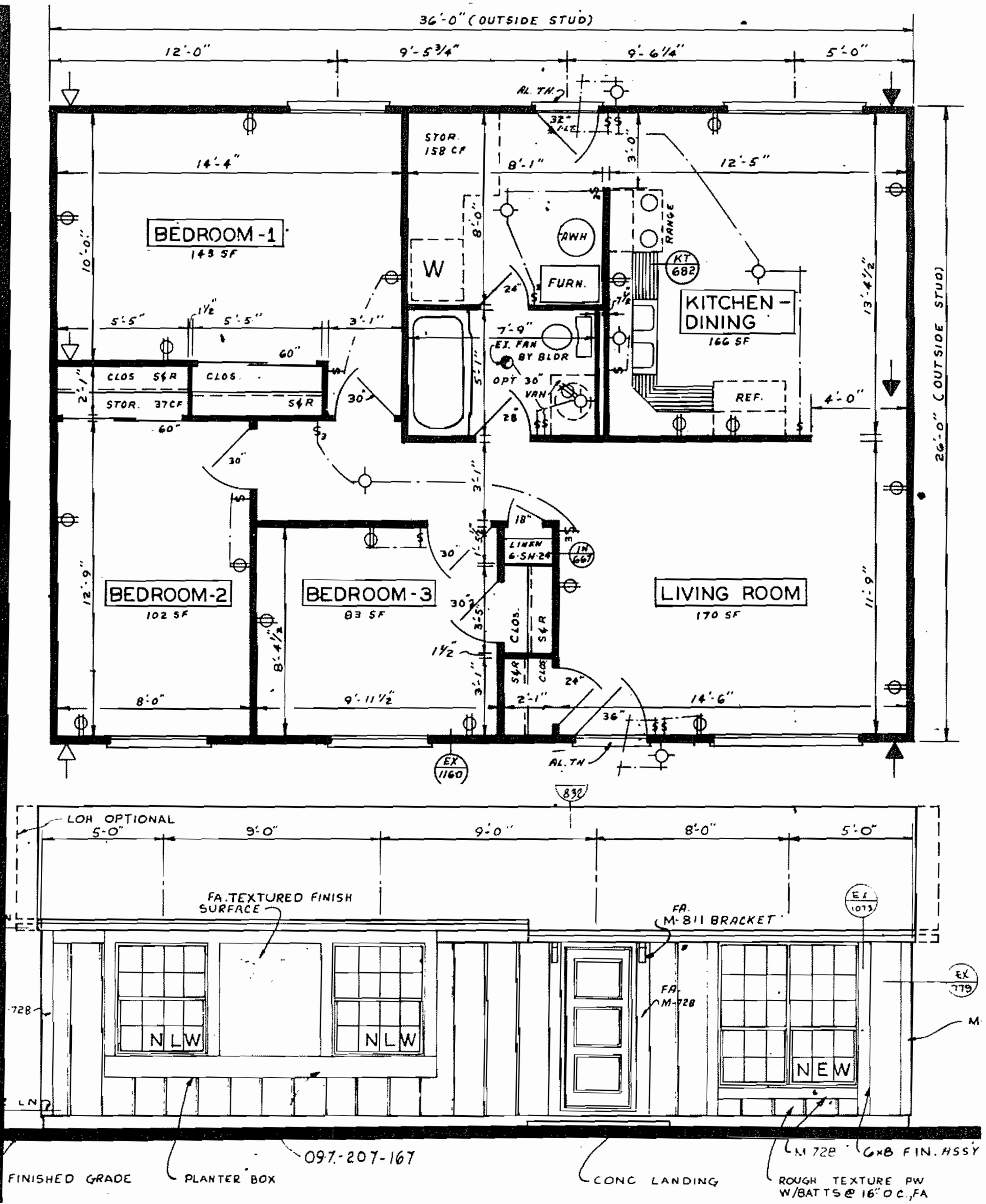
As a National Homes builder, you'll use the system that gives you more style variations, minimum on-site costs, fewer delays, tighter cost controls all the way down the line. Building National Homes the efficient, modern, crane erection way, you'll be doing what good builders should—building better and faster, capturing a bigger share of your market.

The fact that we're the largest company of its kind is important to you. It means we've got the resources and capability to do more for builders than any other company in the industry.

WE DO MORE TO HELP YOU BUILD MORE.
Our program is complete in every respect. No other company comes close to matching the program we put into builder's hands. A program that helps every builder build more, sell more, profit more. It holds true whether you build 10 homes, 50, 100. Or more. Whether you've been building for years, or are just beginning.

WE DO MORE TO HELP YOU GROW MORE.
The more than 1200 builders who joined us in 1973 talked to other companies first. Saw their programs, heard their plans. They took a long, hard look, and then came to National. Because here they get everything a builder needs. Everything. From site to sale.

WE DO MORE TO HELP YOU PROFIT MORE.
After you've talked to the others, talk to us. You'll find nobody does more to put you ahead of the competitors in your market. And keep you ahead year after year.



TOTAL AREA
LIVING 936 SF
STORAGE
OUTSIDE 305 CF
INSIDE 195 CF
TOTAL 500 CF

MODEL 7650
DESIGN 20
RH ELEVATIONS

NATIONAL HOMES CORP

SYSTEMS DESCRIPTION 17

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM	
A. CURRENT PROD. RANGE	Single-family detached, semi-detached, townhouses, garden apartments, schools, single-wide/ mobile homes
B. YRS. OF IND.BLDG EXP	32 years
C. MAIN STRUCT. SYSTEM	Wood
D. BASIC CONFIGURATION	Open panel, closed panel and mechanical cores and panels
E. NUMBER OF PLANTS	7 (1. Lafayette, IN; 2. Effingham, IL; 3. Tyler, TX; 4. Martinsville, VA; 5. Thomson, GA; 6. Horseheads, NY; 7. Meridian, MS)

THE MANUFACTURER P 31

National Homes Corp.
Earl Ave. & Wallace
Lafayette, IN 47902
(317) 447-3131
Attn: Mr. Willard Wirth

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO
a. 2BR-DET.	# 7434	1	24 x 32	768	Basic trailer	1.24	To all
b. 2BR-TOWNHOUSE	# 206	2	20 x 24	960	package =	2.10	states east
c. 3BR-DET.	# 7550	1	26 x 36	936	15'40" x	3.10	of Rocky
d. 3BR-TOWNHOUSE	# 306	2	20 x 28	1,120	8'x10' high	4.12	Mountains
e. 4BR-DET.	# 7815	1	28 x 38	1,064		5.15	
f. 4BR-TOWNHOUSE	# 406	2	20 x 32	1,280		6.12 7.10	

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS
	Closed Vans	Company owned	200 miles	600 miles	$1.50	

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE
a. EXTERIOR	No	ESTIMATED COST $ NR
b. INTERIOR	No	ESTIMATED COST $ NR

D. SITE ERECTION	SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH
	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS					
a. COMPANY*	X	X	X	X	X	X
b. DEALER	X	X	X	X	X	X
c. SUBCONTRACTOR	X	X	X	X	X	X
d. OTHER						

3. CLOSE-IN	a. DAYS	1	4. FINISHING	a. DAYS	15
	b. MAN-HRS.	32		b. MAN-HRS.	100

2. SPECIAL EQUIPMENT REQUIRED

None, however, cranes are provided on NHCC tractors.

E. MAINTENANCE	
Warranty	One year standard FHA warranty.

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS
	10 to 12 weeks	

III. COST INFORMATION

A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
Confidential	

B. $ PER UNIT PER AVERAGE SHIPMENT	
300 miles @ $1.50	$450

C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
	$ NR

D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
1. FOUNDATIONS (PERIMETER)	$ NR
2. ERECTION (EXT.& INT. FINISH INC.)	$ NR

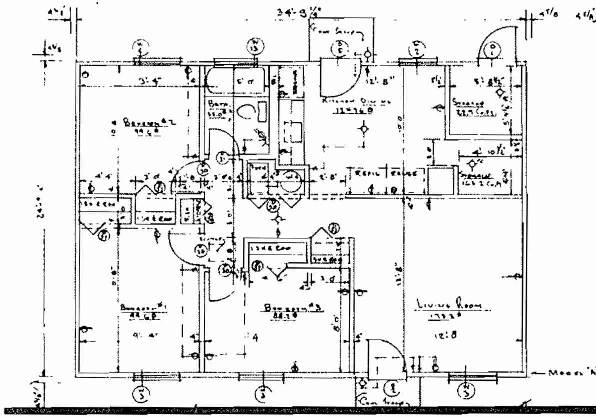
E. BUILDER'S PROFIT	
OF TOTAL DEVELOPMENT COST	NR

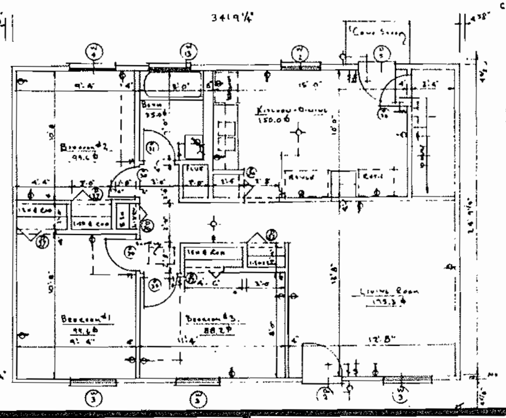
FOOTNOTES

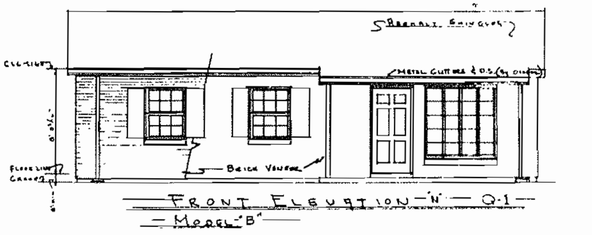
*National Homes Construction Co. is capable of performing these functions on specific jobs.

U. S. Steel Homes
Division of United States Steel Corporation

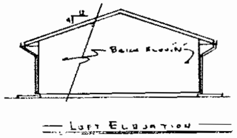
RANCH SERIES 2903
January 15, 1972



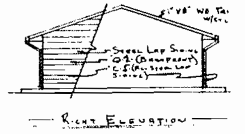




FRONT ELEVATION 'N' — Q-1
— MODEL 'B'



LEFT ELEVATION



RIGHT ELEVATION

THE BASIC #2903 PLANS INCLUDE THE FOLLOWING MATERIALS:

Exterior steel framed wall panels with 1/2" asphalt impregnated sheathing and 1/2" standard gypsum factory applied. 2" insulation installed in panel.

Window panels with Capitol aluminum sash installed in panels. (See plans for light divisions.)
Aluminum screens and steel clad window stools supplied in package.

Ventilating bow window (Andersen wood with single strength glass) included in Model B.)

Steel clad exterior door units - design per elevation plan.
Yale and Towne exterior knob set BR 5298-Brass.
Interior trim and exterior door supplied in package.

Wood sill plates and wood top plates.

Interior steel framed partition panels with 1/2" standard gypsum factory applied.

Interior door panels with pre-finished mahogany doors hung in panels. (Doors bagged for protection.)
Yale and Towne interior knob set No. 5200 series, passage for bedrooms, chrome-brass privacy for baths, and privacy for basement entry.

Plumbing chase walls KD. (Plumbing not included.)

Leigh colonial design, Series PF, steel folding louvered furnace room door. (Slab and crawl plans only.)

Closet header panels with gypsum applied.

Baseboard - unfinished.

Trusses with 24" eave overhang, factory assembled with Gang-Nail fasteners (Model Nos. A & C).

Trusses with 12" eave overhang, factory assembled with Gang-Nail fasteners (Model B - 2 x 4 porch rafter extensions included - KD). Porch columns included in package.

Trussed gable end panels with 12" gable overhang ladders.

3/8" plywood roof sheathing with nails and plyclips.

15# roofing felt.

Metal vent soffit prepainted.
Metal gutterboard fascia cover with eave and gable drip edge prepainted.
Metal pre-finished brick mould included for gable ends and eaves for brick elevations.

All materials for assembly of United States Steel Homes component parts.

THE FOLLOWING MATERIALS ARE AVAILABLE AS ADDITIONAL COST OPTIONS TO THE BASIC #2903 PLAN:

Exterior wall panels with 4" insulation installed in panel.

Window panels with Huttig "Trim-Tilt" wood sash (except for awning #318 by Andersen) with single strength or insulating glass. Wood snap-in grilles showing divided lights. Wood trim and screens included.

Aluminum storm windows for Capitol or Huttig sash.

Exterior architectural treatment materials: Note - Wood shutters and trim materials included as shown on elevation drawings. (Brick ties included for brick elevations.)

Model "A"

C-1	Wood grain designed steel lap siding
N	Full brick
Q-1	Brick front with wood grain designed steel lap siding

Model "B"

N	Full Brick
Q-1	Brick front with wood grain designed steel lap siding

Model "C"

N-5	Full brick with grooved cedar siding

235/240# Class "C" stick down roof shingles with nails. Colors: Black or white.

1/2" plywood roof sheathing in lieu of 3/8" roof sheathing (without plyclips).

2" blanket ceiling insulation.

4" blanket ceiling insulation.

1/2" standard gypsum board (ceiling and plumb walls). Tape, topping, bedding, and corner beads not included.

Closet Options:

1. Leigh provincial design, Series FF, steel folding closet doors.
2. Flush luan mahogany wood folding doors.
3. Leigh steel closet shelves. (Molly screws for attachment included.)

Pre-finished birch room doors in lieu of mahogany.

SYSTEMS DESCRIPTION 18

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER P 46
A. CURRENT PROD. RANGE	Single-family detached, semi-detached and townhouse; garden apartment, commercial/industrial units; schools	U.S. Steel Homes 2549 Charlestown Rd. New Albany, IN 46514 (812) 944-7711
B. YRS. OF IND.BLDG EXP.	25 years	
C. MAIN STRUCT. SYSTEM	Wood and steel	
D. BASIC CONFIGURATION	Closed panels	
E. NUMBER OF PLANTS	2 (1. U.S. Steel Homes Div., New Albany, IN; 2. U.S. Steel Homes Div., Orlando, FL)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4. FLOOR AREA GROSS SQ. FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A. $ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.							IN, IL,		
b. 2BR-TOWNHOUSE							MI, OH,		
c. 3BR-DET.	2221	1	24'9"x44'9"	1,107	NR	NR	KY	NR	NR
d. 3BR-DET.	2903	1	24'9"x34'9"	875	NR		(350 miles	$3,530*	$3,530*
e. 3BR-TOWNHOUSE	T1826	2	18 x 26	1,864	NR		radius)	2,505*	2,505*
f. 4BR-TOWNHOUSE	T2030	2	20 x 30	1,200	NR			2,530*	2,530*

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4. MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Closed trailer vans	Contract carrier and piggyback rail	350 miles	No limitation	NR		300 miles @ $ NR	NR

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
a. EXTERIOR	No	ESTIMATED COST $ NR		
b. INTERIOR	No	ESTIMATED COST $ NR		$ NR

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3 BR, DETACHED)	
a. COMPANY							None	1. FOUNDATIONS (PERIMETER)	$ NR
b. DEALER	X	X	X	X	X	X			
c. SUBCONTRACTOR	X	X	X	X	X	X		2. ERECTION (EXT.& INT. FINISH INC.)	$ NR
d. OTHER									
	3. CLOSE-IN	a. DAYS	1	4. FINISHING	a. DAYS	21-45			
		b. MAN-HRS.	48		b. MAN-HRS.	NR			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	Included in "Standard Terms and Conditions of Sale"	OF TOTAL DEVELOPMENT COST	NR

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	30 to 45 days.		*Not clear what is included in these prices.

Check the full range of quality Weston features and options!

FEATURES

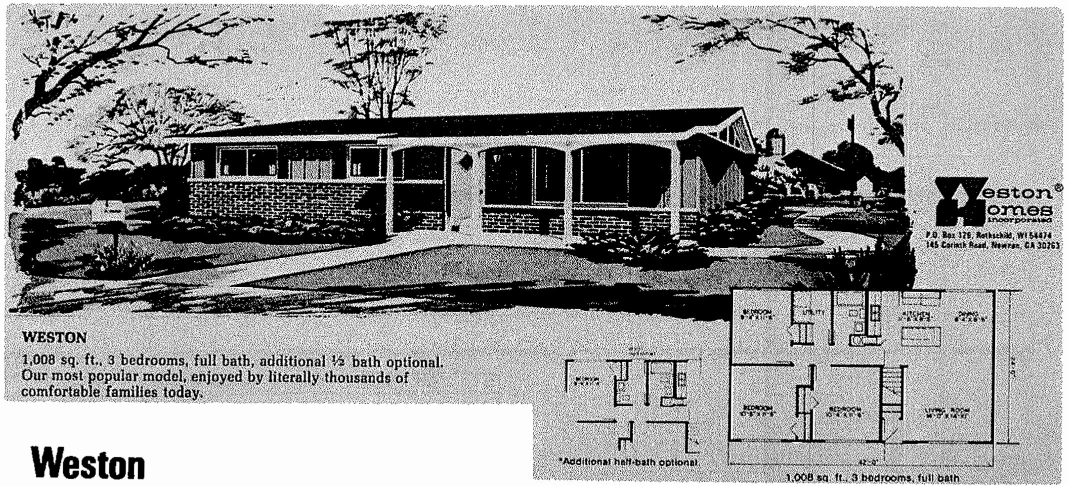
Our highly efficient building system lets you get more without paying more to get it, in any Weston Home. Features you'll find installed in a Weston model include:

- Kitchen . . high-pressure laminated, non-stain, waterproof counter-top and backsplash. Multiple outlets conveniently placed for your plug-in appliances.
- Bath . . . complete in every detail. Full-use medicine chest with lighted mirror. Beautiful vanity with under-bowl storage for towels and bath accessories. Adjustable shower head and diverter.
- Closets . . . six over-size, inside-finished closets located throughout the house include all shelving, rods and hardware installed.
- Fixtures . . . high quality lighting fixtures are installed throughout, with multiple electrical outlets conveniently located in every room.
- Windows . . . are removable, double-strength glass, prefinished, wood framed, double-glider type, with self-storing storms and screens. Wood shutters give exteriors a custom look.
- Doors . . . Snug fitting, full 1¾" wood entry doors with lites. Combination storm doors are finished in baked enamel, have self-storing storms and screens. 1⅜" interior doors, standard. All doors are preframed and installed. All hardware included and installed.
- Complete mechanical package . . . all heating, electrical and plumbing components are top quality throughout. Ample gas, forced air heating system specifically designed for the Weston. A gas hot water heater of appropriate capacity is included and factory installed. Home is entirely pre-wired, with 100 ampere service panel and safety circuit breakers. Lifetime copper plumbing throughout. And rest assured, the Weston meets or exceeds almost every housing standard and code in the country.
- Wall covering . . . on inside of all exterior walls and ceilings is primed, over-size, seamless drywall for smooth appearance and added strength. Ceilings are prefinished, cathedral-beamed, with optional clerestory windows at gable ends.
- Exterior . . . features ruf-sawn wood panel battened, stain primed siding for that rustic architectural effect.

OPTIONS

- Voyageur . . . has large eave overhang, 7' gable end roof extension with carved brackets. Sliding, 6' insulated glass, wood framed patio door has keyed locks and full screens. Presents endless deck or patio possibilities and easy shoreline access.
- Attached garages . . . single is 14'x24', double is 20'x24' . . . install on either end of home. Provide extra storage. Completely detailed in every respect, ready for use. Rear service door included. (Overhead doors not included.) Can be installed as a "dropped" roofline garage, lot configuration permitting, to retain full use of clerestory window and give a bi-level effect.
- Carport . . . has enclosed 4'x8' storage area, generous 12'x24' overall size. Installs at either end of home. Rear entryway included. Can be converted to use as a play area or patio . . . or enclosed later to serve as a true garage.
- Colonial Elevation . . . Our most popular, lower cost option. Lets you add an attractive colonial veranda that creates a distinctive, pleasing effect and provides extra protection against the elements.
- Clerestory Windows . . . install beneath eaves on gable ends of home. Weatherstripped, inner and outer panes are removable for easy cleaning. Adds light, open effect to living room and bedrooms.
- Electric Heating . . . an alternate, electric furnace and water heater option is available. Incorporates 200 ampere service panel.
- Expansions and Additions . . . should you require an expanded plan or minor alterations, consult your Weston Homes dealer.
- Half-Bath . . . can be installed in place of utility room where basement is included. An optional entryway door makes this area an ideal mud-room for children.

Specifications may vary between plant locations. Contact the Weston man in your area. Weston Homes, Inc., reserves the right to change specifications or components without notice, and warrants that such changes will not lessen the quality of its products.



Weston® Homes Incorporated
P.O. Box 176, Rothschild, WI 54474
145 Corinth Road, Newnan, GA 30263

WESTON
1,008 sq. ft., 3 bedrooms, full bath, additional ½ bath optional. Our most popular model, enjoyed by literally thousands of comfortable families today.

*Additional half-bath optional.

1,008 sq. ft., 3 bedrooms, full bath

Weston

Our original and most popular model, the Weston 3-bedroom rancher, is the home experts said couldn't be built at its price. Yet, in just a few short years, thousands of Weston owners have proven the experts wrong.

Large in space (1,008 sq. ft.), low in price . . . the Weston is the best example of economical, permanent housing now available anywhere. This attractive model is ideal for the medium-sized, growing family and proudly takes its place in any setting, urban or rural. It comes to you complete with all heating, plumbing and electrical systems installed.

The liveability of the Weston becomes obvious as you enter. Large living/dining area is highlighted by cathedral beamed ceilings and a full-length clerestory window* in the gable end. There's a beautiful balance of seamless, factory primed drywall on the inner surface of all outside walls, and rich, wood paneling that's pre-sanded, ready for your choice of finish, on the interior walls.

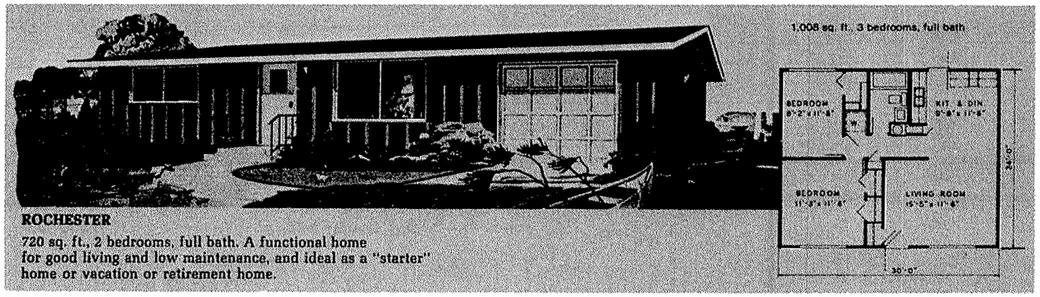
The kitchen, designed with the busy housewife in mind, features an island snack bar that doubles as a convenient serving area. Quality prefinished hardwood cabinets in the island, and above the sink and appliance stations, offer more than ample storage space. Other major features include a modern double sink and a range exhaust fan. (See features.)

Centrally located, the wide, paneled hallway leads to a complete full bath and three lovely bedrooms. The bath includes quality fixtures throughout, like the recessed tub/shower with full height shower enclosure and controls . . . everything from inlaid floor to exhaust fan is complete, ready for you to add towels.

You'll find the utility room with its linen closet offers an added plus! Not only is it sized right for your washer and dryer, but it can be used for additional storage. If basement is included, utility room becomes available for use as a half-bath*, sewing room, or as a mud room, with the addition of an entryway.

Bedrooms are light and airy, all have cathedral beamed ceilings and two share a large clerestory window* in the gable end. Each bedroom has its own "full-use" closet, inside finished, including clothes rails and storage shelves. Wide, bi-folding wood doors give easy access. With the bedroom closets, foyer "guest" closet and the utility room, there is more than ample storage space.

The Weston offers you more . . . more features, more fixtures . . . without asking you to pay more to get them. Add to this one of the most liveable floor plans around, and you have many good reasons for going Weston!
(*Optional)



1,008 sq. ft., 3 bedrooms, full bath

ROCHESTER
720 sq. ft., 2 bedrooms, full bath. A functional home for good living and low maintenance, and ideal as a "starter" home or vacation or retirement home.

SYSTEMS DESCRIPTION 19

FAST DELIVERY PERMANENT HOME - SURVEY OF INTERESTED MANUFACTURERS

I. GENERAL DESCRIPTION OF THE SYSTEM		THE MANUFACTURER P 48a
A. CURRENT PROD. RANGE	Single-family detached, townhouse, motels, duplexes	Weston Homes, Inc. P.O. Box 126 Rothschild, Wisconsin 54474 (715) 359-4281 Attn: Paul T. Ott
B. YRS. OF IND.BLDG EXP	14	
C. MAIN STRUCT. SYSTEM	Wood	
D. BASIC CONFIGURATION	Mechanical cores and panels (closed)	
E. NUMBER OF PLANTS	2 (1. Newnan, GA; Rothschild, WI)	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

III. COST INFORMATION

A. HOUSING TYPE (LIVABILITY)	1. MODEL SELECTED FOR ANALYSIS	2. # OF FLOORS	3. OUTSIDE DIMENSIONS	4.FLOOR AREA GROSS SQ.FT.	5. MODULE/ PACKAGE SIZE	6. PROD. PER SINGLE SHIFT	7. STATES SHIPPED INTO	A.$ PER UNIT F.O.B. PLANT 20 UNITS	50+ UNITS
a. 2BR-DET.	Rochester	1	24 x 30	720	Less than 1 load	Newnan, Ga.-	All states	$ 9,550	$ 9,550
b. 2BR-TOWNHOUSE	Corinth Townhouse	2	22 x 24	1,056	1 drop deck trailer load	4;	east of Mont	11,650	11,650
c. 3BR-DET.	Weston	1	24 x 42	1,008	1 drop deck trailer load	Rothschild,	Wyo,Col,not	10,815	10,815
d. 3BR-TOWNHOUSE	Corinth Townhouse	2	34x24 or 26x24	1632 or 1248	1 load	Wisc.- 8	NM,Tex,Ark,	15,720	15,720
e. 4BR-DET.	Birmingham (1½ bath)	1	24 x 50	1,200	1 truck load		La,Okla,Me,	13,000	13,000
f. 4BR-TOWNHOUSE							Mass,Vt,NH, NJ,Del,Conn.	*(34x24 only)	

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. CARRIER	3. AV. SHIPPING DIST.	4.MAX. SHIPPING DIST.	5. AVERAGE COST/MILE	6. COMMENTS	B. $ PER UNIT PER AVERAGE SHIPMENT	
	Drop deck trailer Rail	Trailer and rail. 75% of shipments were company owned vehicles	250-350 miles	World-wide	$1.25 loaded mile by truck; $0.80 to $1.00 for rail		300 miles @ $1.25	$325

C. STORABILITY	1. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) PROVIDED AND INCLUDED IN F.O.B. PRICE	2. PACKAGING FOR EXTENDED STORAGE (6 MONTHS) NOT NORMALLY PROVIDED AND NOT INCLUDED IN F.O.B. PRICE	C. $ PER UNIT FOR PACKAGING (IF NOT INC. IN FOB)	
a. EXTERIOR	Yes	ESTIMATED COST $ -		$ -
b. INTERIOR		ESTIMATED COST $ -		

D. SITE ERECTION	1. TYPICAL SITE ERECTION PROCESS AND ITS PARTICIPANTS SITE DEV	FOUNDATIONS	ERECTION	UT. HOOK-UP	INT. FINISH	EXT. FINISH	2. SPECIAL EQUIPMENT REQUIRED	D. $ PER UNIT FOR SITE ERECTION (3BR, DETACHED)	
a. COMPANY			X				Hydro crane with a min. 40' boom.	1. FOUNDATIONS (PERIMETER)	$ 1,000
b. DEALER	X	X	X	X	X	X			
c. SUBCONTRACTOR	X	X	X	X	X	X			
d. OTHER	scattered lot then owner	owner	X	X	X	X		2. ERECTION (EXT.&INT. FINISH INC.)	$ 1,800
	3. CLOSE-IN Weston 1,008 sq. ft.	a. DAYS	3 (4 men)	4. FINISHING	a. DAYS	7-10			
		b. MAN-HRS.	100		b. MAN-HRS.	-			

E. MAINTENANCE		E. BUILDER'S PROFIT	
Warranty	Warranty is as stated in dealer operating guide plus supplies warrantees. Have complete home-owners manual furnished with each home purchased.	OF TOTAL DEVELOPMENT COST	15%

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION	2. MISCELLANEOUS SUGGESTIONS	FOOTNOTES
	Typically 4-6 weeks on all standardized products. 8-10 weeks for townhouse. Order to occupancy can be 30 days.	Pick up by buyer rather than utilize company.	

(2) Cost Estimates for Site Preparation, Foundations and Site Erection of a Typical 24'x42'-46' Modular/ Sectional Home by Area of Major Demand for Temporary Housing and State

(a) Western Earthquake Area

ACQUISITION/ FOUNDATION		REGION 1		
		CA	NV	WA
ALT. 1:	EXISTING SITE			
	CLEARANCE (30,000 cu.ft. frame house, 1/4 acre site)	$ 161	$ 167	$ 155
	PERIMETER FOUNDATIONS (excavation, footings, blocks, backfill)	1,657	1,725	1,588
	TOTAL - ALT. 1	$1,818	$1,892	$1,743
ALT. 2:	NEW SITE			
	LOT ACQUISITION (1/4 acre)	$3,528	$3,680	$3,404
	PERIMETER FOUNDATIONS (excavation, footings, blocks, backfill)	1,657	1,725	1,588
	TOTAL - ALT. 2	$5,185	$5,405	$4,992
UTILITY CONNECTIONS:	WATER			
	a. Connection to main in street.	$ 450	$ 469	$ 434
	(b. Well and pump.)	(375	391	361)
	SEWAGE			
	a. Connection to sewer in street.	299	313	289
	(b. Septic tank.)	(168	176	162)
	ELECTRICITY	150	156	145
	TELEPHONE	94	98	91
	TOTAL - UTILITY CONNECTIONS (ALT. a)	$ 993	$1,036	$ 959
SITE ERECTION:	24' x 44' sectional wood frame on foundation including utility hook-ups, exterior and interior finishing.			
	TOTAL - SITE ERECTION	$1,216	$1,263	$1,163
SITE COST:	Landscaping, walks, driveways			
	Miscellaneous (fees, permits)			
	TOTAL - SITE COST	$ 638	$ 665	$ 615

Prepared by McKee-Berger-Mansueto Inc.

(b) Central Tornado Area

ACQUISITION/ FOUNDATION		REGION 2			
		IA	KS	OK	TX
ALT. 1:	EXISTING SITE				
	CLEARANCE (30,000 cu.ft. frame house, 1/4 acre site)	$ 148	$ 162	$ 139	$ 136
	EXISTING BASEMENT	-	-	-	-
	TOTAL - ALT. 1	$ 148	$ 162	$ 139	$ 136
ALT. 2:	NEW SITE				
	LOT ACQUISITION (1/4 acre)	$3,260	$3,560	$3,064	$2,984
	FOUNDATIONS AND BASEMENT	3,032	3,310	2,850	2,775
	TOTAL - ALT. 2	$6,292	$6,870	$5,914	$5,759
UTILITY CONNECTIONS:	WATER				
	a. Connection to main in street.	$ 416	$ 454	$ 391	$ 381
	(b. Well and pump.)	(346	378	326	317)
	SEWAGE				
	a. Connection to sewer in street.	277	303	260	253
	(b. Septic tank.)	(156	170	146	143)
	ELECTRICITY	139	151	130	127
	TELEPHONE	87	94	82	79
	TOTAL - UTILITY CONNECTIONS (ALT. a)	$ 919	$1,002	$ 863	$ 840
SITE ERECTION:	24' x 44' sectional wood frame on foundation including utility hook-ups, exterior and interior finishing.				
	TOTAL - SITE ERECTION	$1,113	$1,213	$1,015	$1,025
SITE COST:	Landscaping, walks, driveways				
	Miscellaneous (fees, permits)				
	TOTAL - SITE COST	$ 589	$ 643	$ 553	$ 539

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(c) Southern Hurricane and Flood Area

ACQUISITION/ FOUNDATION		REGION 3									
		AL	AR	FL	GA	LA	MS	NC	SC	TE	VA
ALT. 1:	EXISTING SITE										
	CLEARANCE (30,000 cu.ft. frame house, 1/4 acre site)	$ 122	$ 130	$ 133	$ 139	$ 131	$ 123	$ 121	$ 115	$ 127	$ 126
	STILT FOUNDATIONS (10' high, stairs)	1,117	1,197	1,226	1,270	1,203	1,131	1,108	1,051	1,167	1,155
	TOTAL - ALT. 1	$1,239	$1,327	$1,359	$1,409	$1,334	$1,254	$1,229	$1,166	$1,294	$1,281
ALT. 2:	NEW SITE										
	LOT ACQUISITION (1/4 acre)	$2,672	$2,864	$2,932	$3,040	$2,880	$2,708	$2,652	$2,516	$2,792	$3,213
	PERIMETER FOUNDATIONS (excavation, footings, blocks, backfill)	1,247	1,332	1,366	1,435	1,349	1,264	1,247	1,179	1,298	1,294
	TOTAL - ALT. 2	$3,919	$4,196	$4,298	$4,475	$4,229	$3,972	$3,899	$3,695	$4,090	$4,507
UTILITY CONNECTIONS:	WATER										
	a. Connection to main in street.	$ 341	$ 366	$ 373	$ 388	$ 367	$ 345	$ 337	$ 320	$ 356	$ 353
	(b. Well and pump.)	(284	304	312	323	306	287	282	268	296	294)
	SEWAGE										
	a. Connection to sewer in street.	228	243	249	258	194	230	225	214	237	235
	(b. Septic tank.)	(128	137	140	145	138	129	127	121	133	133)
	ELECTRICITY	114	122	125	129	122	115	113	107	119	117
	TELEPHONE	71	77	78	81	77	72	71	67	94	73
	TOTAL - UTILITY CONNECTIONS (ALT. a)	$ 754	$ 808	$ 825	$ 856	$ 760	$ 762	$ 746	$ 708	$ 806	$ 778
SITE ERECTION:	24' x 44' sectional wood frame on foundation including utility hook-ups, exterior and interior finishings.										
ALT. 1:	TOTAL - ON STILT FOUNDATIONS	$1,059	$1,131	$1,160	$1,218	$1,146	$1,116	$1,071	$1,051	$1,001	$1,102
ALT. 2:	TOTAL - ON PERIMETER FOUNDATIONS	$ 913	$ 975	$1,000	$1,050	$ 988	$ 968	$ 925	$ 913	$ 863	$ 950
SITE COST:	Landscaping, walks, driveways										
	Miscellaneous (fees, permits)										
	TOTAL - SITE COST	$ 482	$ 517	$ 530	$ 549	$ 520	$ 489	$ 479	$ 455	$ 504	$ 499

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(d) Eastern Tropical Storm Area

ACQUISITION/ FOUNDATION		REGION 4										
		CT	DE	MA	MD	ME	NH	NJ	NY	PA	RI	VT
ALT. 1:	EXISTING SITE											
	CLEARANCE (30,000 cu.ft. frame house, 1/4 acre site)	$ 165	$ 162	$ 164	$ 149	$ 142	$ 149	$ 167	$ 182	$ 166	$ 158	$ 148
	STILT FOUNDATIONS (10' high, stairs)	1,515	1,491	1,511	1,371	1,304	1,364	1,528	1,672	1,522	1,454	1,356
	TOTAL - ALT. 1	$1,680	$1,653	$1,675	$1,520	$1,446	$1,513	$1,695	$1,854	$1,688	$1,612	$1,504
ALT. 2:	NEW SITE											
	LOT ACQUISITION (1/4 acre)	$3,624	$3,568	$3,616	$3,280	$3,120	$3,268	$3,656	$4,000	$3,644	$3,480	$3,244
	PERIMETER FOUNDATIONS (excavation, footings, blocks, backfill)	1,691	1,657	1,674	1,537	1,469	1,537	1,717	1,879	1,708	1,623	1,520
	TOTAL - ALT. 2	$5,315	$5,225	$5,290	$4,817	$4,589	$4,805	$5,373	$5,879	$5,352	$5,103	$4,764
UTILITY CONNECTIONS:	WATER											
	a. Connection to main in street.	$ 462	$ 455	$ 461	$ 418	$ 398	$ 417	$ 466	$ 510	$ 465	$ 469	$ 413
	(b. Well and pump.)	(385	379	384	349	331	348	388	425	387	370	344)
	SEWAGE											
	a. Connection to sewer in street.	308	303	307	279	265	277	311	340	309	296	275
	(b. Septic tank.)	(173	171	173	157	150	156	175	191	174	167	155)
	ELECTRICITY	154	151	153	139	133	139	156	170	156	148	138
	TELEPHONE	96	95	96	88	83	87	97	106	97	93	86
	TOTAL - UTILITY CONNECTIONS (ALT. a)	$1,020	$1,004	$1,017	$ 924	$ 879	$ 920	$1,030	$1,126	$1,027	$1,006	$ 912
SITE ERECTION:	24' x 44' sectional wood frame on foundation including utility hook-ups, exterior and interior finishing.											
ALT. 1:	TOTAL - ON STILT FOUNDATIONS	$1,436	$1,407	$1,321	$1,305	$1,247	$1,305	$1,457	$1,595	$1,350	$1,378	$1,291
ALT. 2:	TOTAL - ON PERIMETER FOUNDATIONS	1,238	1,213	1,225	1,125	1,075	1,125	1,256	1,375	1,250	1,188	1,113
SITE COST:	Landscaping, walks, driveways											
	Miscellaneous (fees, permits)											
	TOTAL - SITE COST	$ 655	$ 644	$ 653	$ 592	$ 564	$ 589	$ 660	$ 723	$ 657	$ 629	$ 586

Prepared by McKee-Berger-Mansueto Inc.

(3) Median Values of Single-Family Homes, Contract Rent and Income for Areas of Major Demand for Temporary Housing -- Selected States

Relief Situation	State Selected
Western Earthquakes	California
Central Tornadoes	Kansas
Southern Hurricanes and Floods	Louisiana
Eastern Tropical Storms	Pennsylvania

State	Median Value of Single-Family Home	Median Contract Rent	Median Income
California	$23,100	$113	$10,700
Kansas	12,000	75	8,700
Louisiana	14,600	62	7,500
Pennsylvania	13,600	73	9,600

Source: U.S. Department of Commerce, 1970 Census of Population and Housing.

C. MANUFACTURERS OF SPECIAL RELOCATABLE SYSTEMS

1. INTRODUCTION AND SUMMARY

The industrialized housing industry is organized in two principal parts: the mobile home industry and the manufactured housing industry.* In the two preceding reports these industries were profiled and their products evaluated for HUD's disaster relief mission.

This report does not treat a clearly definable group of manufacturers but focuses instead on manufacturers of "special relocatable systems," a term developed for this study. These systems include housing systems developed for a variety of purposes by various public and private agents. However, these systems have one important aspect in common: they are fairly marginal phenomena if considered in the context of the whole building industry. But these systems and their manufacturers are viable. Some of the companies have grown dramatically during recent years and seem less affected by the current slump in construction than other producers.**

This report is organized into three main sections:

- Relocatable systems developed for the military.

- Relocatable systems developed for the private market.

- Other commercial relocatable systems.

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* The subsystems and components industry serves as supplier to these industries and to the building industry as a whole.

** Witness manufacturers building camp systems.

a. Relocatable Systems Developed for the Military

The military traditionally has had a strong interest in relocatable shelters. Tents have served this purpose throughout the ages. Additional and more rigid relocatable shelters are required today for special equipment and semi-permanent installations.

During the past decade the military has tried to use the technology and research resources of the aerospace industry to develop new, easily relocatable shelter systems. Several prominent aerospace manufacturers have participated in ambitious programs designed for this purpose. As a result, several new and extremely rugged systems have been developed; however, most have not gone beyond the prototype phase. These systems are engineered to be transportable by air, sea and land. The newer ones are "containerized" -- that is, they are built to be shipped in 8'x8'x5'-40' containers. Since October, 1972, the Department of Defense (DOD) has required that all relocatable systems comply with container standards of the International Standards Organization (ISO).

Most interesting is the military's recent reassessment of its previous concern with new technology. Partly because of cost problems, partly because of greater awareness of commercially available systems, the military is now showing more interest in possible adaptation of marketed technology.

b. Relocatable Housing Systems Developed for the Private Market

Although most manufactured housing is not designed to be relocatable, the commercial sector provides a variety of special relocatable housing systems.

The most easily identified industry segment is the manufacturers of camp systems -- that is, structures specifically developed for temporary use in construction camps, oil fields and the like.

A second small group of manufacturers who expressed interest in this study produces honeycomb panel systems, a technology originally developed for airplanes.

Dome systems were included because the geodesic principle is often said to have superior structural efficiency.

Finally, a group of odd but sometimes innovative housing systems developed for various purposes was combined under the label miscellaneous systems.

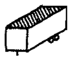
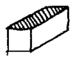
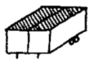
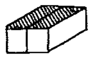
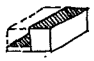
c. Other Commercial Relocatable Shelter Systems

Another group of relocatable building systems is designed and marketed not for housing but for general shelter purposes. Two of these categories -- air structures and metal structures -- have frequently been considered for disaster relief. The third category -- container vans -- was included because containers are designed for frequent and rugged shipment and because the military regards them as important temporary structures.

Since these shelter systems are incomplete for housing purposes, they are evaluated in combination with separate mechanical core subsystems. Separate mechanical cores are discussed in the report called "Selected Components."

Based on criteria for pre-selection, 11 of the 30 special relocatable systems were pre-selected for special cost-effectiveness analysis in Task Report II. Figure 28 presents an overview of the 30 systems evaluated and the 11 systems pre-selected for cost-effectiveness analysis.

FIGURE 25
SPECIAL RELOCATABLE SYSTEMS BY BASIC CONFIGURATION

BASIC CONFIGURATION / INDUSTRY SEGMENT	ONE BOX		EXPANDABLE BOX		TWO OR MORE SECTIONAL BOXES		SECTIONAL BOX(ES) AND KNOCK-DOWN(S)	CORE AND PANELIZED	CORE & SPECIAL PACKAGED ENCL.
	ON WHEELS	GENERAL	ON WHEELS	GENERAL	ON WHEELS	GENERAL			
	 1	 2	 3	 4	 5	 6	 7	 8	 9
MANUFACTURERS OF SPECIAL RELOCATABLE SYSTEMS									
a. Military									
(1) Air Force				**USA Home[2] Goodyear ES/C[2]				**Goodyear MPASS[1]	Goodyear Personnel Shelter EXP[1]
(2) Army								AFCS[1] Transportable Rec. Shelter[1C]	MUST Air-Supported Shelter[1]
(3) Navy				N. Am. Rockwell TACOSS[2C]		N. Am. Rockwell Quick Camp[2C]	Northrop USMC[2C]		
b. Private Market Housing Systems									
(1) Camp Systems	(Atco Ind. Ltd.[2]) (Atlantic Int'l.[2]) (Elder Int'l.[2]) (Porta-Kamp[2])					(Atco Ind. Ltd.[2]) (Atlantic Intl.[2]) (Elder Int'l.[2]) (Porta-Kamp[2])	(Atco Ind. Ltd[2]) **Atlantic Int'l[2] (Elder Int'l.[2]) Porta-Kamp[2]	**Atco Ind. Ltd.[2]	
(2) Honeycomb Panel Systems								Endure Prod.[1] **Panelfab Intl.[2]	
(3) Dome Systems									Circle[1] Dome E.[1] **Geodesic[1] O'Dome[1] Univ. Hsg. Syst.[2] A.G. Windfield[2]
(4) Miscellaneous Systems		Atlas Portable[2]		**Altair Ind.[2] Interdesign Inc[2]					
c. Other Commercial Relocatable Shelter Systems									
(1) Air Structures									Air-O-Struct.[1] Birdair Struct.[1]
(2) Metal Structures									**Armco[1] **Concor[1] Stransteel[1]
(3) Container Vans						**Fruehauf or similar[1C]			

C - Containerized System

1 - Existing technology without integral mechanical core.
2 - Existing technology with potential integral mechanical core.
* - Included in cost-effectiveness analysis as marketed (meeting HUD/EPS Level I retention criteria).
**- Included in cost-effectiveness analysis with a floor plan specially adapted to meet the Minimum Livability Standards for Temporary Housing established for this study.
( ) The systems produced by the manufacturer in this category ("Basic Configuration) are not specifically evaluated in the report.

2. INDUSTRY PROFILE

a. Military Demand for Relocatable Housing and Shelter

War has been an important agent in the development of technology, including such marginal fields as relocatable housing. From the beginning of history, participants in military campaigns have used tents, the oldest and best known relocatable shelter. The ancient art of tent-building has survived and gained sophistication throughout the ages.

Even today, in an age of nuclear arsenals, the tent is the principal shelter for soldiers in the field. However, recent technological sophistication has created the need for additional types of relocatable shelters. Needed are more rigid shelters to house sophisticated equipment serving logistical, maintenance, administrative, medical and other support functions during military missions. Also needed are relocatable semi-permanent shelters for temporary military installations. As stated in a recent Army report:

> One of the major lessons learned during operations in Southeast Asia was the need for modern base development facilities. Among these was a family of pre-engineered/prefabricated relocatable structures to be used to support Army equipment, operations and personnel in semi-permanent installations.*

Conventional methods of building such facilities have been criticized for lack of cost-effectiveness. Accord-

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* U.S. Army Engineer School, "Pre-Engineered Logistical and Administrative Structures (PLAST)," p. xii.

ing to an Army report, these methods

> required excessive amounts of manpower for erection and were not designed to be relocatable or retrievable. As a result those structures erected in overseas areas were either given or sold to a country or abandoned when the need for their use no longer existed. Two reasons for this existed. Manpower requirements for disassembly of the structures were excessive in relation to salvage benefits achieved. In those cases where retrieval was attempted the amounts and sizes of components salvaged were not sufficient to reconstruct a similar building.*

(1) Emergence of Relocatable Building Systems for Semi-Permanent Military Purposes During World War II

As pointed out in the preceding report, the military has been actively developing relocatable semi-permanent structures since World War II. In the beginning of the war, housing for large numbers of defense workers had to be provided quickly. To avoid creation of future "ghost towns," the government strongly encouraged relocatable manufactured construction. Some of today's largest housing manufacturers developed from small companies which participated in that program.

After the war, however, manufactured housing became more dependent on the private market. As a result, relocatability was less important than the ability to compete with conventional, permanent construction. Today only special segments of the manufactured housing industry advertise their products as relocatable. The typical manufacturers try to make their models as similar to conventional construction as possible.

The military's need for relocatable shelters during World War II also was responsible for large-scale

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* U.S. Army Engineer School, "Pre-Engineered Logistical and Administrative Structures (PLAST)," p. xii.

production of the famous quonset hut which helped the metal building industry emerge. After the war, metal building manufacturers also had to adjust to private market demands and relocatability became less important than competition with conventional construction.*

(2) Proliferation of Experimental Systems During the Vietnam Era

The Vietnam War generated a large-scale need for temporary military support structures. Mainly due to the space program and the arms race, technology had become far more sophisticated than it was in the early 1940's. It appeared that new scientific approaches and materials could help create entire new methods of housing construction. The war offered an opportunity to experiment. During the initial phase each branch of the military service began developing relocatable shelter systems. Often these systems were designed to meet unique tactical needs and serve a wide range of functions including kitchen/mess, latrine/shower, classrooms, administration, chapels, vehicular maintenance, supply storehouses, repair shops, hospitals, aircraft hangars, enlisted clubs and barracks.

However, these early efforts were often uncoordinated. Each branch of service worked on its own systems in its own laboratories with its own requirements. Military shelter systems proliferated, but their applicability was limited by duplication of efforts, unnecessary specialization and lack of a comprehensive, coordinated approach. Recognizing these problems, DOD issued "Guidelines for Relocatable Buildings" in May, 1970, and began an inventory of systems being used or developed. The "Reference Manual on Shelters" prepared by the U.S. Army Natick Laboratories in January, 1972, represents one of the first comprehensive inventories. It contains

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* The Army still uses metal structures like the "Butler Hut" although they cannot be relocated easily.

descriptions and illustrations of 130 shelters. Presumably these were all the systems actually available or planned by the Army, Air Force and Marine Corps. Tents still accounted for nearly 50 per cent of all shelters in the catalogue, but this category included advanced, large, air-supported single-wall and double-wall tents along with conventional military tents.

Most non-tent shelters were designed not for housing but for equipment. They ranged from large relocatable hangars to small mechanical modules.

Most housing systems in the catalogue were being developed by the U.S. Army Cold Regions Research and Engineering Laboratory for use by small groups of scientists or research workers in the Arctic. Only one non-tent system is designed as a housing shelter for a broad range of climates -- the expandable personnel shelter of the Air Force Bare Base System. It represents one of the first tangible results of several ambitious research and development projects initiated by the Air Force and Navy at the end of the Vietnam War.

(3) New Multi-Purpose Shelter System Families

The USAF Bare Base System was developed in the late 1960's to provide shelter and equipment in support of tactical air operations anywhere on short notice. Goodyear Aerospace has been the principal contractor. The system includes hardware to support up to 4,500 airmen at sites with airfield pavement and water which can be made potable. Segments of the system can be used for smaller bases. The system consists of three main support areas: Personnel Support, Aircraft Support and Base Support. The system must meet the following criteria:

- The system must be fully operational within 72 hours after arrival.

- The equipment must last 10 years (five years of storage and two uses per year).

- Erection and storage of the equipment must be handled by personnel.
- The system must be usable and storable in a broad range of climates.

The U.S. Navy developed similar systems. First the Seabee Camp System was developed by North American Rockwell Corporation, another prominent aerospace manufacturer, under a 1970 contract with the Naval Facilities Engineering Command. The objective of this system is stated in the contractor's final report:

> The purpose of the Quick Camp System is to provide minimum, but complete, facilities for the rapid deployment of Seabee groups to virtually any place on earth. The support facilities, provided by the system, are deployable to a forward and/or remote area from an advanced base by helicopter or truck and provide a completely intermodal transportation capability, to the advanced base, compatible with all existing carrier modes.*

The Naval Facilities Engineering Command also funded the prototype development by North American Rockwell of expandable containers designed to serve many functions, including habitation. The complete "family" of these containers was planned to form the Tactical Container Shelter System (TACOSS) which was to be part of the Navy Advanced Base Program.

Northrop Corporation, another aerospace manufacturer, has worked for the Navy since 1971 on another relocatable shelter project. The contract called for procurement documents and prototype development of a "Family of Standardized Shelters and a Logistics Trailer Intended for Use by All U.S. Fleet Marine

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* North American Rockwell, 1972, p. 3. The Seabees are the Navy's Corps of Engineers.

Forces."* While the Air Force and Navy pursued these ambitious research and development projects with aerospace contractors, the Army tended to rely more on its own "in-house" capabilities. As mentioned above, the U.S. Army Natick Laboratories conducted research on relocatable shelters. The Army Security Agency developed a panelized shelter system known as Transportable Recoverable Shelters. In addition, Army headquarters is developing and administering the Army Facilities Components System (AFCS), a comprehensive planning tool for construction of disposable, relocatable and mobile buildings for temporary or semi-permanent use during military missions in various climate zones.**

(4) Current Trends

The military has spent a substantial amount of money to develop relocatable housing systems. The lessons learned are of great interest for this study.

(a) Renewed Interest in Commercially Available Technology

The most significant trend may be the military's current reassessment of its earlier preference for new technology involving the aerospace industry and in-house research and development. The final report on the "Development of a Quick Camp System for Seabees" stated the rationale for previous reservations against commercially available technology:

> Commercial units are not intermodally compatible, are not tailored to the military missions, and have some components of questionable durability.***

Two recent in-house studies by the Air Force and Army suggest that this attitude is being challenged primarily because of expense involved in

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* Northrop Corporation, Volume 1, p. 1-1.

** In this study "relocatable" and "mobile" represent two degrees of relocatable systems.

*** Seabold, p. 1.

the development of new technology. The "Austere Base Concept Study" completed by an Air Force study group in July, 1973, compares the cost-effectiveness of three commercially available shelter systems to that of Goodyear's Personnel Support Area of the Bare Base System. The study concluded that "significant cost savings . . . are possible in the Personnel Support Area"* through the use of commercial technology. The study recommends a similar evaluation of alternatives to other present Bare Base components.

In a similar effort, the U.S. Engineer School in Belvoir, Virginia recently conducted a study on "Pre-Engineered Logistic and Administrative Structures (PLAST)." The two principal objectives were:

- To identify requirements for a more easily transported family of standard, lightweight, pre-engineered and/or prefabricated structures, preferably reusable, capable of rapid assembly and disassembly (if reusable) constructed of lightweight durable materials.

- To examine the state of the art in commercial off-the-shelf and developmental structural systems and evaluate their advantages and disadvantages against the requirements.**

The study led to the following conclusion:

> The preferred construction system is one providing a relocatable/retrieval capability with significant reductions in the dollar cost of materials and in the construction manhour requirements. <u>Currently there are many commercial systems available which can meet these requirements</u>. (Emphasis added)***

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* USAF, "Austere Base Concept Study," p. 3.

** U.S. Army Engineer School, p. xiii.

*** <u>Ibid.</u>, p. F-40.

The 1973 "Joint Services Catalogue of Pre-Engineered Facilities which are Retrievable and Relocatable" succeeded the "Reference Manual on Shelters" quoted above. A review of the new catalogue reveals the same trend toward commercially available technology.

- Thirty-five of the 100 available shelter systems in the catalogue are developed and manufactured by Porta-Kamp Mfg. Corporation -- commercially available housing systems.

- Although the catalogue has a section on "Facilities under R and D" no mention is made of the Seabee Quick Camp system, TACOSS or the U.S. Marine Small Shelter System -- systems that are the subject of ambitious research and development contracts with aerospace manufacturers.

Finally, the current study by Benham, Blair and Affiliates of Medical and Dental Facilities for the Navy incorporates the requirement that "all building envelope systems studied must be commercially available." Furthermore, they must have been previously built, field tested and used in either commercial or military applications.

Thus, the military's current interest in relocatable structures seems clearly to point away from the costly approach of developing new technology. Now the focus seems to be on making the best possible use of available and proven systems meeting or adapted to specified military requirements.*

(b) Containerization

The second important trend has been the military's growing recognition of containerization -- the ability to ship and store relocatable shelter systems in container form. The first document re-

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* The memo of approval of the PLAST study includes an important statement on the need to test commercial systems for compliance with military requirements.

quiring containerization was the "Policy Guidelines for the Development of Containerization" issued by the Chief of Naval Operations in August, 1968. Based on these guidelines research and development contracts for relocatable housing and shelter systems sponsored by the Navy have required compliance with ISO container standards. ISO standards specify dimensions (8'x8'x5', 6'-8", 10', 20', 40'), maximum gross weight, strength requirements, standard corner fittings and testing requirements for shipping containers using more than one mode of transportation and designed to interface with standardized vehicles.

In October, 1972, the Secretary of Defense issued Instruction 4500.37 making ISO containerization of relocatable systems mandatory for all services. Systems in use or in advanced prototype development were exempt. Therefore, compliance with the ruling has varied within the three military branches. The Seabee Quick Camp System, TACOSS and the Marine Corps Small Shelter Program all required the use of intermodal ISO shipping containers (8'x8'x20') outfitted for living. The containers themselves serve as habitats when in the field, as storage facilities when not deployed, and as cargo containers in transit. While the Seabee System uses rigid containers, TACOSS includes three-to-one fold-out containers, and the Marine Small Shelter System uses knock-down containers. Certain other systems, especially panelized systems, use the container strictly as a volume for shipping stacked panels.

(c) Unskilled Labor

A third important trend has been the design requirement for unskilled labor in field erection and dismantling. This design criterion was introduced because of the unknown make-up of the erection crew, potential combat conditions in the field and "instant" deployment needs of the systems.

(d) Family Housing Program

Certain trends in the family housing programs of the services also are relevant to this study. A few years ago relocatable housing systems -- such as the expandable USA Home of the Air Force -- were developed for this purpose. DOD also developed a sophisticated program for permanent family housing geared to industrialized technology.

The USA Home program has been discontinued and mobile homes are providing relocatable family housing wherever needed.

The preferred form of family housing is off-base in civilian communities near military installations. On-base construction is considered wherever permanent housing is needed and existing resources are inadequate. Despite DOD's initial plan to use the advantages of industrialized housing, recent contracts for permanent military family housing have been awarded almost exclusively to local builders using conventional construction technology. Table 37 summarizes expenditures and numbers of units built during the past four years of the housing program.

TABLE 37

DEFENSE FAMILY HOUSING
SUMMARY OF SELECTED APPROPRIATED AMOUNTS
(dollars in thousands)

	Enacted				Requested
	FY 1970	FY 1971	FY1972	FY1973	FY 1974
New Construction	$105,507	$194,833	$255,740[1]	$ 270,987	$ 351,904
(No. of Units)	(4,800)	(8,000)	(9,862)[1]	(11,938)[2]	(11,688)
Mobile Home Facilities	-0-	1,200	7,280	5,387	5,700
(No. of Spaces)	(-0-)	(439)	(2,350)	(1,403)	(1,340)
Improvements	11,540	19,196	31,668	39,498	62,510
Leasing	23,658	28,684	33,589	37,643	44,703
(No. of leases, end-year)	(9,669)	(11,466)	(13,482)	(13,964)	(17,262)
Operation & Maintenance	373,219	395,686	440,706	535,842	622,913
Total Appropriation	688,476	806,464	945,025[1]	1,064,046	1,250,567

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[1] Includes 430 units for $1,070,000 for SAFEGUARD sites enacted in the DOD Appropriation Act, P.L. 92-204.

[2] Includes 218 units for SAFEGUARD sites authorized in P.L. 92-436. These are to be financed from savings and no appropriation has been made for them.

SOURCE: Department of Defense.

Thus, the present family housing programs appear of no more technological interest than commercial manufactured housing systems discussed in the preceding industry report.

b. Private Demand for Relocatable Housing

The preceding report discusses the manufactured housing industry. It shows that this industry emerged in response to the need for relocatable housing during World War II but that the post-war demand for permanent housing forced most manufacturers to de-emphasize the relocatability of their products. Even the mobile home has gradually become a quasi-permanent housing system typically moved only once -- from the manufacturer's plant to the site.

However, the economy has generated certain special demands for relocatable housing. Some manufactured housing producers have specialized to meet these demands. For this study these systems are categorized into camp systems, honeycomb panel systems, dome systems and miscellaneous systems.

(1) Camp Systems

Appendix III-C lists names and location of four manufacturers of relocatable camp systems. Camp systems have been developed since the 1950's to service the housing needs of international companies involved in remote operations, especially oil exploration, drilling, mining and construction. The world-wide scope of these manufacturers evolved from humble beginnings: the construction of portable field offices.

The basic product line among the four companies is similar. However, there are interesting variations. They differ from framed panels with 2"x4" wood studs 24" on center, with nail or mortis-and-tenon connection to structural panels with a 1½" polystyrene core bonded on each side with sheet aluminum.

In contrast to regular packaged housing systems, camp systems are specifically engineered for repeated dismantling and shipment. Generally they employ a small rigid box with or without integral chassis and wheels. However, it became evident that long-distance transportation costs could be reduced if the unit can be "knocked down" into a shipping package with floor and ceiling forming the bottom and top of the package, the walls and partitions being stacked inside. The "knock-down" (KD) ships at 1/4 to 1/5 the bulk of the permanently erect unit and therefore results in substantial savings in transportation costs.

A permanently erect unit (housing all the mechanical equipment) combined with one or more knock-down units can efficiently produce relocatable housing.

Since commercially available housing systems specifically designed for long shipment and relocation are most relevant to this study, two further advantages of camp housing should be noted:

- The industry is accustomed to maintain a greater design flexibility than, for example, typical mobile home producers.

- The industry can provide a comprehensive scope of services. Most companies will provide a fully erected camp including complete shipping arrangements, delivery to site, and on-the-site erection supervision including water and sewer system engineering and construction. This service is flexible, however, as the client himself can often perform those services.

Because they are often shipped to rather undeveloped areas where construction skills are limited and maintenance is difficult, the housing systems are easy to erect, generally requiring only simple hand tools and local labor. However, a crane is normally required, due to the weight of the KD roof.

As noted earlier, the military has become aware of camp systems and is using them with or instead of systems specifically developed for military purposes.

Mobile homes have also been used as camp housing. However, international companies tend to prefer camp systems to single-wide mobile homes because of lower overseas shipping costs, more spacious and convenient layouts and greater durability. Double-wide mobiles are even less useful than camp systems since they are not built for repeated relocation.

(2) Honeycomb Panel Systems

Producing for a less specialized market and capitalizing on technological advances and growing acceptance of industrialized construction, a few companies produce special multi-purpose packaged systems that promise easy relocatability. The two companies identified in this category produce honeycomb panels originally developed for aircraft.* Both are located in Florida. The basic component of these systems is an insulated, structural honeycomb, completely pre-finished metal-faced (interior and exterior) panel. These panels are available in varying thicknesses with special integral fastening systems and are used as walls, floors and ceilings.

Since panels are small components easily combined to produce different plans, these companies market their products to a wide range of users: educational facilities, medical and health centers, tourist facilities and commercial buildings.

Most of these units are permanently installed on a prepared concrete slab foundation. However, the companies provide a floor support system made up of honeycomb panels and can thus be relocated. With a small building, relocation is often achieved with the unit fully erected using a skid-mounted frame. With a larger unit, the panels can be dismantled before relocation.

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* For names and locations, see Appendix III-C. With few exceptions, typical lightweight packaged systems are wood-framed.

(3) Dome Systems

Sparked by the geodesic dome concept first designed by R. Buckminster Fuller to "do more with less," several companies began producing geodesic domes. These are available "off the shelf" and customized. Dome manufacturers mainly cater to the vacation home and recreational structure market since dome houses are still often considered too unconventional for permanent housing. However, FHA approvals have been obtained for geodesic domes and producers stress the suitability of domes as first homes.

"Orange peel" dome systems are also on the market. These systems may require less time to assemble than geodesic domes, but they lack the structural strength of the geodesic principle and are therefore limited to small sizes.

Dome manufacturers contacted during the study are small young companies. They were interested in the study and claimed that domes should be considered relocatable structures. However, there is minimal experience regarding repeated dismantling and reuse of currently marketed dome systems. All dome systems surveyed come without an integral mechanical system, some without an integral floor system. Nevertheless, domes were included in the analysis because of their unique structural advantages.

(4) Miscellaneous Systems

During the study a number of companies were contacted which manufacture or hold patents to special unusual housing systems designed to be inexpensive and/or relocatable. These systems range from an expandable vacation home to portable multi-purpose modules, a half-cylindrical PVC house like the quonset hut and a collapsible unit designed for disaster relief. If marketed, these systems are produced by small companies. They were included in the study because of their innovative features and the interest expressed by their manufacturers.

c. Other Commercial Relocatable Shelter Systems

Three types of commercially available shelter systems were included in the evaluation of existing technology: air structures, metal structures and container vans. These systems are not commonly used for housing but they may offer important structural advantages.

(1) Air Structures

Air structures were originally developed during the early 1940's to meet Air Force needs to shelter personnel, vehicles, aircraft, missiles, communication centers and radar antennae. They are now used commercially as recreation enclosures for activities like swimming and tennis.

There are single-wall and double-wall air structures. The former require maintenance of an interior pressure exceeding exterior pressure.

Because of the limited market and erratic demand for air structures, the industry is unstable, with only a few strong companies currently producing these systems. Several companies producing air structures two years ago are now out of business.

No specific instances were found of air structures being used as individual housing units, although one Army battalion shelter enclosing 210 square feet at a cost of $20,000 was discovered. To work efficiently, air structures usually span large, open spaces.

Because of their obviously relocatable nature, air structures are included for analysis in this study.

(2) Metal Structures

The impetus for metal building construction on a large scale started during World War II with the need for quick, inexpensive, easily erected shelters.

After the war, the same manufacturers sold metal buildings to meet domestic shelter needs. With new technological advances, plans and systems resembled conventional construction more than the earlier systems had.

Even though metal buildings are not used much for housing today, they were included for analysis in this study, especially in light of the role of the quonset hut during World War II.

(3) Container Vans

The commercially available container van, as used in truck, rail and ship transport, is manufactured by nearly 100 companies across the country. Units are sometimes produced to ISO standards.

As currently produced for the commercial market, these shipping containers are not housing systems. However, they may be relevant to this study for three reasons: previous experience by the military, proven durability of shipping containers to withstand rugged conditions and wide availability and choice of materials commercially available.

3. EVALUATION OF SPECIAL RELOCATABLE HOUSING AND SHELTER SYSTEMS FOR USE IN DISASTER RELIEF MISSIONS

Unlike mobile homes and manufactured housing, special relocatable systems are not produced or marketed by an organized industry. As discussed earlier, various sources have contributed to development of such systems. While mobile home and manufactured housing producers have their own trade associations, journals and lobbies that serve as clearinghouses of information, a survey of existing special relocatable housing and shelter systems depends much more on original research and personal contacts.

From a review of available literature and contacts with manufacturers and agencies, 30 special relocatable systems were identified to be relevant to the study. These systems can be made to comply with the minimum livability standards for temporary housing developed for this study and offer features of potential interest for temporary disaster housing. These systems may not represent the full range of relevant current technology, but all major currently available systems are covered and at least one representative example has been identified for each basic type.

Figure 28 lists the 30 systems in relation to industry segments and basic configuration. In this section each system is described and evaluated for inclusion in the detailed cost-effectiveness analysis in Task II (Volume 5) of this study.

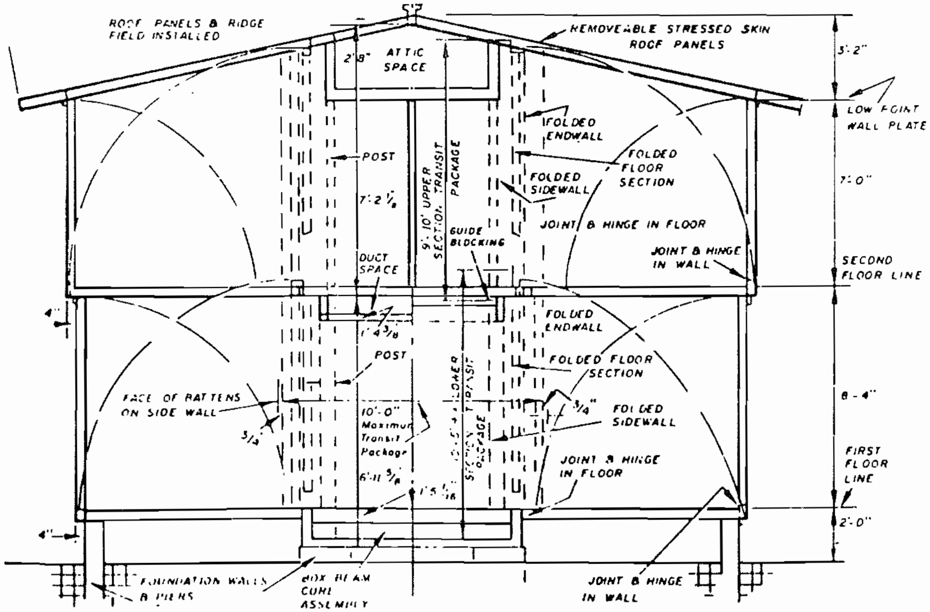
The military systems described in this section usually resulted from recent research and development contracts with aerospace manufacturers. Many design criteria established within these research and development programs are not applicable to temporary housing for disaster relief. For example, disaster relief missions typically require units to be transported by truck and train but not by air and helicopter as well. Although relocation is a requirement for HUD, set-up and strike-down times need not be limited to one hour, as in certain military programs. These goals of wide-ranging flexibility, extreme climate control, "instant" mobility via intermodal transporation and adherence to established military specifications ("mil specs") for construction have combined to produce costs of $55-$130/sq.ft. in the TACOSS expandable ISO container and $30/sq.ft. in the Bare Base Personnel Shelter. Also, most existing relocatable military systems were developed either as shelter systems only (and are not directly usable as living quarters) or as group living quarters (and are not directly usable for single-family housing).

a. Relocatable Systems Developed for the Military

SYNOPSIS

SERVICE	SYSTEM	MANUFACTURER
(1) Air Force	(a) USA Home	None
	(b) Expandable Shelter/Container (ES/C)	Goodyear Aerospace
	(c) Modular Processing & Support System (MPASS)	"
	(d) Expandable Personnel Shelter (EXP)	"
(2) Army	(a) Army Facilities Component System (AFCS)	Various
	(b) Transportable Recoverable Shelter	"
	(c) MUST Air-Supported Shelter	"
(3) Navy	(a) Tactical Container Shelter System (TACOSS)	North American Rockwell
	(b) Seabee Quick Camp	"
	(c) U.S. Marine Corps Small Shelter Design and Test Program	Northrop Corp.

FIGURE 26
USA HOME



Cross-section drawing shows how the relocatable house folds up for shipment (broken line) and is unfolded for placement on the foundation.

The Defense Dept. is convinced that our home manufacturers can solve the overseas housing problems and at the same time, by performing all of the building functions but final erection in U.S. plants, provide a significant saving in foreign exchange costs.

A $2,807,000 order of 292 manufactured relocatable duplex housing units was placed with F.C. Stiles Co. of Grand Rapids, Mich.Current Defense Dept. plans are to purchase 400 more of the units in 1966.

Developed by Victor Spector and Associates of Falls Church, Va., the prototype was produced by Madway Mainline Homes of Irwin, Pa., and erected at Andrews Air Force Base.

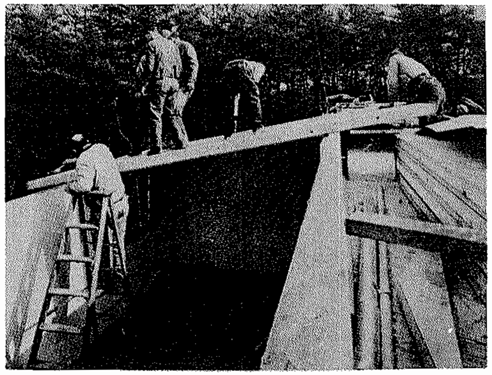
According to Leon Julius, deputy chief, Housing Div. of the U.S.Air Force,, the 2-story duplex design was selected to permit a greater site density, and to provide a smaller folded package for ease of handling and transportation overseas.

Each family unit consists of an upper floor section with bedrooms and a full bath, and a lower floor section with kitchen, living-dining room, half-bath and utilities areas. The house may be put over a basement if required. Designs include tow, three and a four bedroom family units.

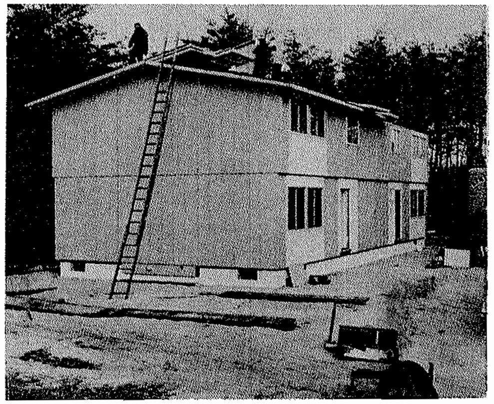
The units are shipped in four packages, with an extra package for the fourth bedroom when it is used. All finishing materials and appliances are packed inside.

The packages weigh about 17,000 pounds each for the basic house, and the fourth bedroom package withs about 7,000 lbs.

One of the most important advantages to this fold-up unit over previous relocatable houses is that the packages are small enough to be placed in the hold of a ship, according to Maj. Walter F. Geisinger, deputy chief of the Design Branch, Air Force Housing Division.



Under roof in one day, duplex can be readied for relocation at another site with equal ease.



USAHome III,"

a (1-a) USA Home (USAF)

Manufacturer: none (program discontinued)

System Evaluated:

Basic Configuration: Expandable Box

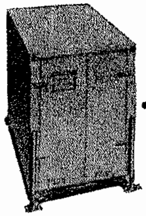
Description: A conventionally built three-to-one expandable unit (in some cases, two stories) with a central mechanical core and folding side walls. Requires a prepared concrete block foundation; roof panels are field erected. Forced-air oil-fired heater and A/C utilize a duct system factory-installed in the boxed beam core assembly that serves as the main structural support.

Evaluation: Adaptable to Minimum Livability Standards. Complete construction documents available for study. Since not all parts are hinged, greater risk of pilferage and attrition than completely hinged expandable box systems.

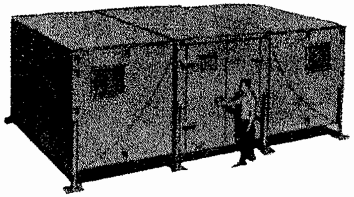
Intended performance: similar to temporary housing for disaster relief.

Included in cost-effectiveness analysis.

MODEL ES/C SHELTERS

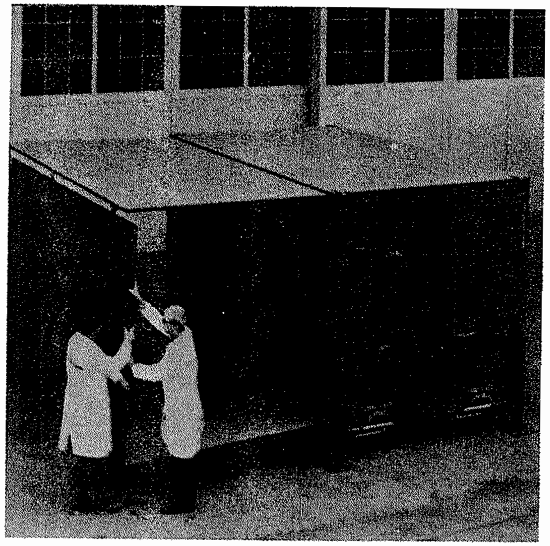


Shipping Mode
8 ft x 8 ft x 13 ft



Deployed
13 ft x 20 ft

- Provides more than 260 square feet of clean, well-lighted floor space for use in disaster operations as:
  - Kitchen
  - Food storage and preparation
  - Toilet facilities
  - Shower facilities
- Can be erected in less than 30 minutes on unprepared surface.
- Three units can be transported on one 40-foot flat bed tractor/trailer.
- 550 cubic feet of container volume available within folded shelter for interior furnishings and equipment
- Designed for operation in 60-knot winds (90-knot gusts). Suitable for tropic to arctic conditions.
- Contains integral interior lighting and wiring for convenience outlets and heater/ventilation units. Also has exterior area lighting fixtures.



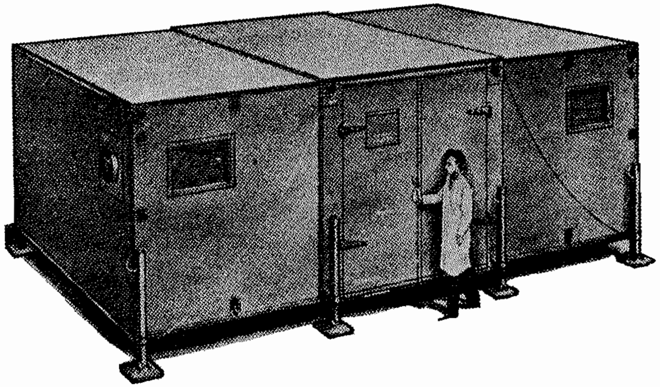


FIGURE 27
EXPANDABLE SHELTER/CONTAINER
(ES/C)

GOODYEAR AEROSPACE
CORPORATION
ARIZONA DIVISION
LITCHFIELD PARK, ARIZONA 85340

a (1-b) Expandable Shelter/Container (ES/C) (part of USAF Bare Base System)

Manufacturer: Goodyear Aerospace Corporation

System Evaluated:

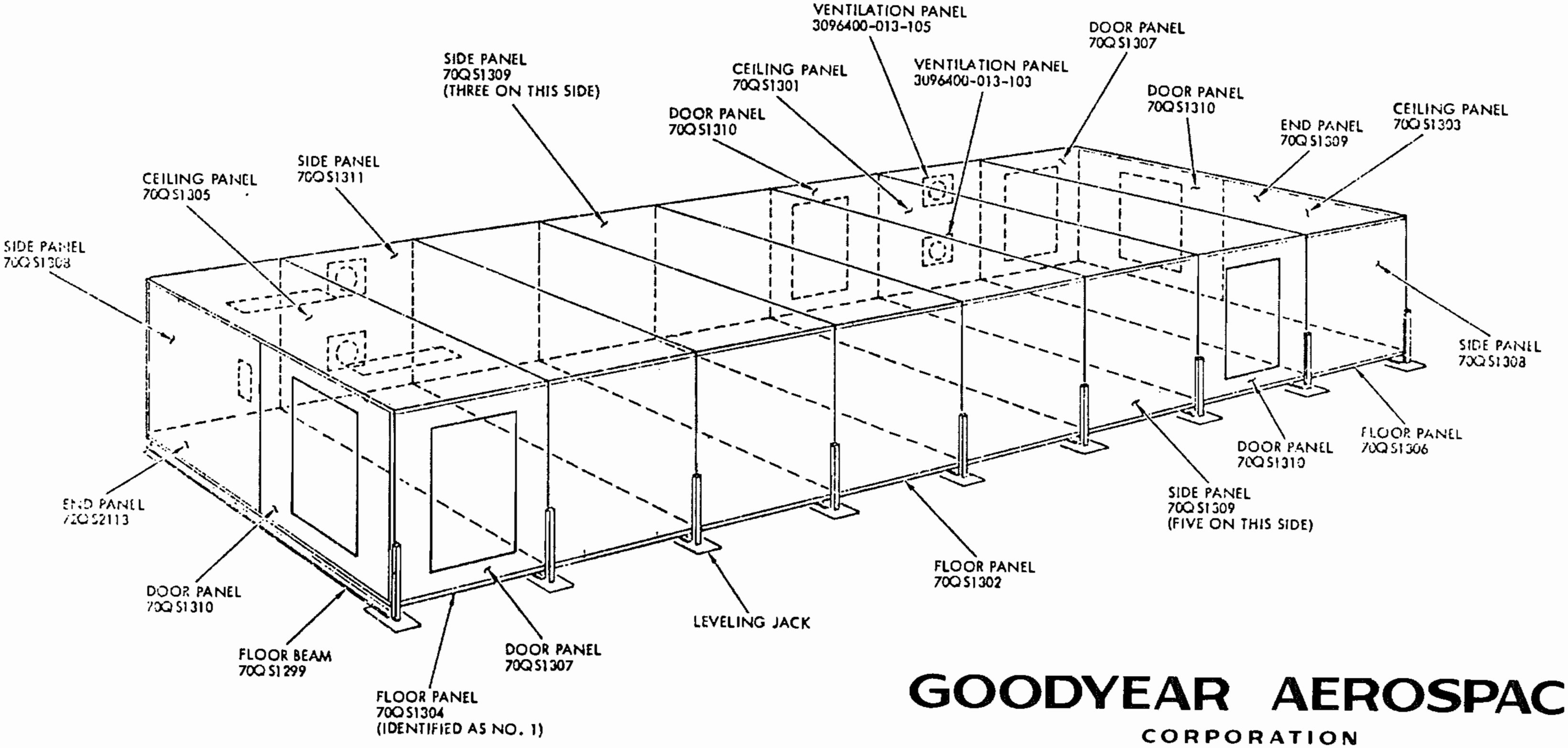
Basic Configuration: Expandable Box

Description: A three-to-one expandable rigid box (8'x13'x8' opens to 21'-5"x13'x8') utilized for heavy equipment, usually outfitted as kitchens, latrines or medical facilities. Panel construction is resin-impregnated paper honeycomb bonded between aluminum sheets. Can be transported by fixed-wing aircraft, helicopter, ship, rail, truck, fork-lift or mobilizer.

Evaluation: The standards established for development of this system exceed reasonable requirements for temporary family housing for disaster relief and result in excessive initial cost. (See note at end of section a.)

Not included in cost-effectiveness analysis.

FIGURE 28
MODULAR PROCESSING AND SUPPORT SYSTEMS (MPASS)



GOODYEAR AEROSPACE
CORPORATION
ARIZONA DIVISION
LITCHFIELD PARK, ARIZONA 85340

MODULAR PROCESSING AND SUPPORT SYSTEMS

a (1-c) Modular Processing and Support System (MPASS)
(Part of USAF Bare Base System)

Manufacturer: Goodyear Aerospace Corporation

System Evaluated:

Basic Configuration: Core and Panelized

Description: A lightweight modular panel system consisting of flat 2" thick paper honeycomb with aluminum siding sandwich panels. Floor and ceiling panels are 6'x12' and wall panels are 6'x8' high. Connection between the panels is achieved by a roto-lock, and the joint is covered with special tape.

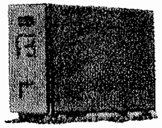
Evaluation: The system can easily be adapted to Minimum Livability Standards. The system has been proposed by the manufacturer as a temporary housing system for disaster relief under the name "Modular Building System." Goodyear's roto-lock offers a solution to the assemblage and disassemblage of light-weight panelized systems that can result in a significant reduction of damage and erection time if such systems are repeatedly relocated.

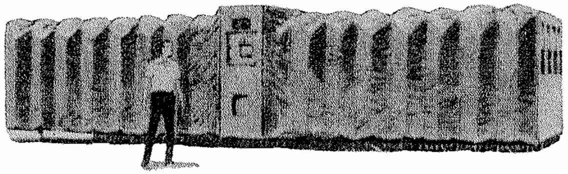
Included in cost-effectiveness analysis.

FIGURE 29
EXPANDABLE PERSONNEL
SHELTER (EXP)

MODEL EXP SHELTERS

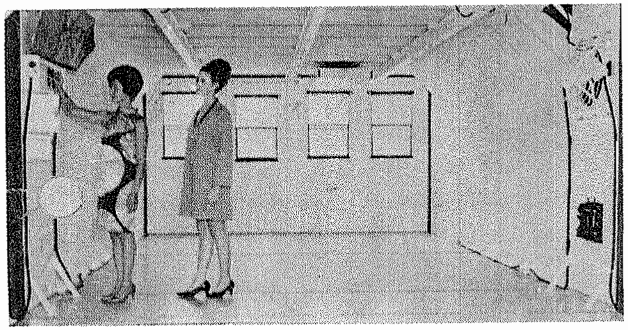
Shipping Mode
2 ft 8 in. x 13 ft x 8 ft





Deployed
13 ft x 32 ft

- Provides more than 400 square feet of clean, well-lighted living or work space for:
  - Single-family living unit
  - Dual-family living unit (with center divider wall)
  - Administrative office
  - Dining area
  - School room
  - Child care center
  - Volunteer crew barracks
  - First aid, pharmacy, or hospital ward
- Can be erected in less than one hour on unprepared surface.
- Nine units (nine to 18 family emergency units) can be transported on one 40-foot flat bed tractor/trailer.
- 50 cubic feet of container volume available within folded shelter for cots, tables, chairs, or other furnishings.
- Designed for operation in 60-knot winds (90-knot gusts). Suitable for tropic to arctic conditions.
- Contains integral electrical wiring for lighting, convenience outlets, and heater/ventilation units. Also includes exterior area lighting.



GOODYEAR AEROSPACE
CORPORATION

ARIZONA DIVISION

LITCHFIELD PARK, ARIZONA 85340

a (1-d) Expandable Personnel Shelter (EXP)
(Part of USAF Bare Base System)

Manufacturer: Goodyear Aerospace Corporation

System Evaluated:

Basic Configuration: Special Packaged Enclosure w/o Integral Mechanical Core

Description: Expandable container (2'8"x13'x8' opens to 32'x13'x8') utilized paper foamboard to open accordion-style and is weather-protected by a vinyl flysheet. The units can be quickly airlifted to furnish "instant" barracks and light work areas.

Evaluation: The system has been proposed to the government by the manufacturer as emergency shelter for disaster victims. While its suitability as emergency shelter was not evaluated for this study, the system was considered unsuitable as temporary housing for disaster victims because of the low damage resistance of the paper foam material and its relatively high cost. The USAF is considering alternate personnel shelter systems for the Bare Base Program for economic reasons (Austere Base Study).

Not included in cost-effectiveness analysis.

FIGURE 30
ARMY FACILITIES COMPONENTS SYSTEM (AFCS)

(No illustrations available.)

a (2-a) Army Facilities Component System (AFCS)

Manufacturer: Various

System Evaluated:

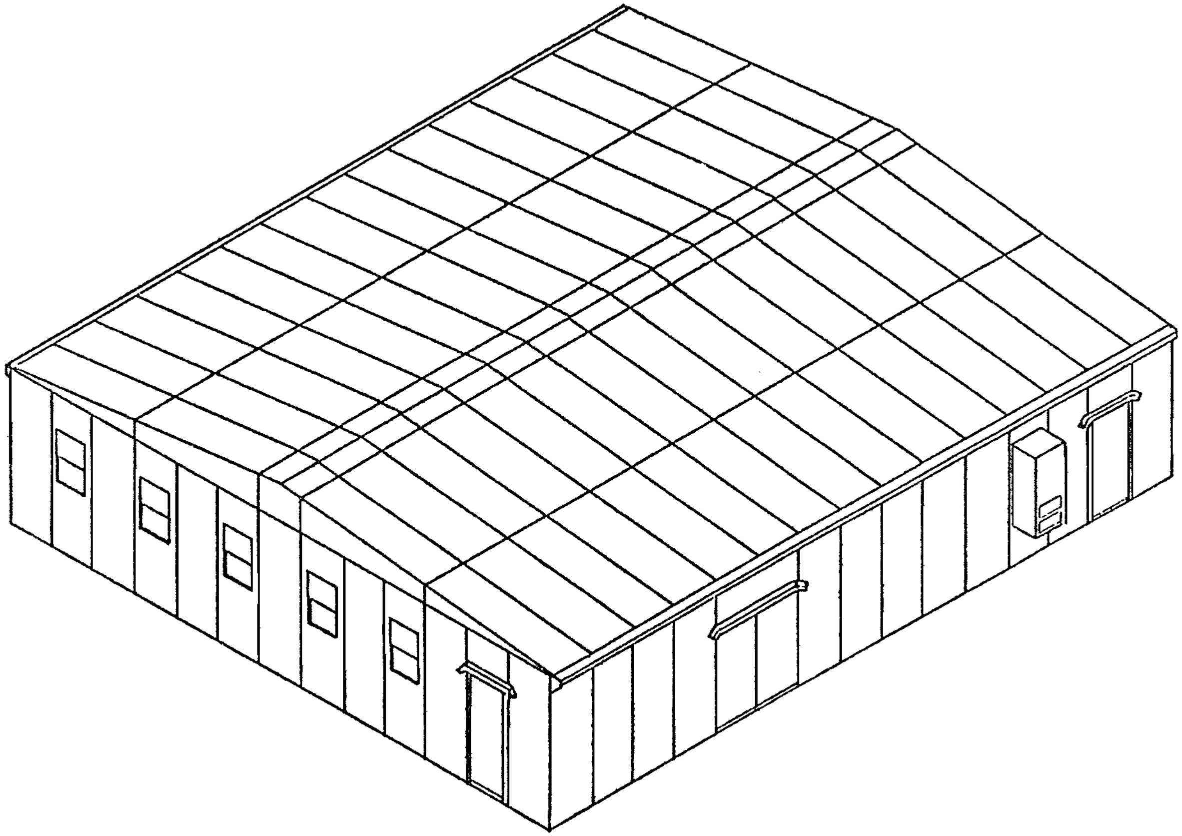
Basic Configuration: Various panelized and conventional systems

Description: A comprehensive tool to assist military planners, supply agencies, and construction personnel that have a role in Army construction in theaters of operation. Provides design standards for disposable, pre-engineered relocatable and mobile structures for use in temperate, tropical, desert and frigid climates. A volume of designs and site layouts is still in preparation.

Evaluation: AFCS is a planning and procurement catalog including a broad variety of hardware systems in different combinations.

Inclusion in cost-effectiveness analysis is not applicable.

FIGURE 31
TRANSPORTABLE, RECOVERABLE SHELTER



TRANSPORTABLE, RECOVERABLE SHELTER

DEPARTMENT OF THE ARMY

a (2-b) Transportable Recoverable Shelter (U.S. Army Security Agency)

Manufacturer: Various

System Evaluated:

Basic Configuration: Panelized without Integral Mechanical Core

Description: A relocatable building that would be utilized for contingency operations and troop support for immediate deployment in response to urgent unprogrammed crisis missions. No existing Army or commercial market systems were found suitable. R&D produced a prefabricated component system utilizing aluminum framing membranes and aluminum skin infill panels with an optional panelized floor assembly. Widths can be 21', 40', 60' or 80', while unlimited lengths in 9' modules can be attained.

Evaluation: The system has been offered to HUD for emergency shelter purposes. While it may have a potential for use as mass emergency shelter, it is a large scale shelter not suitable for individual family housing as defined in the Minimum Livability Standards.

Not included in cost-effectiveness analysis.

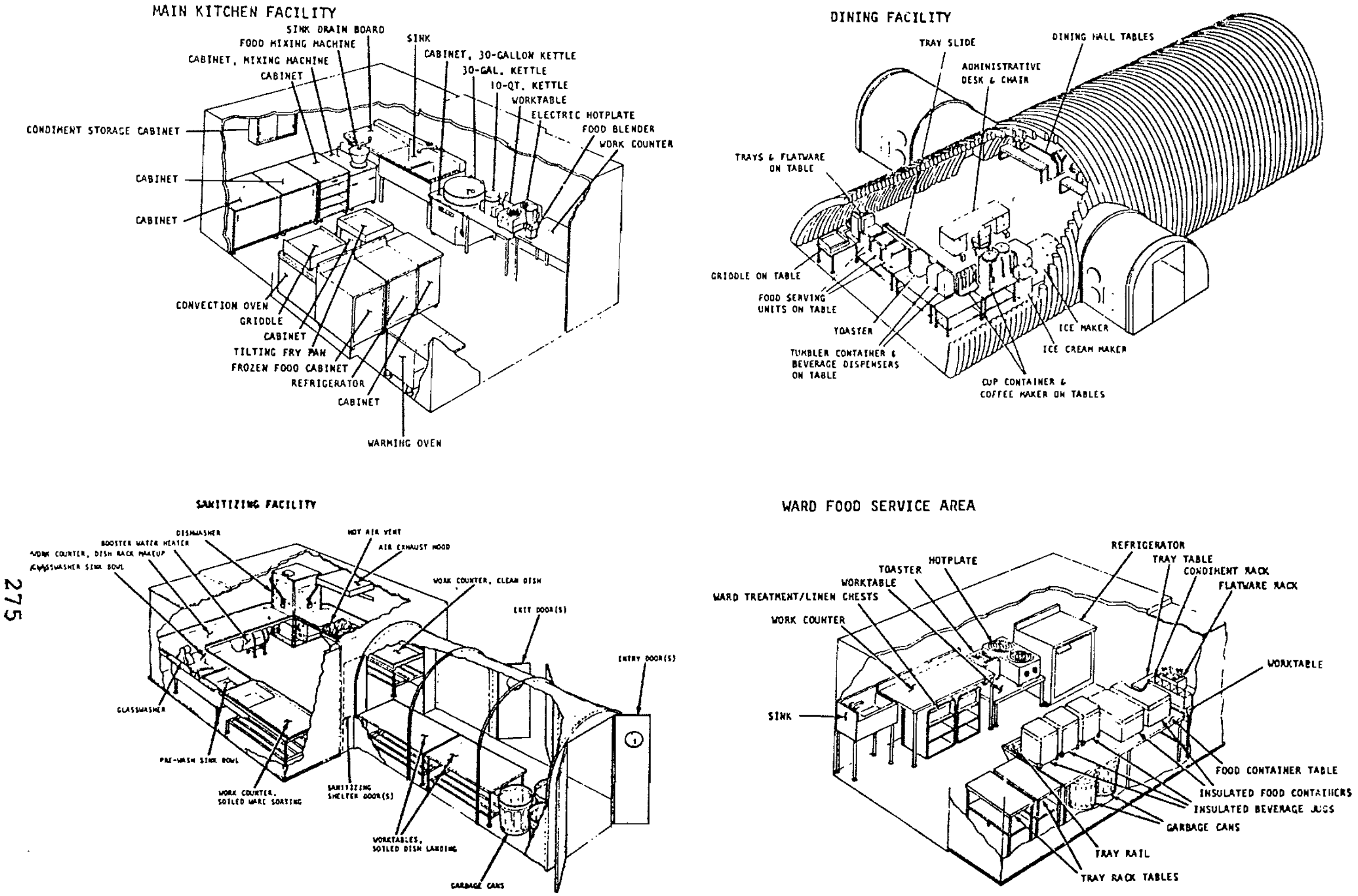


FIGURE 32
MUST AIR-SUPPORTED SHELTER

MUST FOOD SERVICE SYSTEM

a (2-c) MUST Air-Supported Shelter

Manufacturer: Developed by the U.S. Army Medical Research & Development Command for Competitive Procurement

---

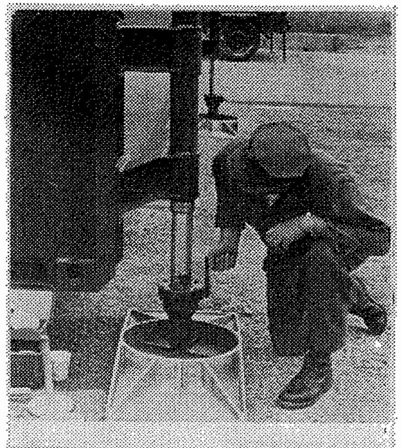
System Evaluated:

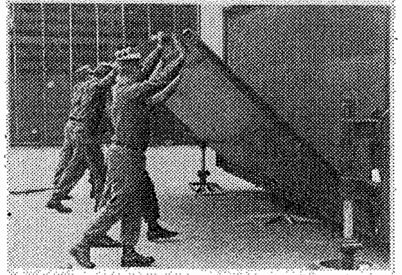
Basic Configuration: Special packaged Enclosure w/o Integral Mechanical Core

Description: An air-supported double-wall shelter system made of synthetic coated polyester cloth with zip-connections and T and + elements. The system is designed for use as field hospital, food service system (dining facility) and related uses.

Evaluation: The system may be suitable as emergency shelter for disaster victims. However, the low damage resistance of the exterior skin and the unusual appearance render it unsuitable as temporary housing for disaster victims.

Not included in cost-effectiveness analysis.





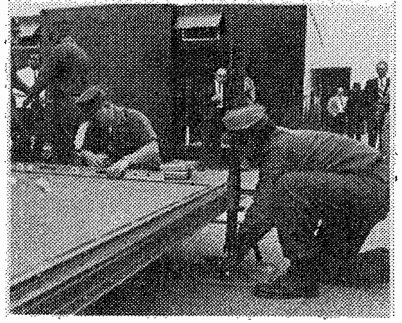


FIGURE 33

TACOSS DESCRIPTIONS

TACOSS I: Detachment Subsistence Unit
Ward-room type galley-mess service for 13-26 man. In shipping moda the unit is an 8' x 8' x 20', type 1-C, ISO container. At destination, it expands to 480 sq. ft. of floor space, 8' x 20' x 24'. All equipment and furniture stores inside container in shipping mode. Upon deployment, the unit requires only electric power and water from outside sources. Gross Weight: 13,080 pounds. Estimated production cost per unit: $35,000.

TACOSS II: Detachment Sanitary Unit
Shower, head, and laundry facilities for 13-26 men. Non-expandable unit, ships and operates from 8' x 8' x 20' container mode. Electric power, water and drainage field are shipped with the unit. 'Gross Weight: 7,615 pounds. Estimated production cost: $19,000.

TACOSS III: Detachment Medical Unit
Medical/administrative space for small camp or detachment of 13-26 men; contains/shower head, 4 bunks and furniture. Can operate as small headquarters and dispensary unit. All equipment and furniture, for operation, ships in the 8' x 8' x 20' container; expands to approximately 8' x 20' x 24'. Requires water and electric power from outside source for operation. Gross Weight: 10,064 pounds. Estimated production cost: $28,000.

TACOSS IV: Provision Storage
Designed for back-up storage for rations, with refrigeration equipment compartment and 3 storage compartments to provide frozen, refrigerated and dry storage. Equipment compartment has small engine/generator that allows unit to operate without exterior source of electric power during overland shipment. Unit can also operate on commercial power or shipboard power. Gross Weight: without cargo: 9,785 pounds. Estimated unit cost: $34,000.

TACOSS V: Equipment & Shop Unit
This small shop unit ships in the Type I-C container mode; then expands to provide roughly 480 sq. ft. of shop space. Equipped with central storage shelf unit, for storage of organizational tools and work benches. Designed to support working party of 13-26 men. Gross Weight: 8,965 pounds approximate. Estimated cost: $26,500.

TACOSS VI: Detachment Personnel Unit
Expandable unit ships and expands as described above. Inside the unit are 12 modular bunks with integral lockers. Equipped with environmental control unit. Gross Weight: 9,550 pounds approximately. Estimated cost: $26,400.

TACOSS VII: Utility Unit
This module, contained in an ISO, type I-C container, provides electrical power and water purification capability for an encampment. Contains 2-60KW diesel engine driven generators, a 10 gallon per minute water purification unit, and 700' of electric distribution cable. Sides fold up to provide a roofed, open air generator station. Water purification equipment can be removed and located as requirad. Gross Weight: 17,933 pounds. Estimated cost: $29,500.

TACOSS VIII: Frozen Storage Unit
Standard, intermodal frozen food storage unit with equipment and frozen storage compartments built into a standard ISO, I-C, 8' x 8' x 20' container. Unit can operate on own generator, commercial power, shipboard power, or power available at a typical Seabee camp. Gross Weight: 8,915 pounds without cargo. Estimated cost: $10,150.

TACOSS IX: Galley Unit, Large
Full galley with baking capability for 250 men. Unit expands to provide approximately 480 sq. ft. operational floor space. All galley and baking equipment deploys in the expanded unit; however, two smaller containers are required to supplement the main module in the shipment of equipment. Smaller modules are then usable at destination for garbage hut, storage, etc. Unit is environmentally controlled. Requires only water and electric power from outside sources. Gross Weight: 16,205 pounds. Estimated cost: $64,250.

TACOSS X: Sanitary Unit, Large
Shower and head facilities for 100 men. Human waste is cycled into an incinerator for burning at end of each day. Unit is expandable. All equipment, including incinerator, stores in tha module in the shipping mode. Requires only water and electric power from external sources. Incinerator fires electrically and burns diesel fuel. Gross Weight: 10,920 pounds. Estimeted cost: $63,750.

a (3-a) Tactical Container Shelter System (TACOSS)

(Part of U.S. Navy Advanced Base Functional Component System)

Manufacturer: Developed by North American Rockwell Corp. under contract with Naval Facilities Engineering Command

---

System Evaluated:

Basic Configuration: General Expandable Box (ISO containerized)

Description: Expandable (8'x8'x20' opening to 24'x8'x20') and non-expandable ISO containers utilized as heavy equipment facilities (kitchens, bathrooms, medical) for use in contingency operations. Wall panels are phenolin-impregnated kraft paper honeycomb between aluminum skin layers. The system is transported by land, sea and air in civilian or military transports. Assembly is by unskilled personnel.

Evaluation:

The standards established for development of this system exceed reasonable requirements for temporary family housing for disaster victims and result in excessive initial costs.

Not included in cost-effectiveness analysis.

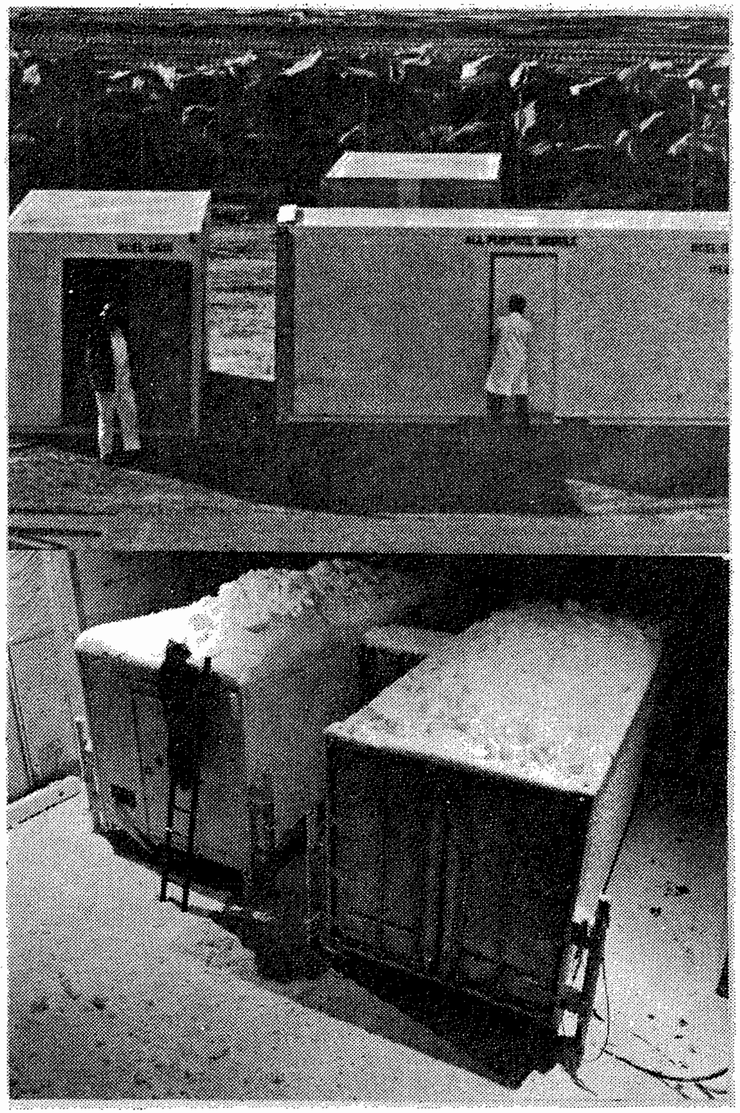


FIGURE 34
SEABEE QUICK CAMP
SYSTEM

Quick Camp Mission

The Quick Camp System is to provide minimum, austere, but complete, facilities for the rapid deployment of between 13 and 104 Seabees to the same location. This location is to be considered remote or in a forward area and requires a tenure of not more than six months. These support facilities shall be deployable from an advanced base location by helicopter or truck and provide intermodal transportation capability to the advanced base site compatible with existing carrier capabilities and requirements insofar as practical. Each camp shall include completely outfitted berthing, messing, head, administrative, and minor recreation facilities. Depending on operational conditions and requirements, some camps may also include minor shops, working space, and laundry facilities.

SEABEE
quick camp
system

DEPARTMENT OF THE NAVY ★ NAVAL CIVIL ENGINEERING LABORATORY ★

Sponsored by

NAVAL FACILITIES ENGINEERING COMMAND

a (3-b) Seabee Quick Camp System

Manufacturer: Developed by North American Rockwell Corp. under contract with the Naval Facilities Engineering Command

---

System Evaluated:

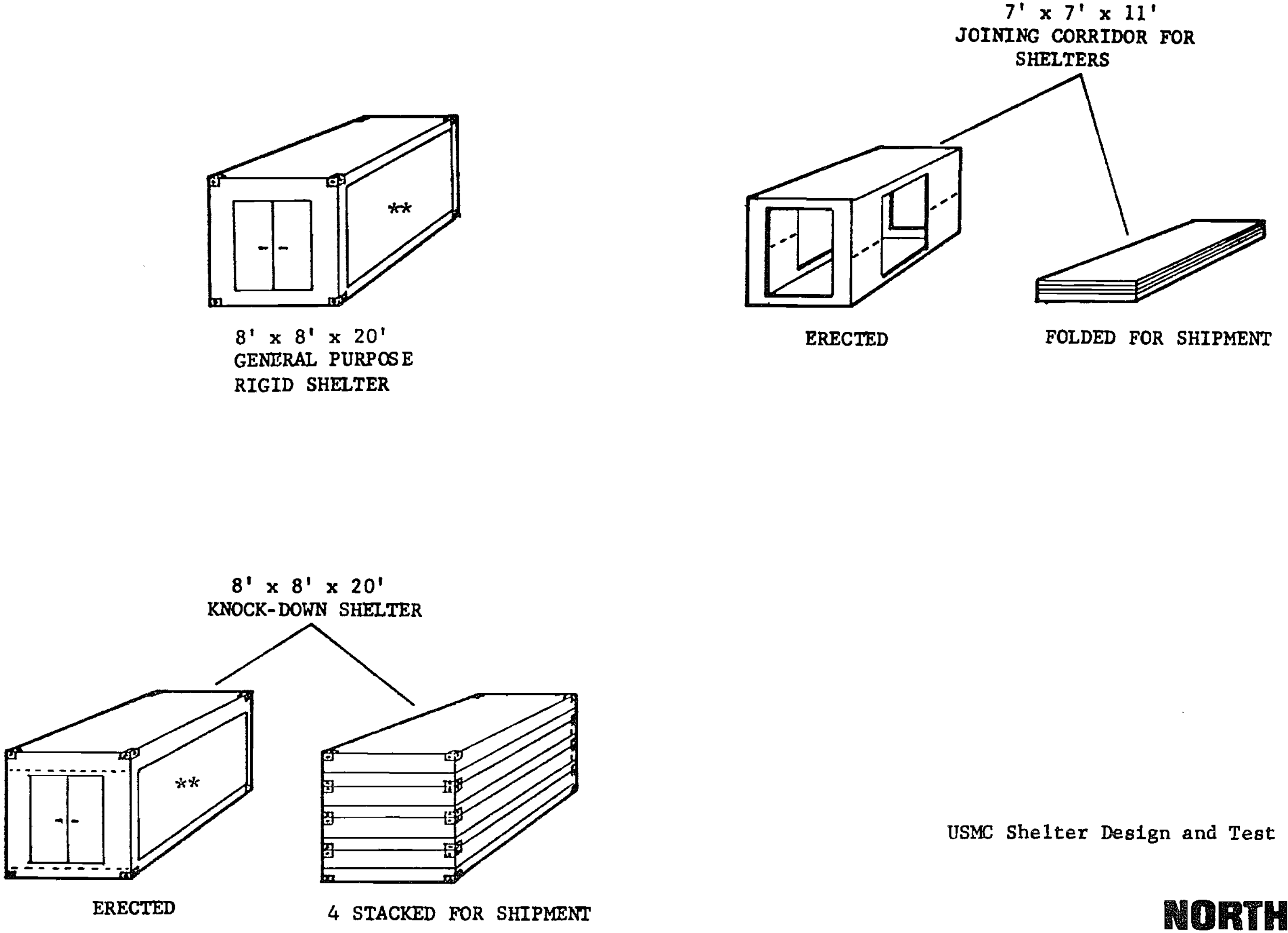
Basic Configuration: General Sectional Box(es) (ISO Containerized)

Description: Standard non-expandable 8'x8'x20' shipping containers outfitted for living. They serve as habitats for Navy Seabees in the field, as temporary storage facilities when not deployed, and as cargo containers in transit. They can be transported by ship, truck, rail and aircraft, including helicopter.

Evaluation: The standards established for development of this system exceed reasonable requirements for temporary family housing for disaster victims and result in excessive initial cost.

Not included in cost-effectiveness analysis.

FIGURE 35
U.S. MARINE CORPS SMALL SHELTER
DESIGN AND TEST PROGRAM



a (3-c) U.S. Marine Corps Small Shelter Design and Test Program

Manufacturer: Developed by Northrop Corp. under contract with the Naval Facilities Engineering Command.

System Evaluated:

Basic Configuration: Sectional Box(es) and Knock-Down

Description: Sectional Box and knock-down 8'x8'x20' ISO cargo containers that can be complexed wall-to-wall (rigid sectionals and K-D's), and end-to-end (K-D's). Developed to replace a series of existing Marine Shelters.

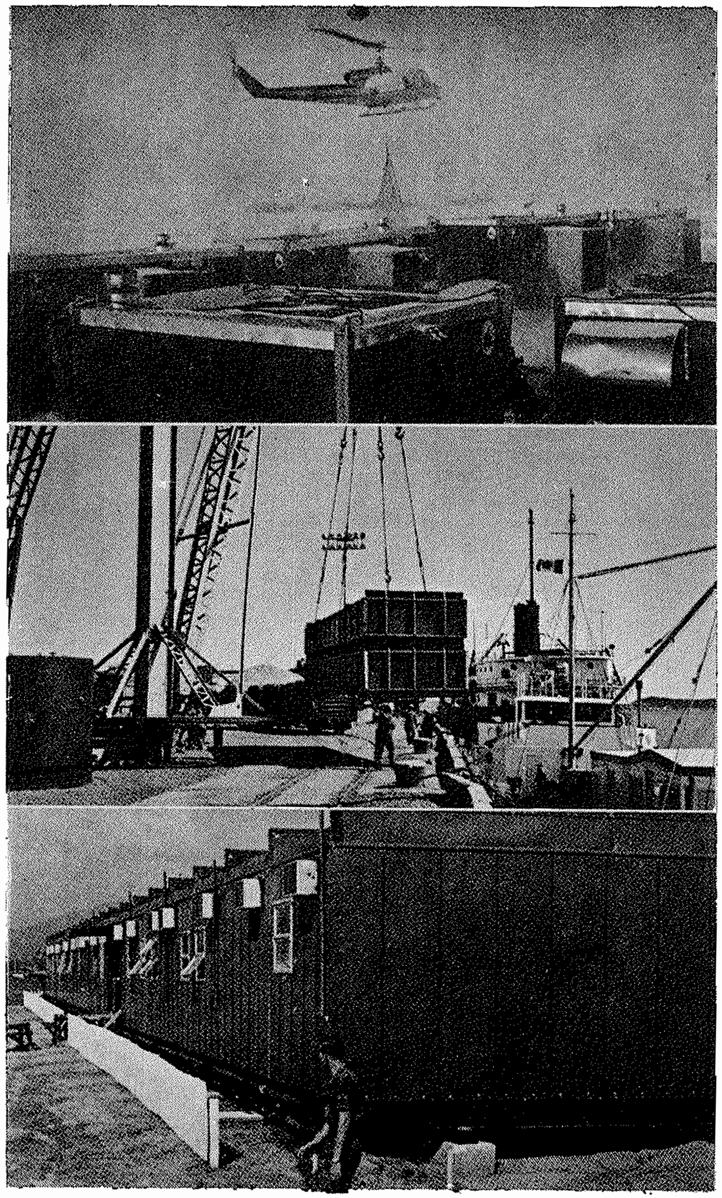
Evaluation: The standards established for development of this system exceed reasonable requirements for temporary family housing for disaster victims and result in excessive initial cost.

Not included in cost-effectiveness analysis.

b. Relocatable Housing Systems Developed for the Private Market

SYNOPSIS

INDUSTRY SEGMENT	MANUFACTURER (EXAMPLE)
(1) Camp Systems	(a) Atco Industries, Ltd.
	(b) Atlantic International
	(c) Elder International
	(d) Porta-Kamp
(2) Honeycomb Panel Systems	(a) Endure Products
	(b) Panelfab International
(3) Dome Systems	(a) Circle Construction
	(b) Dome East
	(c) Geodesic
	(d) O'Dome
(4) Miscellaneous Systems	(a) Altair Industries
	(b) Atlas Portable
	(c) Interdesign, Inc.
	(d) Universal Housing Sys.
	(e) A.G. Windfield



A portrait of ATCO

FIGURE 36
ATCO INDUSTRIES, LTD.

1. Aero Space Research - M.R.I.
2. Helicopter Lift Camp
3. Engineering and Research
4. Sto N Tow Cargo Trailer
5. Cattle Liners
6. Large Caravan Type Units
7. Arctic Housing
8. Relocatable Schools
9. Industrial Camp Complex
10. Multistorey Structures
11. Offshore Housing and Heliport
12. Prebuilt Residential Housing
13. 20 Man Complex
14. Rail - Ship - Truck Cargo Containers

ATCO is a composite of many industries. Each one of them is highly diversified and complex.

ATCO is engineering. ATCO is research. ATCO is manufacturing. ATCO is housing. ATCO is transportation. ATCO is a worldwide service for large international corporations, and a local service for small contractors.

Therefore, to present a visual portrait of ATCO in its entirety would clearly be impossible, for ATCO is involved in many branches of industry and many spheres of engineering. Also, it frequently happens that ideas which are revolutionary today are obsolete tomorrow.

Even so, a broad overall concept of ATCO may be seen in our cover illustration. We call this "A TOTAL VISUAL CONCEPT OF ATCO."

It portrays the fact that ATCO is built on ideas—and that these ideas take seed, germinate and grow to mature fruition in scores of highly ingenious end products.

At ATCO we strive to give every customer, the largest and the smallest, the same high standards of efficiency — both in the products we deliver and in the service we deliver with them. For, whether the order is for a single camp trailer or an industrial town—it's an important order for ATCO.

ATCO
INDUSTRIES LTD.

b (1-a) Camp Systems

Manufacturer: ATCO Industries, Ltd.
(Product range includes mobile homes, modular housing, industrial mobile units, general sectional boxes and panel and core systems.)

System Evaluated:

Basic Configuration: Panel and Separate Mechanical Core

Description: A special prototype camp system consisting of 8'x8' wood-framed panels stacked together to form a packing case reducing the bulk of the structure by more than 80 per cent. A special space-saving mechanical core unit is shipped separately.

Evaluation: Adaptable to Minimum Livability Standards. Demonstrates an innovative approach to the packaging of a relocatable structure and the resulting advantage of record bulk reduction.

Included in cost-effectiveness analysis.

OUR THREE BASIC DESIGNS

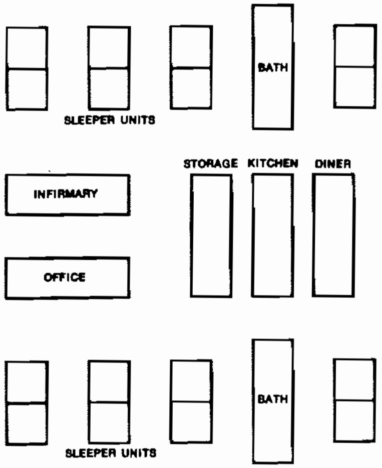
Atlantic International can design a field camp for you that meets your requirements precisely. You get all the space and facilities that you need, and you don't have to pay for anything you don't need.

You can choose one of three basic designs shown here, or any larger or smaller variation of them.

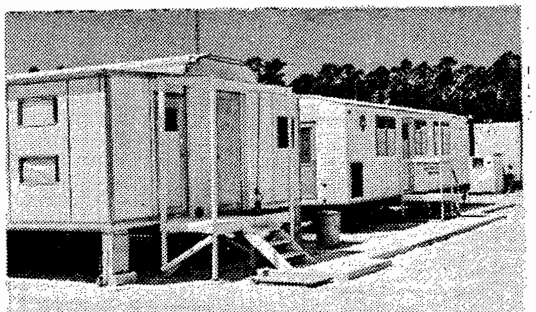
Individual Units: Easily wheel mounted, this is often the type of camp preferred by highway, pipeline or geo-physical crews requiring maximum mobility. A central bath serves all units. The offices, living quarters, diners are separate.

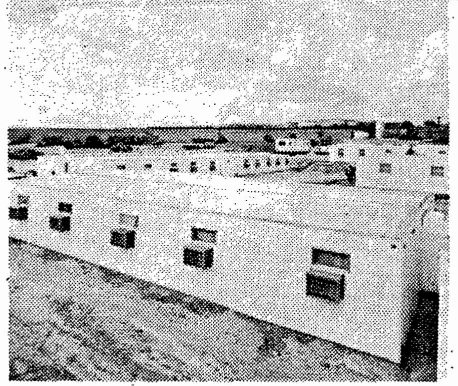
Multiple Units: This more advanced, more permanent camp is still available at a relatively moderate price. The central complex of kitchen and diner, and the baths for each building offer increased efficiency and convenience.

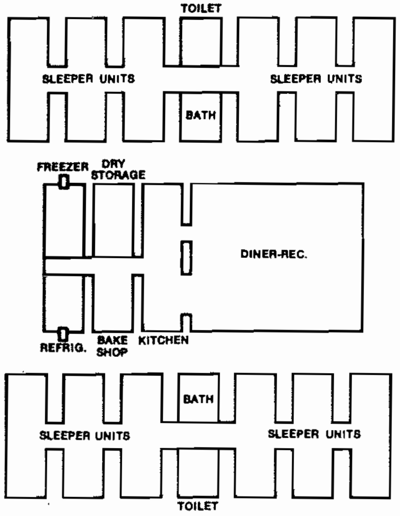
Modular Units: This is our most advanced camp, variations of which could be used as large apartment complexes. The combined buildings save space and provide open areas as required. This type of camp is often preferred when separate rooms within a larger building are needed.



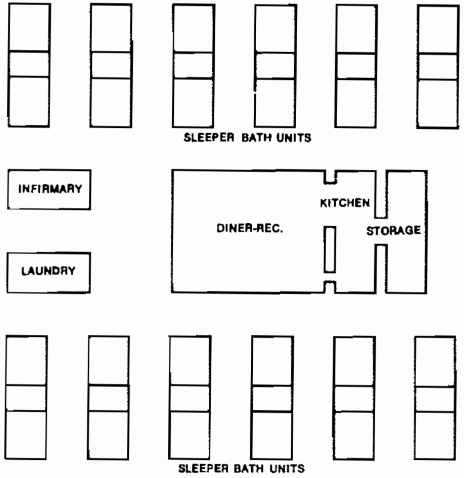
INDIVIDUAL UNITS







MODULAR UNITS



MULTIPLE UNITS

FIGURE 37
ATLANTIC INTERNATIONAL

Atlantic International

DIVISION OF ATLANTIC MOBILE CORPORATION
P O BOX 412, HUNT VALLEY, MARYLAND 21030 USA
P O BOX 60603, HOUSTON TEXAS 77060 USA
CABLE ATLANKAM TELEX 87562

b (1-b) Camp Systems

Manufacturer: Atlantic International, Inc.
(Product range includes industrial mobile units, general sectional boxes and knock-down sectional boxes.)

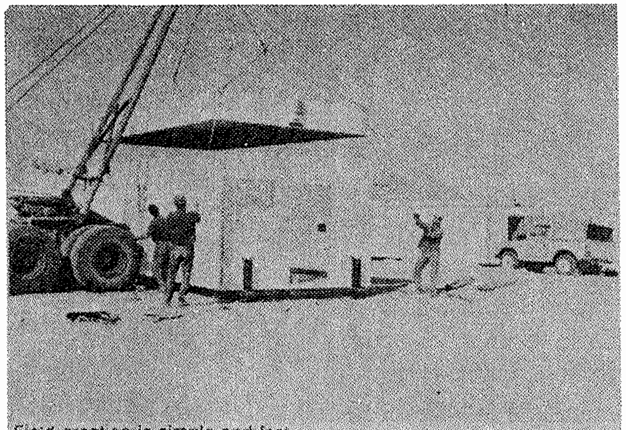
System Evaluated:

Basic Configuration: Sectional Box and Knock-Down

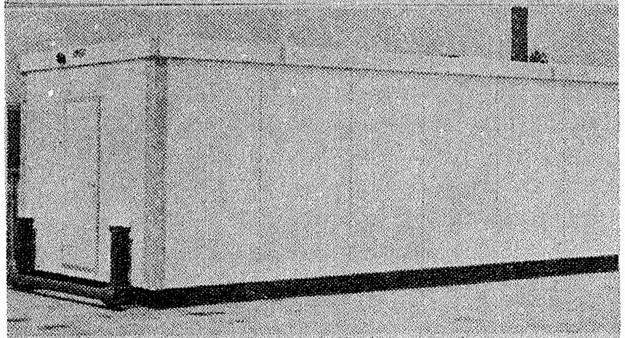
Description: The knock-down technique has become the most frequently used solution to relocatable camp structures. Floor and ceiling of a knock-down building serve as bottom and top of the packing case, saving up to 80 per cent on freight volume. Panels are made of 2x4's with simple nailed connections. This system utilizes one permanently erect sectional box which includes kitchen and bathroom, and an additional knock-down section to be attached to the erect box.

Evaluation: The combination of a permanently erect sectional box with a knock-down facilitates the shipment of the mechanical system and of furniture within the housing unit. This configuration can be considered the camp industry's most successful type of relocatable housing.

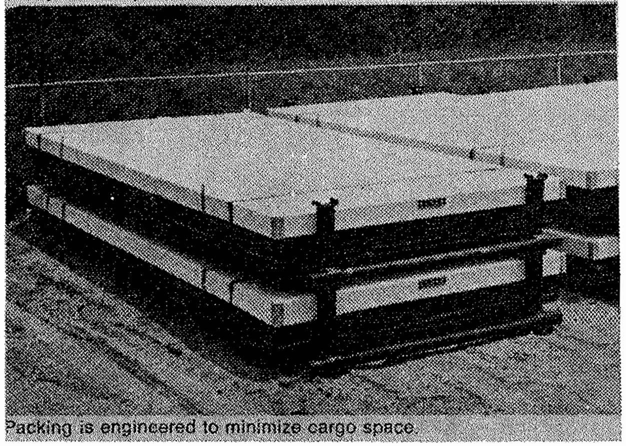
Included in the cost-effectiveness analysis.



Field erection is simple and fast.



Heavy oilfield-type skids and rugged aluminum exteriors.



Packing is engineered to minimize cargo space.

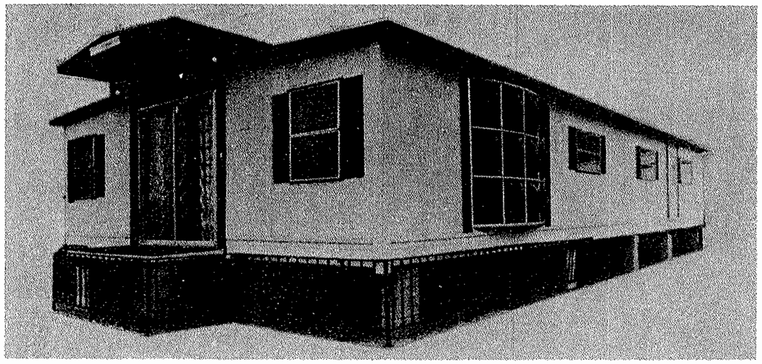


FIGURE 38
ELDER INTERNATIONIAL
INC.

Elder International began more than 25 years ago as Elder Trailer and Body, a small firm in Denver, Colorado, building trailers for the geophysical industry. To keep abreast of the growing international oil and construction industries, Elder expanded its operations to Houston, Texas, for the readily accessible rail and port facilities. Here it operated in a somewhat larger shop serving the oil related and construction industries.

In 1964, Elder purchased Oilfield Truck Equipment Company, an on-and-off-the-road transportation equipment manufacturing concern. The two firms combined their operations into the larger plant and the name was changed to Elder Oilfield Inc. Elder only managed to stay in this location for a little more than a year before its plant capacity was over extended.

In 1965, Elder purchased an eight-acre site and built its present plant and headquarters facility. This plant has been expanded four times to what it is today (photo above). The complete eight acres are developed and there are 71,000 square feet of floor space under roof. Not only does Elder have this plant, but the Special Projects Division of the company maintains plants in California and Mississippi.

The company has three divisions: the Transportation Division, the Field Camp Division, and the Special Projects Division. As the years progressed, Elder's Field Camp Division became more and more involved in other types of housing. This division is now actively engaged in producing field camps, construction camps, offshore housing, fiberglass buildings, microwave, and instrument housing and a host of others.

To better manage our constantly growing business, the Special Projects Division was formed to actively pursue large projects. In just a few years Elder has become the world's leading designer and supplier of modular hospitals.

Elder's Engineering staff is complete in every phase with experienced professional engineers. People who know and understand modular construction.

In 1970, Elder changed its name to Elder International, Inc. We feel that we are truly an international company. There is never a day when at least one of our nearly 200 employees is not in a foreign country. Elder products can be found on every continent and in nearly every country of the world. We have served the governments and companies of many nations and have become a leader in our industry. Let Elder serve you.

Elder
International
Inc

b (l-c) Camp Systems

Manufacturer: Elder International
(Product range includes industrial mobile units, general sectional boxes and knock-down boxes.)

System Evaluated:

Basic Configuration: Expandable Box

Description: Similar to Guerdon expandable mobile home. Production discontinued.

Evaluation: The system was included under the present manufacturer, Guerdon Industries.

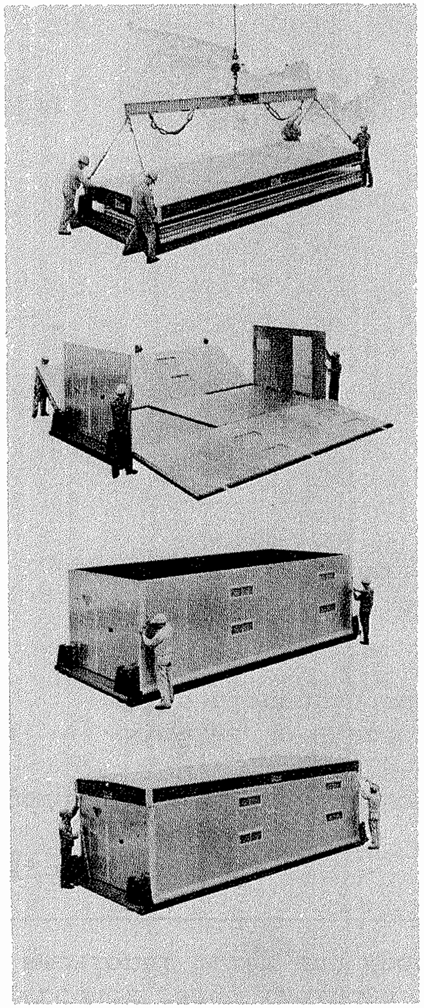
FIGURE 39
PORTA-KAMP

The World Standard of Quality in Portable Buildings

The new approach we have developed to portable offshore buildings is just another example of the creative engineering we at Porta-Kamp have been applying to the needs of industry since 1955. We started with a folding tent-building for geophysical crews. Then we developed a knock-down technique for larger buildings, so they could be shipped flat with 1/5 of the usual cube and 80 per cent savings in freight. We hold the patents and licensing rights for that one. From those beginnings we have developed other concepts and techniques which have become world-wide standards. Now we have eight basic product lines, those shown at right, and we will develop more as new needs arise. We've shipped our products, from single modules to entire camps of more than 300 units, to remote areas in 100 countries around the world. That's a record we at Porta-Kamp are proud to stand on.

PORTA·KAMP
HOUSTON

Phone: (713) UN 9-3294 / P.O. Box 7064 • Houston, Texas 77008



For instance, we hold the patents* and offer a licensing arrangement on the basic design of the knock-down building. (See photos at right.) This building folds to make its own packing case . . . saves up to 80% on freight . . . and re-erects in 30 minutes!

b (1-d) Camp Systems

Manufacturer: Porta-Kamp
(Product range includes industrial mobile units, general sectional boxes and knock-down boxes.)

System Evaluated:

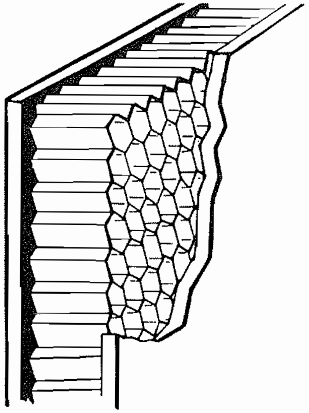
Basic Configuration: Sectional Box and Knock-Down

Description: Similar to Atlantic International. Panels are made of 2x4's with mortis-and-tenon and glued connections.

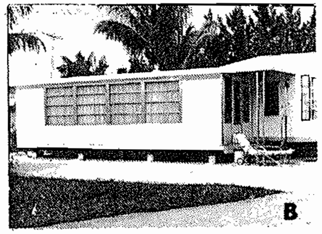
Evaluation: The manufacturer did not provide adequate data.

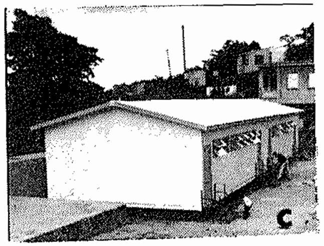
Not included in cost-effectiveness analysis.

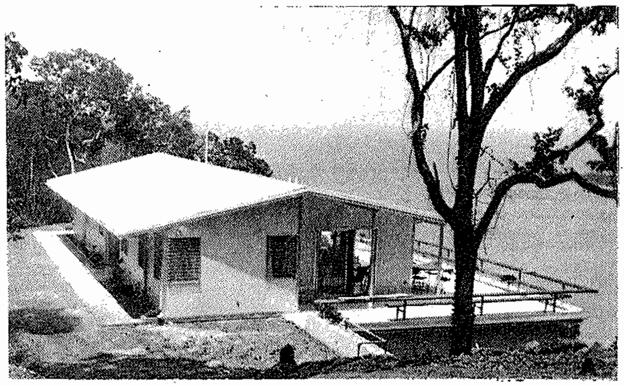
FIGURE 40
ENDURE PRODUCTS, INC.



THE BASIC ENDURE-A-BILT HONEYCOMB PANEL







Since 1947 ENDURE-A-LIFETIME PRODUCTS, INC. has been perfecting a revolutionary construction system which has affected the entire building industry. It's the aluminum faced insulated structural panel module.

Already famous for major contributions to the National Space Program and commercial construction, this system has caught the imagination of those who have long experienced the cumbersome inadequacy of out-dated building materials and methods.

ASTONISHINGLY DIFFERENT!
Now our modular bilt structural panels are utilized in structures ranging from small guard houses to industrial buildings.

TIME PROVEN!
Not an experiment, but time proven in the field; architecturally designed – and engineered to meet all building codes.

BASIC COMPONENTS!
The basic component is an insulated, structural, completely pre-finished panel for exterior walls, interior partitions, and roof. Available in varying thickness with special integral fastenings that insure dimensional stability. Windows, doors, louvers, etc. built into the panels. Electrical conduit and raceways concealed in the panels. The ease and rapidity of erection of any Endure structure, with a minimum amount of labor, is truly astonishing.

ENDURE A LIFETIME
ALUMINUM PRODUCTS, INC.

b (2-a) Honeycomb Panel Systems

Manufacturer: Endure Products, Inc.
(Products include wide range of panels adaptable to various commercial and residential building types.)

System Evaluated:

Basic Configuration: Panelized

Description: A system utilizing sandwich-type structural panels composed of two outer skins of aluminum, steel, wood, or other material laminated to a honeycomb core. This design was originally developed for use in high-performance aircraft.

The panels are completely structural, joining together with locking devices to form a building. Standard thicknesses are 2" and 3", standard widths are 36", 40" and 48".

The system lends itself to custom design, although the manufacturer provides standard designs. Erection does not require heavy equipment such as cranes.

Evaluation: The Panelfab system included in the cost-effectiveness analysis was selected to represent this type of system.

Not included in cost-effectiveness analysis.

FIGURE 41
PANELFAB INTERNATIONAL

this is panelfab international corporation

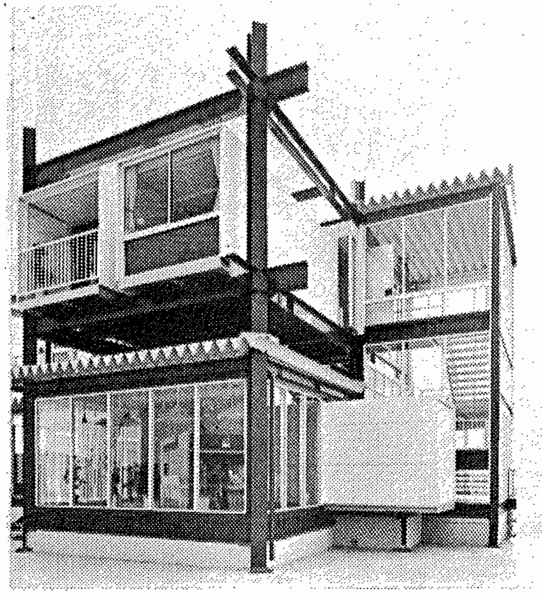
Panelfab International Corporation is a multi-million dollar manufacturing and export operation serving a widely-diversified multi-national construction market.

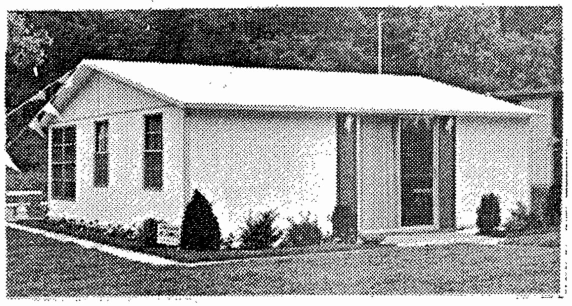
Panelfab International Corporation is a publicly-owned company with several thousand stockholders. Its stock is traded Over-The-Counter.

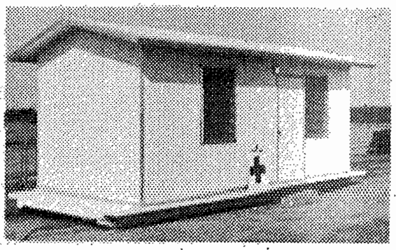
Panelfab International Corporation, along with its subsidiary companies, is primarily engaged in the design, engineering, and manufacture of structural building panels which, when erected, form complete free-standing building units.
The Company's principal product—the structural, load-bearing panel—has been used in residential, institutional and commercial markets, both domestic and foreign, in more than 9,000 building applications during the past 20 years. Panelfab building systems and components have been shipped to virtually every state in the U.S. and to more than 50 foreign nations.

The following pages depict the Panelfab manufacturing process and major applications of the Panelfab building system and its related accessory supply services.

panelfab International Corporation
1600 N.W. LE JEUNE RD. • MIAMI, FLORIDA 33126







b (2-b) Honeycomb Panel Systems

Manufacturer: Panelfab International
(Products include wide range of panels adaptable to various commercial and residential building types,and sectional boxes called "space capsules.")

System Evaluated:

Basic Configuration: Panelized

Description: A system utilizing sandwich-type structural panels composed of two outer skins of aluminum, steel, wood or other material laminated to a honeycomb core. This design was originally developed for use in high-performance aircraft.

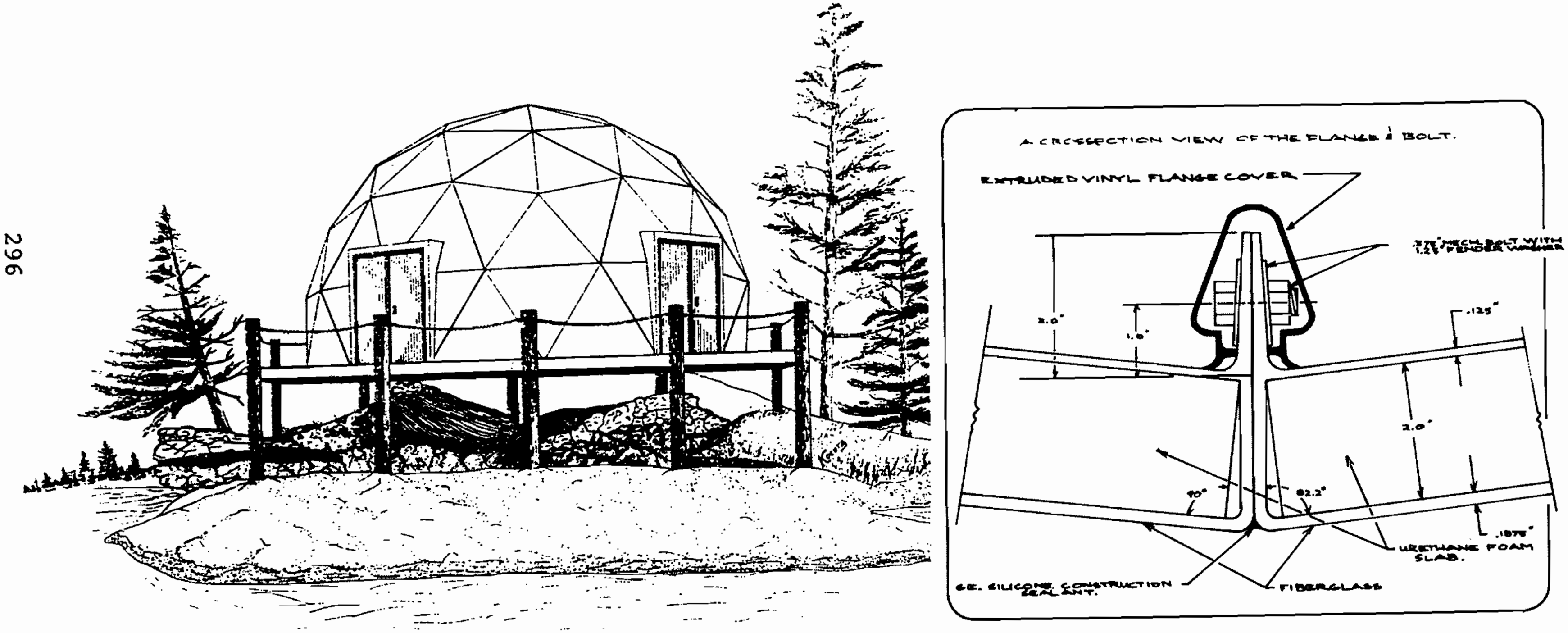
The panels are completely structural, joining together with locking devices to form a building. Standard thicknesses are 2" and 3", standard widths are 36", 40" and 48".

The system lends itself to custom design, although the manufacturer provides standard designs. Erection does not require heavy equipment such as cranes.

Evaluation: A highly successful honeycomb panel system.

Included in cost-effectiveness analysis.

FIGURE 42
CIRCLE CONSTRUCTION



circle construction

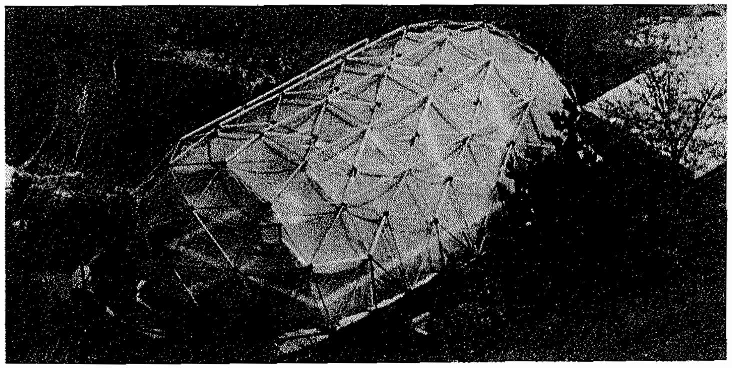
571 EAST 4th ST., WINONA, MINNESOTA 55987
507-454-3565

b (3-a) Dome Systems

Manufacturer: Circle Construction
(Product range - geodesic dome vacation homes.)

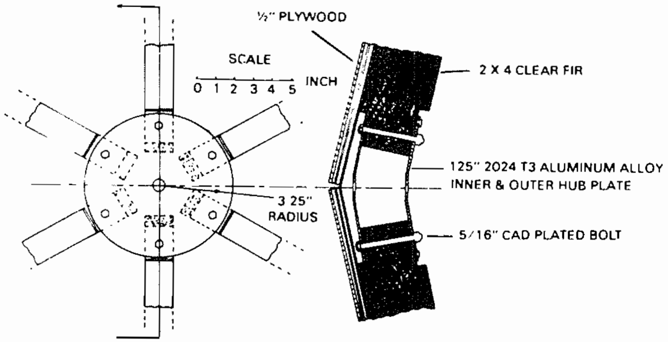
System Evaluated:

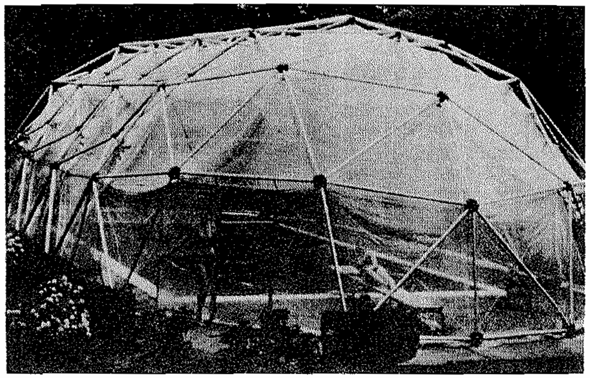
Basic Configuration:	Special Packaged Enclosure
Description:	24' and 30' diameter, panelized geodesic domes.
Evaluation:	Geodesic Structures was pre-selected to represent this type of system. Not included in cost-effectiveness analysis.



Wood Dome is constructed with the unique Dome East hub system, which eliminates all difficult woodworking and excessive use of materials in fabricating a dome. It also enables the entire shell to be assembled in a weekend by four or more people. Only a hammer and a few wrenches are needed to bolt together our color-coded frame and nail on our precoded panels.

detail of hub (patent pending)





SHELTERDOME IS . . .
a proven geodesic dome concept now available at comparatively low cost and provides trouble-free, clear-span space enclosures. This system is based on the incredible strength and reliability of the geodésic dome concept, first designed by R. Buckminster Fuller to "do more with less". The Shelterdome system is a geodesic aluminum frame with a suspended membrane that enables fast erection. Standard size Shelterdomes are in stock for immediate delivery. Custom domes of larger sizes and in-between sizes can be fabricated and delivered in a matter of weeks.

DOME EAST
corporation

325 duffy ave.
hicksville
new york 11801
(516) 938-0545

FIGURE 43
DOME EAST CORPORATION

b (3-b) Dome Systems

Manufacturer: Dome East Corp.
(Product range - geodesic domes from 14' to 75' in diameter with custom in-between and larger sizes available.)

System Evaluated:

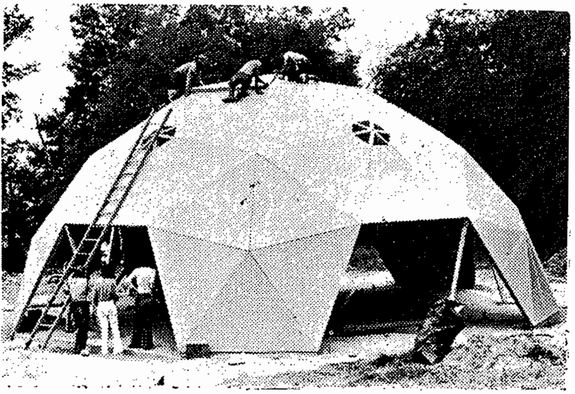
Basic Configuration: Special packaged enclosure

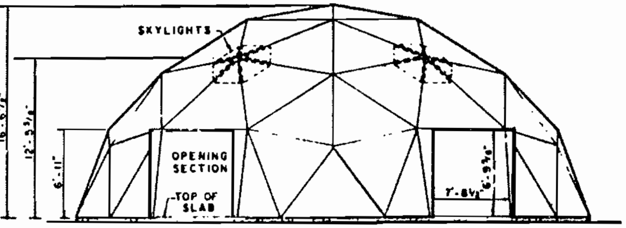
Description: Standard size geodesic domes with metal pole structure and infill panels or liners; also made in panelized wood sections for vacation homes.

Evaluation: The metal dome system manufactured by Dome East is not applicable for temporary housing. The wood system is similar to the system selected as a representative example of wooden dome systems (Geodesic Structures).

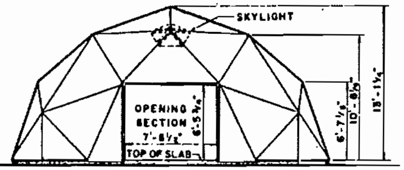
Not included in cost-effectiveness analysis.

FIGURE 44
GEODESIC STRUCTURES





Model D-39



Model D-26

TRIANGULAR SPACE FRAMES are made of precision mill-beveled 2 x 4 kiln-dried Douglas fir framing members and DFPA exterior grade Douglas fir plywood -- with a medium density plastic overlay. The plywood is surface glued and stapled to the framing members. Interior metal clips are also applied and framing members pre-drilled for three (3) bolts in each side.

JOINTS between triangular space frames are weatherproofed on-site with butyl caulking and covered with plastic flashing. (Caulking, flashing and necessary materials for application are furnished with standard dome models.)

BASE PLATES are 2 x 4 kiln-dried Douglas fir, pre-drilled for anchor bolts. Ribbon caulking is furnished for weatherproofing between base plates and concrete slab.

HARDWARE includes 3/8" x 3-1/2" hex-head bolts with washers and nuts (for bolting space frames together), 18 gauge galvanized steel tension straps, and galvanized nails for installation.

LEFT, RIGHT, AND OVERHEAD CANOPIES are 5/16" DFPA exterior grade Douglas fir plywood with medium density plastic overlay which is glued and stapled to both sides of the frame.

OPTIONS: 1" rigid urethane insulation 1/4" interior plywood, cut to size (with trim strips). 1/4" pre-finished interior plywood, cut to size (with mouldings). A variety of "opening sections" including: insulated sliding glass doors, double-hung windows, swing-out doors, casement windows, and triangular space frame closures (all opening sections include trim). Custom designed opening sections can be ordered with any dome model.

Geodesic Structures, Inc.
P. O. Box 176 • Hightstown, New Jersey 08520

b (3-c) Dome Systems

Manufacturer: Geodesic Structures

System Evaluated:

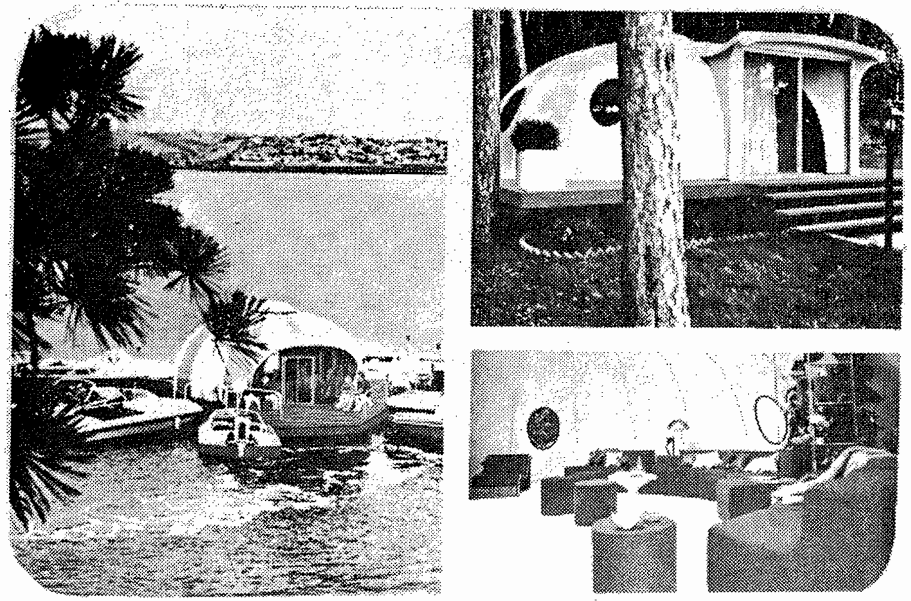
Basic Configuration: Special Packaged Enclosure

Description: Geodesic wood panelized domes; present production sizes from 26' to 59' diameters.

Evaluation: The best documented geodesic dome used to evaluate a dome system in comparison with other types of potentially applicable systems.

Included in cost-effectiveness analysis.

FIGURE 45
O'DOME



The O'Dome has two layers of strong fiberglass encasing and bonded to a slab of insulating foam. The outstanding structural integrity of the O'Dome is accomplished by a series of steel plates securing its base, a patented tongue and groove connector along the panel edges, a tensioned aircraft cable threaded horizontally through the panel centers and a metal ring at the skylight opening. The addition of the doorway and skylight complete the external structure. The result is a weatherproof, flame-retardant, maintenance free, super-ellipsoid dome — a structure of remarkable strength and durability ... providing 530 square feet of unobstructed living space.

Each O'Dome comes complete with panels, doorway components, sliding glass door, skylight and all necessary hardware. Shipping weight is approximately 2,000 pounds.

The O'Dome has been engineered and independently tested to conform to the performance standard of the three largest building code agencies in the United States. Results have been established by an ongoing program of testing, which has subjected the O'Dome to the equivalent of heavy snow loads, extreme wind velocity, impacts, and fire. The most recent program was completed in 1973 by Dr. David Sikarskie , professor in the University of Michigan Aerospace Engineering Department. The documented results demonstrate that the O'Dome meets or surpasses building code requirements on local, state, regional and national levels.

Heating and cooling of the O'Dome pose no problem. Because of its design and insulating qualities, we have found that it requires less BTU's per square foot of floor space than more conventional structures to heat and air condition. We suggest 17,000 BTU for cooling and 30,000 for heating. This should be more than adequate to keep you comfortable despite the weather.

O'DOME IS A PRODUCT OF TENSION STRUCTURES, INC., 9800 Ann Arbor Road, Plymouth, Michigan 48170
Telephone: 313 / 455-5800

b (3-d) Dome Systems

Manufacturer: Tension Structures (O'Dome)
(Product range - geodesic dome vacation homes.)

System Evaluated:

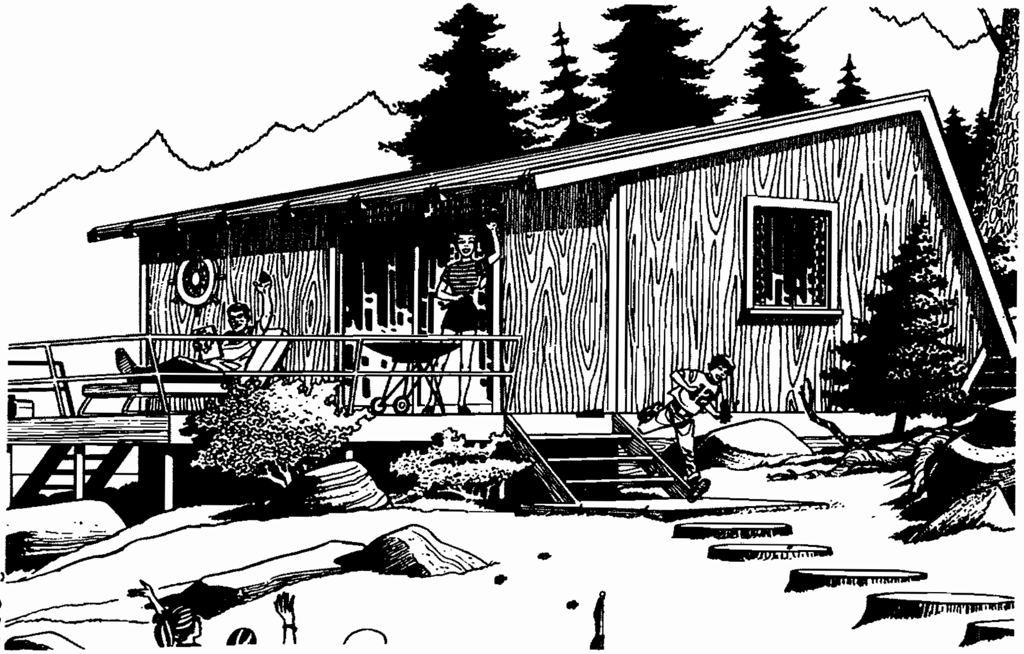
Basic Configuration: Special Packaged Enclosure

Description: General dome ("orange peel"). Fiberglass reinforced, panelized sections.

Evaluation: O'Dome currently manufactures a 25' diameter dome which is too small to be adapted to the Minimum Livalbility Standards.

Not included in cost-effectiveness analysis.

FIGURE 46
ALTAIR INDUSTRIES, INC.

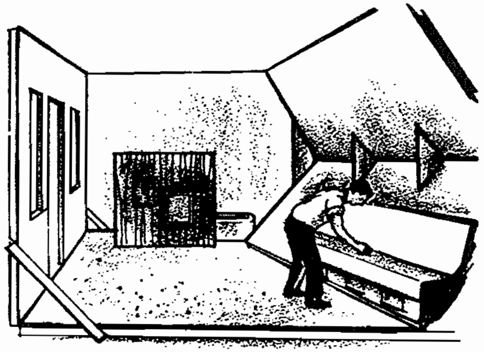


MOVE BY LAND, SEA OR AIR

Fully containerized for storage and transportation, each Altair unit can be easily moved by truck, ship, rail—even helicopter. Because it's relocatable, it can be simply re-containerized for shipment to another location.

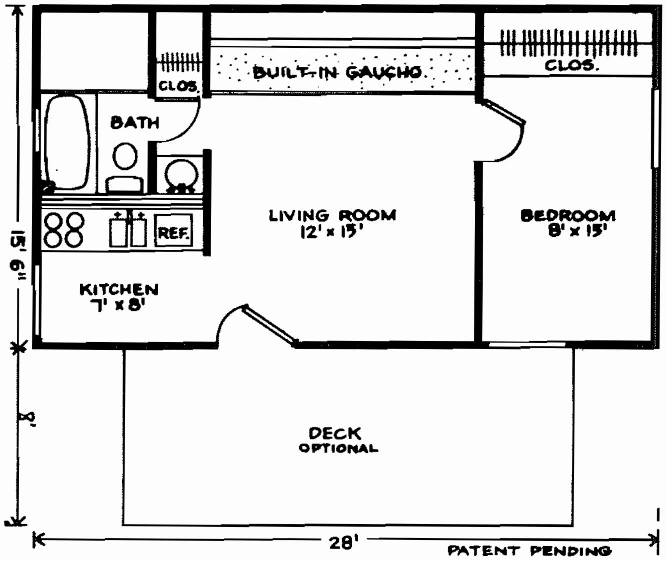
CONSTRUCTION

Over five years of careful engineering have combined the most modern materials and manufacturing techniques to build quality into all aspects of the Altair Recreational Home and to give many years of carefree living.



INSTALL IN A DAY

Installation is quick and easy. Once placed on the simple pier or pole foundation, the unit can be unfolded and finished in a day. Completely pre-wired, pre-plumbed, and panelized, all the components required for completion are shipped inside the container.



ALTAIR INDUSTRIES, INC.
255 CHANNEL STREET • SAN FRANCISCO, CALIFORNIA 94107

b (4-a) Miscellaneous Systems

Manufacturer: Altair Industries

System Evaluated:

Basic Configuration: Expandable Box

Description: System uses stressed-skin, polystyrene laminated panels; a 10' wide by 4'-6" high by 28'-32' long units unfolds by employing hinges to a deployed configuration of 18' wide by 8' high by 28'-32' long. Part of the system in an integral mechanical core. Patents pending.

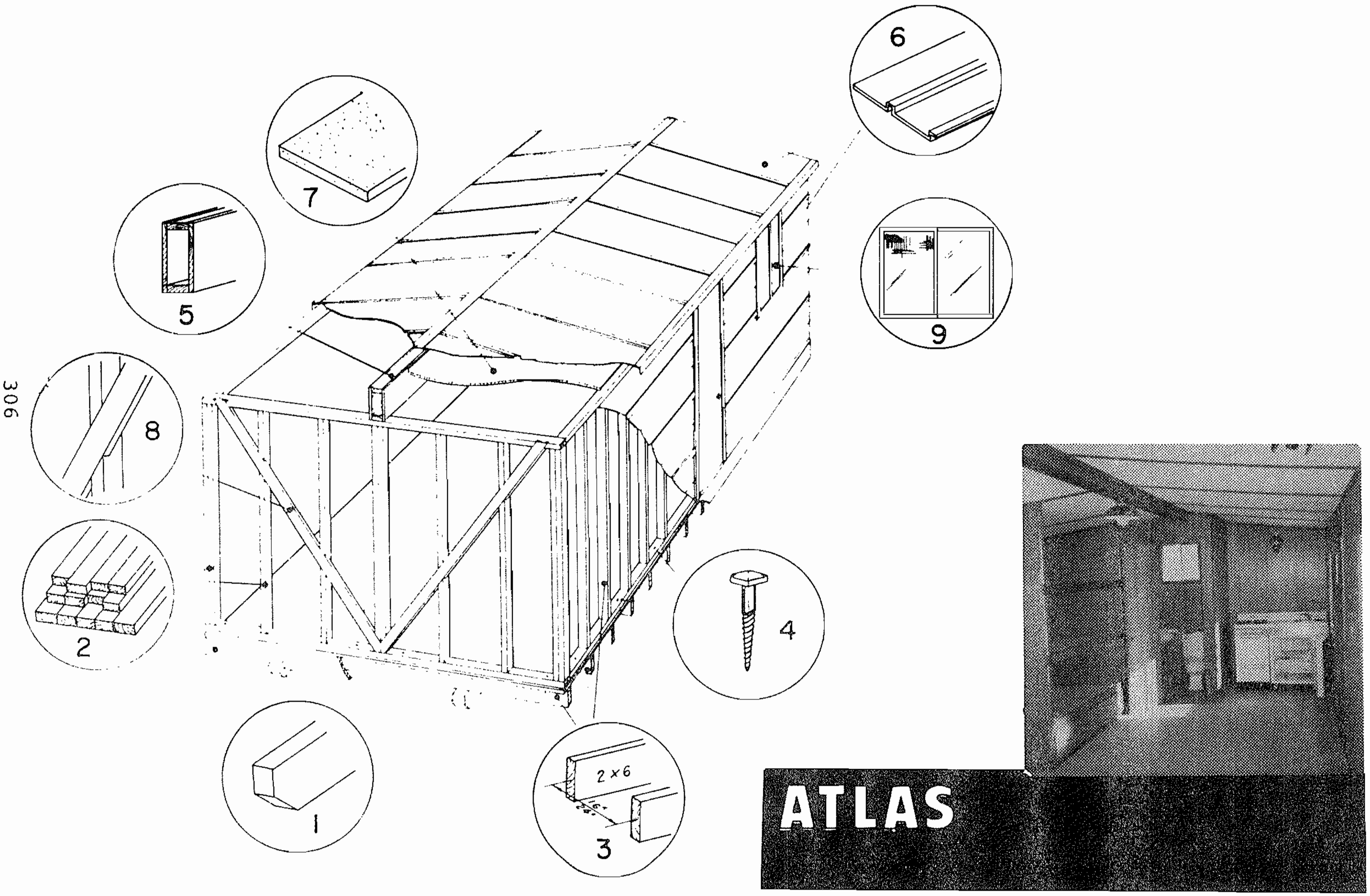
Evaluation: The system can be adapted to the Minimum Livability Standards. The manufacturer supplied all information requested. The Altair expandable box system offers a greater volume reduction than other expandable box systems evaluated since both width and height are reduced in the folded position.

Included in cost-effectiveness analysis.

PORTABLE

Portable as a trailer unit. Permanent as conventional structures. Less expensive than either. Atlas Portable buildings can be moved innumerable times with complete safety, minimum expense and without any site preparation necessary.

FIGURE 47
ATLAS PORTABLE



b (4-b) Miscellaneous

Manufacturer: Atlas Portable
(Marketed for various types of light commercial uses and as vacation home)

System Evaluated:

Basic Configuration: One Box Without Wheels

Description: A modular system using conventional wood-frame construction with aluminum siding, shipped on flat-bed trucks.

Evaluation: The manufacturer did not provide enough data to include the system in the cost-effectiveness analysis. The units shown are one-room units substantially smaller than the Minimum Livability Standards. Moreover, a one-box system without running gear is at a disadvantage if compared for cost-effectiveness with standard single-wide mobile homes in disaster relief missions since it requires heavy equipment for site erection, deactivation, shipment and storage.

Not included in cost-effectiveness analysis.

CONTINENTAL
UNITED STATES

TYPICAL TWO-MODULE UNIT
364 SF

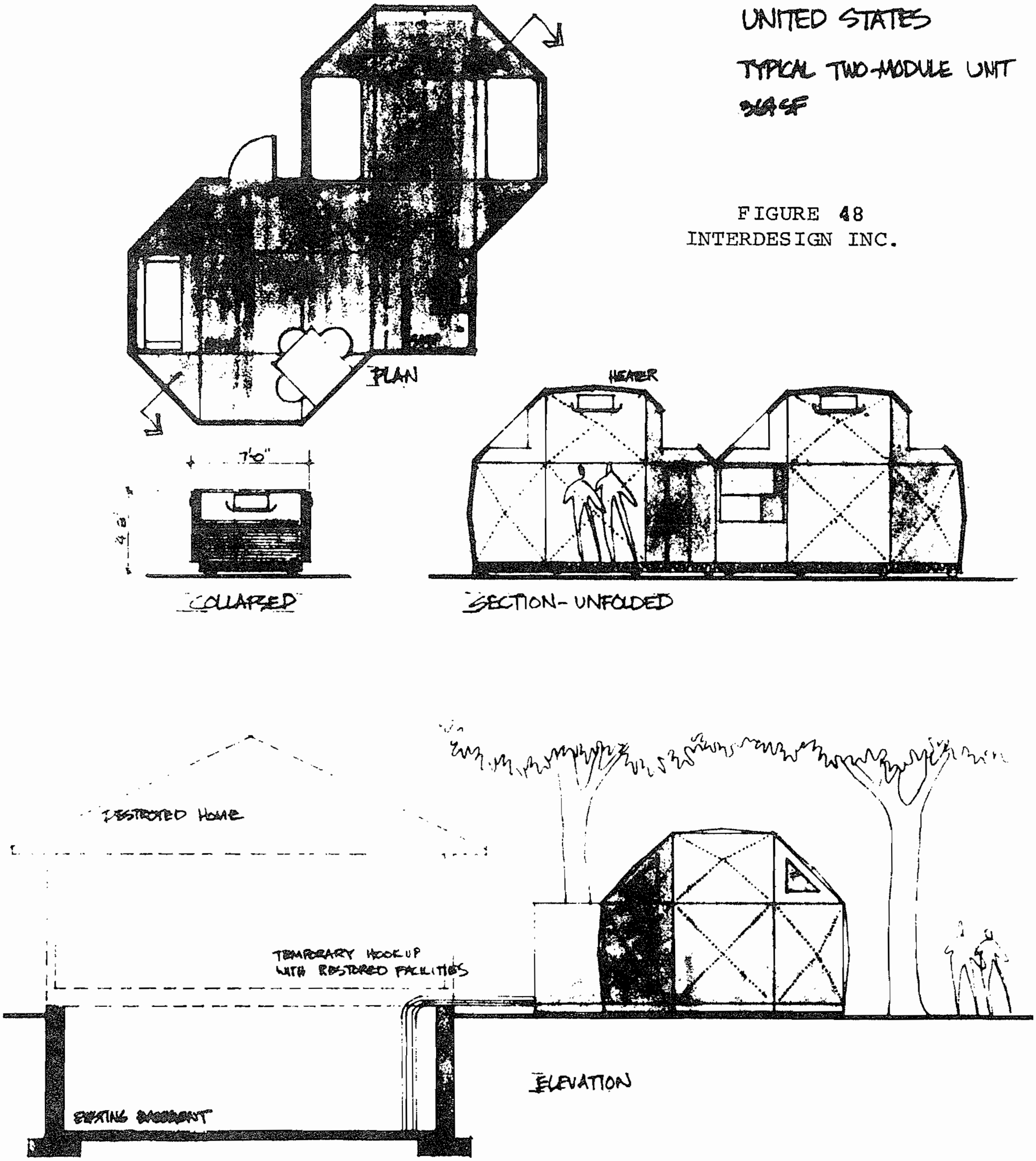


FIGURE 48
INTERDESIGN INC.

Emergency Housing Concept

InterDesign Inc.

1409 Willow Street 335-7878
Minneapolis - Saint Paul/Minnesota

b (4-c) Miscellaneous

Manufacturer: Interdesign, Inc.

System Evaluated:

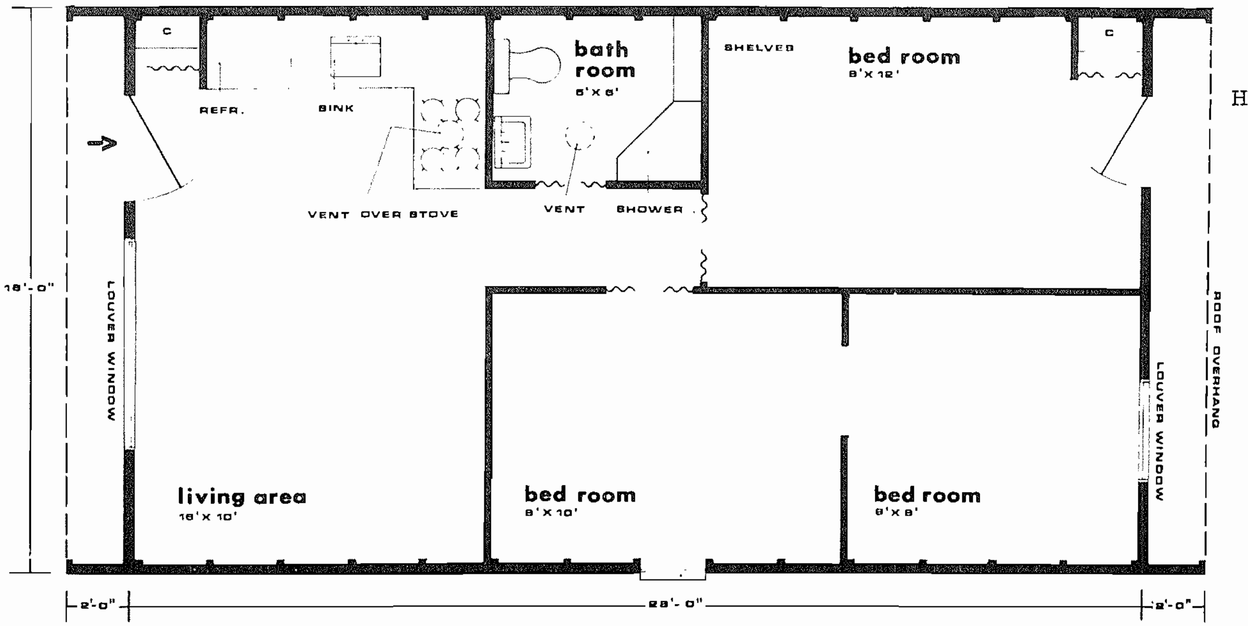
Basic Configuration: Expandable Box

Description: Fiberglass wall panels are used to form an expandable hexagonal-shaped unit. The system was designed in response to HUD's request for information on emergency housing systems in 1971.

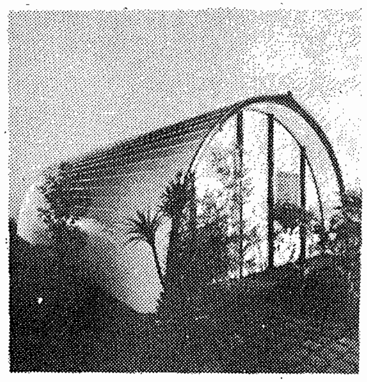
Evaluation: The system exists as a design proposal only. No prototype has been developed and no connection details are available.

Not included in cost-effectiveness analysis.

FIGURE 49
UNIVERSAL
HOUSING SYSTEMS, INC.



TYPICAL FLOOR PLAN—The beauty of the Universal Home is not only its exceptional value, but the roomy comfort and essential living space it provides. While the basic floor plan includes three bedrooms modifications can be made.



DUO-WALL patented*

DOUBLE WALL Hollow Vinyl Siding used exclusively in THE UNIVERSAL HOME

keeps weather out...comfort in
MEETS FHA BUILDING STANDARDS

*U.S. Patent #3,395,508—EXTRUDYNE, INC.

UNIVERSAL HOUSING SYSTEMS, INC.
360 East 65th Street, New York City, N.Y. 10021
(212) 472-0373

b (4-d) Miscellaneous

Manufacturer: Universal Housing Systems, Inc.

System Evaluated:

Basic Configuration: Special Packaged Enclosure

Description: 18'-wide "quonset hut" type shape made completely of extruded thermo-plastic profiles.

Evaluation: If used as temporary housing for disaster relief, this recently developed system would exhibit a high risk of pilferage and attrition because of the many individual parts. Furthermore, there is no provision for an integral relocatable floor system and an integral heating system.

The fire rating could not be determined. Moreover, only general sales information was provided by the manufacturer.

Not included in the cost-effectiveness analysis.

FIGURE 50

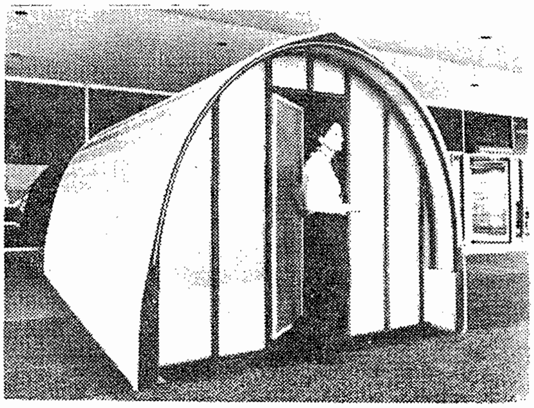
PLASTICS CONSULTANTS • RESEARCH • DEVELOPMENT **ARMAND G.WINFIELD INC.**
82 DALE STREET, WEST BABYLON, NEW YORK 11704 (516) 249-2462
CABLE ADDRESS: WINPLAS WESTBABYLON

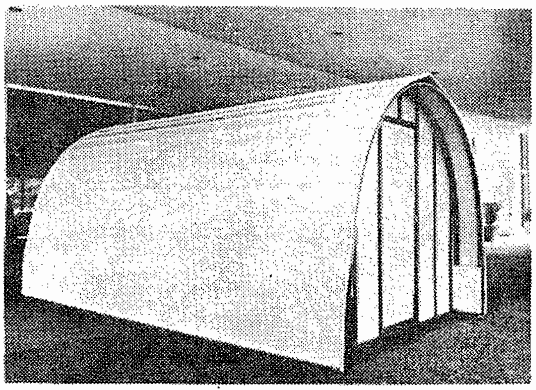
EMERGENCY STRUCTURE

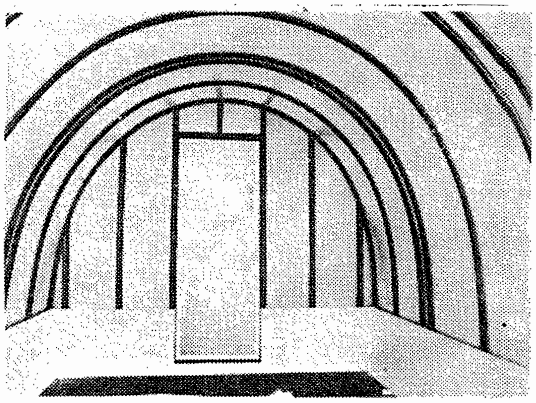
ARMAND G. WINFIELD INC., Plastics Consultants, have designed, developed and constructed an Emergency Structure made with PVC (polyvinyl chloride) extrusions. This structure was shown in cooperation with the Society of Plastics Engineers Inc.'s National Technical Conference: Plastics in Building Construction: Realities and Challenges, Pittsburgh, Pennsylvania, November 8, 9 and 10, 1972.

This prototype is experimental—and partially incomplete. However, it demonstrates how inexpensive, easily available and attractive extruded PVC can provide a light-weight, rapidly erected livable structure which can be used in devastated areas where conditions result from earthquakes, floods, hurricanes, tornados, etc. PVC extrusions in a variety of profiles, configurations, corrugated sheeting and miscellaneous trims are precut, predrilled and numbered. They can be palletized for rapid shipment by truck or plane to a disaster area where they can be assembled by unskilled, on-site labor at minimum costs and maximum efficiency. The total raw material cost for this insulated 8′ x 14′ prototype was under $400.

PVC's low price, as well as its non-burning and weather resistant characteristics, make it an attractive potential material for building systems. PVC is also light, strong and colorful. This system can be adapted for vacation homes, agricultural green houses, farm buildings, camp sites, barracks, tool sheds, storage buildings, radomes, etc.







The photographs were taken at the Pittsburgh Hilton Hotel during the SPE NATEC noted above. After the conference, the Emergency Structure was presented to the Pittsburgh Model Cities program (Robert L. Boulden, Executive Director) where it will remain in a Model Cities park area.

ARMAND G. WINFIELD INC., Plastics Consultants, are well known in the field of applications engineering and in the field of low cost housing—especially for developing countries. ARMAND G. WINFIELD INC.'s offices and laboratory work areas are located at 82 Dale Street, West Babylon (Long Island), New York 11704 (516 249-2462) where other low cost and emergency systems are available both for viewing and for discussion. Your inquiries are welcome.

The company and/or its principals are members of The Society of the Plastics Industry, Inc., Society of Plastic Engineers, Inc., Plastics Institute (Great Britain) Plastics Institute of Australia and International Association of Housing Science

b (4-e) Miscellaneous

Manufacturer: None
Developed by Armand G. Winfield, Inc.

System Evaluated:

Basic configuration: Special Enclosure

Description: "Quonset hut" shape made completely of polyvinyl chloride extrusions. The system appears identical with Universal Housing Systems, Inc. system described before.

Evaluation: Manufacturer was not able to provide adequate data. System has drawbacks similar to Universal Housing Systems, Inc.

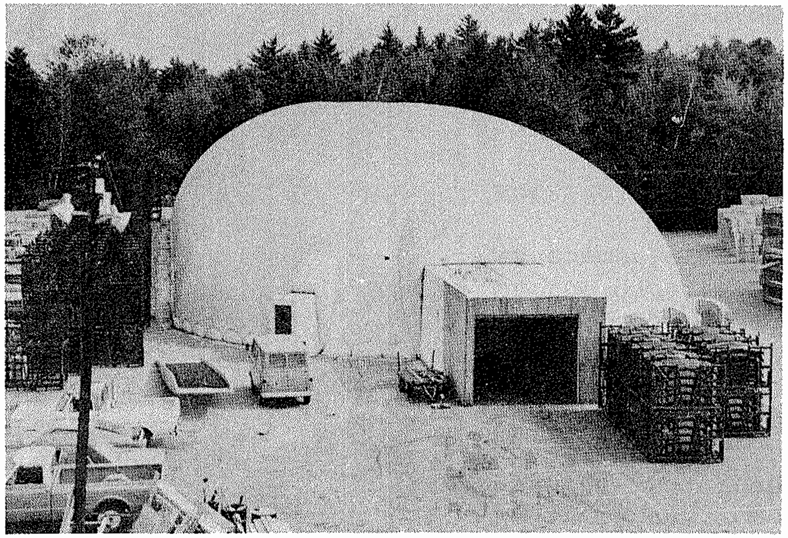
Not included in cost-effectiveness analysis.

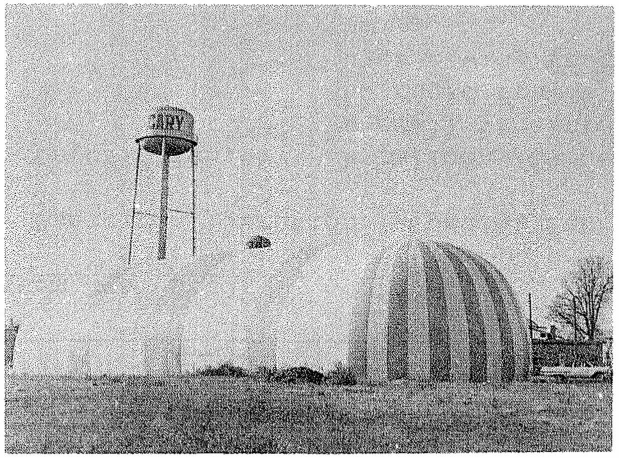
c. Other Commercial Relocatable Shelter Systems

SYNOPSIS

INDUSTRY SEGMENT	MANUFACTURER (EXAMPLE)
(1) Air Structures	(a) Air-O-Structures
	(b) Birdair Structures
(2) Metal Structures	(a) Armco
	(b) Concor
	(c) Stran-Steel
(3) Container Van	(a) Fruehauf Division (or similar)

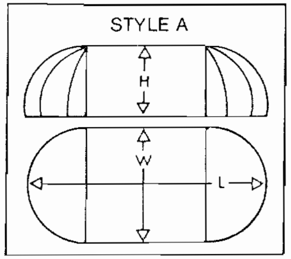
FIGURE. 51
AIR-O-STRUCTURES, INC.

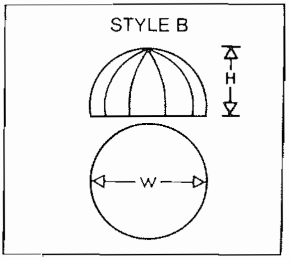




AIR-O-STRUCTURES has been in continuous operation since 1899. We first entered the field of Air supported buildings in 1959. We have a long list of satisfied customers and we will be pleased to furnish you with the names of the proper persons should you wish to contact them for references and recommendations.

Air structures are custom made and can be designed in unlimited styles and sizes to meet your requirements.





AIR-O-STRUCTURES P.O. BOX 296 • AUBURN, MAINE 04210 • 207-782-0200

c (1-a) Air Structures

Manufacturer: Air-O-Structures, Inc.
(Product range includes air supported structures for military, commercial and industrial applications)

System Evaluated:

Basic Configuration: Special Packaged Enclosure

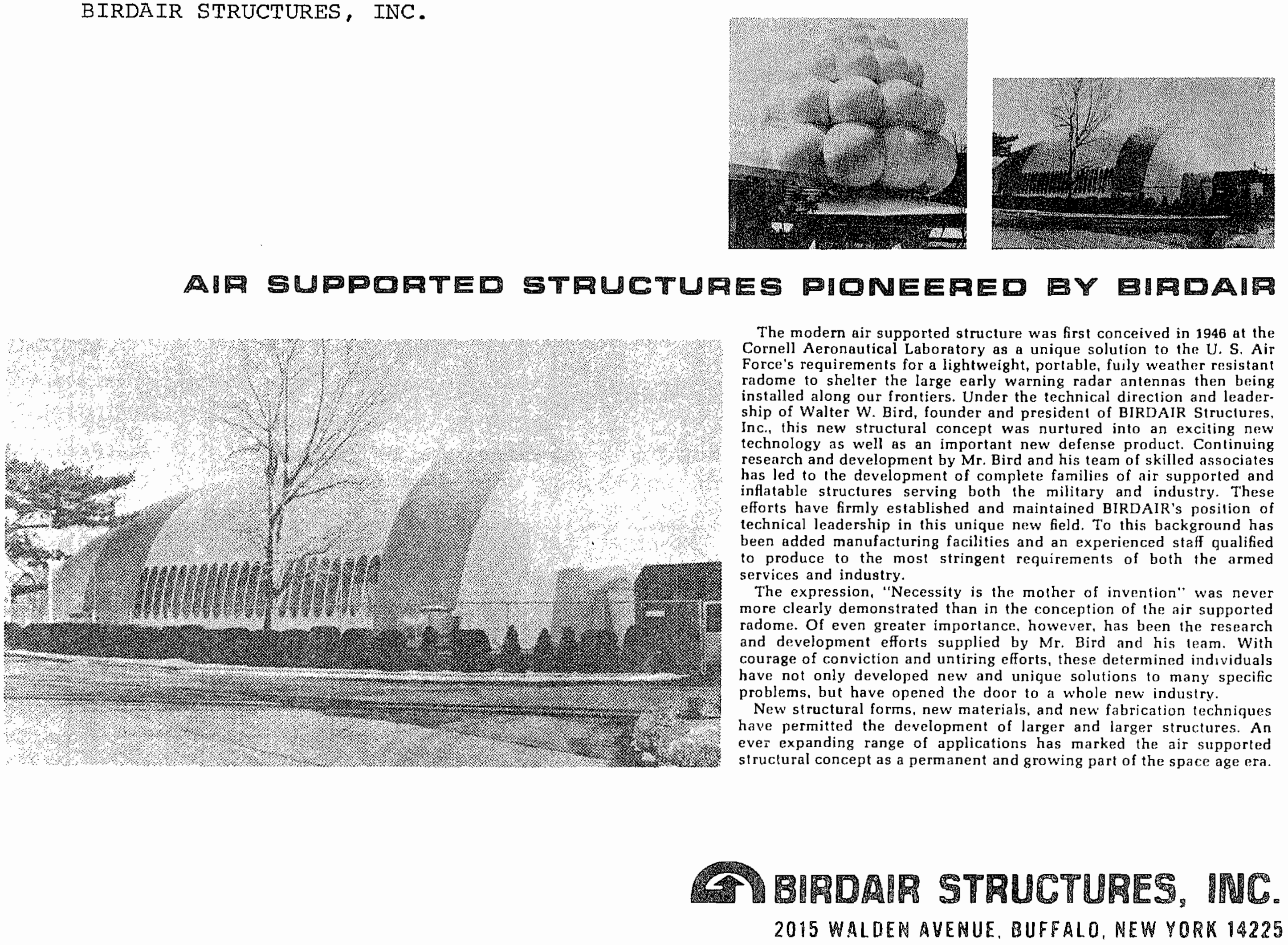
Description: A balloon-like envelope, supported and stabilized by maintaining a small pressure differential within the envelope. Requires no rigid frames, beams or supporting ribs. Size can be varied over a wide range of lengths, widths and heights.

Evaluation: No instances were found in which air structures were used as individual housing units. Air structures are not recommended for individual housing applications, due to inherent partitioning problems, (doors and windows), solar problems, and the questionable durability of the membrane for the intended use.

On the other hand, air structures can play an important role as community spaces on group sites for temporary housing.

Not included in cost-effectiveness analysis.

FIGURE 52
BIRDAIR STRUCTURES, INC.



AIR SUPPORTED STRUCTURES PIONEERED BY BIRDAIR

The modern air supported structure was first conceived in 1946 at the Cornell Aeronautical Laboratory as a unique solution to the U. S. Air Force's requirements for a lightweight, portable, fully weather resistant radome to shelter the large early warning radar antennas then being installed along our frontiers. Under the technical direction and leadership of Walter W. Bird, founder and president of BIRDAIR Structures, Inc., this new structural concept was nurtured into an exciting new technology as well as an important new defense product. Continuing research and development by Mr. Bird and his team of skilled associates has led to the development of complete families of air supported and inflatable structures serving both the military and industry. These efforts have firmly established and maintained BIRDAIR's position of technical leadership in this unique new field. To this background has been added manufacturing facilities and an experienced staff qualified to produce to the most stringent requirements of both the armed services and industry.

The expression, "Necessity is the mother of invention" was never more clearly demonstrated than in the conception of the air supported radome. Of even greater importance, however, has been the research and development efforts supplied by Mr. Bird and his team. With courage of conviction and untiring efforts, these determined individuals have not only developed new and unique solutions to many specific problems, but have opened the door to a whole new industry.

New structural forms, new materials, and new fabrication techniques have permitted the development of larger and larger structures. An ever expanding range of applications has marked the air supported structural concept as a permanent and growing part of the space age era.

BIRDAIR STRUCTURES, INC.

2015 WALDEN AVENUE, BUFFALO, NEW YORK 14225

c (1-b) Air Structures

Manufacturer: Birdair Structures, Inc.

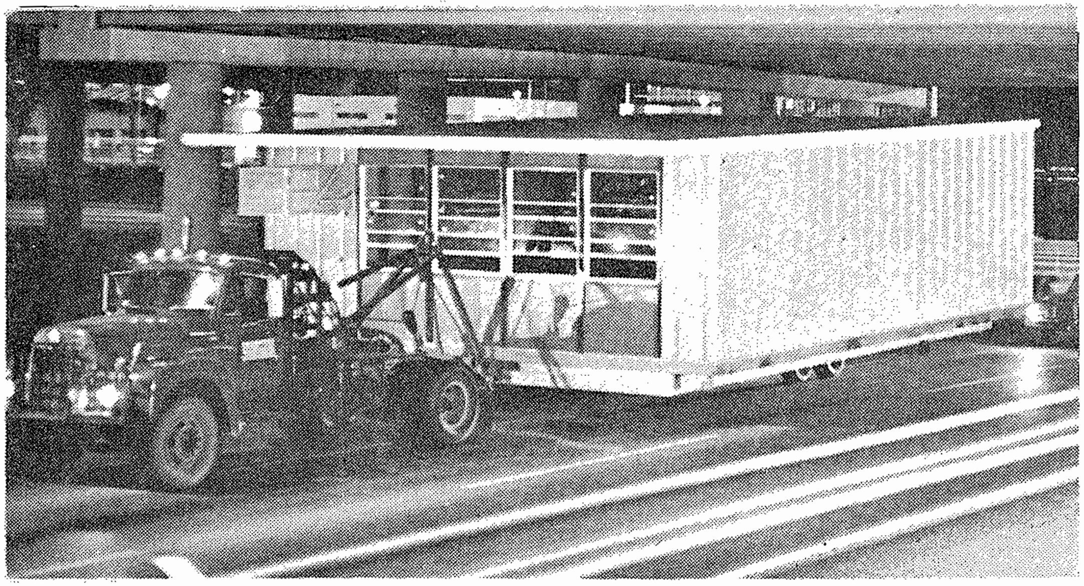
System Evaluated:

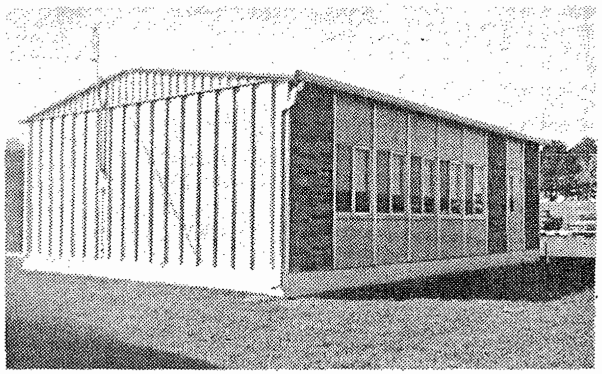
Basic Configuration: See Air-O-Structures.

Description: See Air-O-Structures.

Evaluation: See Air-O-Structures.

Not included in cost-effectiveness analysis.





Portable classrooms provide a ready-made solution to problems of shifting populations and overcrowded conditions. Not only can they be transported to meet peak student requirements within a district, but their low cost and fast construction make them practical for emergency-type situations.

QUICKLY ERECTED. Your Armco Self-Framing Building, including the optional accessories you may select, is fabricated to exacting tolerances. All parts are marked and referenced to erection instructions supplied —simplifying and speeding up erection.

EASILY INSULATED. If insulation is required for heating and cooling, Armco Liner Panels provide both insulation and interior steel wall finishing. Or, for conventional finishing, batt-type material is easily applied between the interlocking ribs of the 16-inch-wide STEELOX Panels inside the building.

MOVING, EXPANSION SIMPLIFIED. Smaller Armco Self-Framing Buildings are often picked up and removed intact. Larger buildings may need dismantling and re-erection at the new location. But since assembly is by removable fasteners, movement can be achieved without loss of material. This would be impossible with masonry structures. Expansion is easily achieved by adding component parts.

LESS MAINTENANCE. Because these Self-Framing Armco Buildings are all of steel, there is nothing to rot. Practically all components are metallic-coated or otherwise protected to deter possible corrosion. Roof life is excellent. And when selected with factory-applied color wall panels, they will give many years of service.

FIGURE 53
ARMCO STEEL CORPORATION

ARMCO

Armco Building Systems
Manufactured by Armco Steel Corporation, Metal Products Division,
Middletown, Ohio and Armco Canada Ltd., Guelph, Ontario

c (2-a) Metal Structures

Manufacturer: Armco Steel Corporation
(Product range includes portable classrooms, industrial warehouse and office building, storage sheds)

System Evaluated:

Basic Configuration: Special Packaged Enclosure

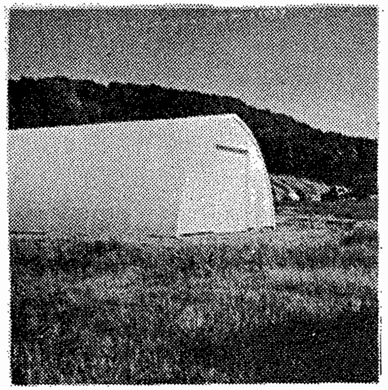
Description: Self-framing structures which can be erected from a knocked-down condition and dismantled for storage and re-erection or assembled in transportation modules.

Evaluation: Although little used in housing today, the applicability of this system to disaster relief seemed worth studying further in light of the role of the quonset hut during World War II. As currently used, metal systems are marketed as relocatables for commercial and institutional uses.

Included in cost-effectiveness analysis.

FIGURE 54
CONCOR COMPANY, INC.

In the construction industry, buildings must be moved from project to project every six to eighteen months. The ease of erecting and dismantling along with the clear span and height make these buildings particularly desirable for repair and storage shops.



Model A-3-4 building 40′ x 24′ used for housing stationary air compressor on tunnel project. Contractor: Conn. Rambone Corp. Installation time one day.

Model A-3-4 building 40′ x 56′ used to house and maintain heavy construction equipment on highway project. Contractor: Enfield Road Construction Co.

CONCOR
COMPANY INC. BUILDING RENTALS

Write to:
CONCOR CO., INC.
145 MEADOW STREET
P.O. BOX NO. 3297
FRAMINGHAM,
MASSACHUSETTS 01701

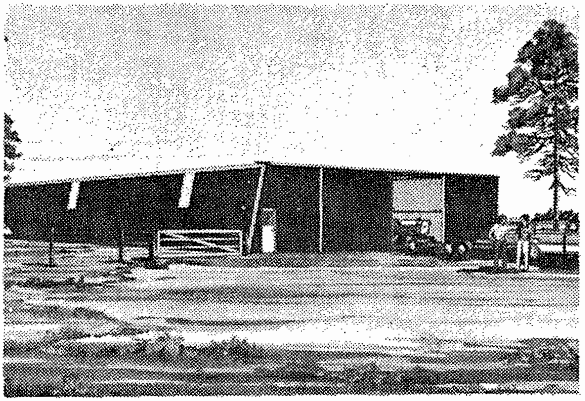
c (2-b) Metal Structures

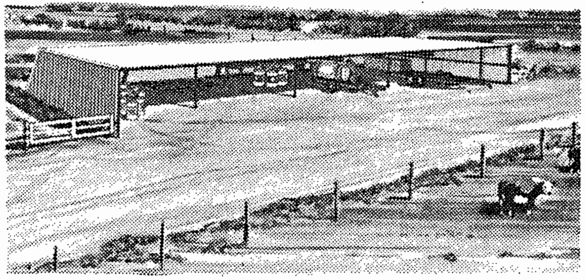
Manufacturer: Concor Company, Inc.

System Evaluated:

Basic Configuration:	Special Packaged Enclosure
Description:	The Frameless Metal Arch Building as manufactured by Concor Co., Inc. is similar to the quonset hut as manufactured during World War II. Flat panels shipped in knocked-down form can be manually erected without columns or other permanent supports.
Evaluation:	The frameless metal arch or quonset hut is a proven temporary housing system. It can also be erected and dismantled quickly, according to the manufacturer. It is marketed as a relocatable structure. Included in cost-effectiveness analysis.

FIGURE 55
STRAN-STEEL CORPORATION





Back in the 40's Quonset shipped tough, easily erected buildings all over the world in answer to military needs. Thousands of them.

They did a rugged job economically.

Today, Quonset engineers have taken advantage of almost 30 years of engineering/manufacturing technology.

Results?

A new line of factory color-coated buildings and shelters to meet your needs today. Places to put everything. From machinery storage to livestock shelter. From grain storage to tool shed. Or a warehouse or retail store. Quonset's got it all.

These are tough buildings, made of super-strong 80,000 psi steel panels over rugged steel frames. (Most manufacturers use ordinary 33,000 psi steel).

And every new Quonset has something in common with its ancestor:

It does a rugged job economically.

But there's a big difference in appearance and versatility. This booklet gives you a sampling.

QUONSET®
P.O. Box 14603 Houston, Texas 77021

Stran-Steel Corporation
Building Systems Subsidiary of
National Steel Corporation

c (2-c) Metal Structures

Manufacturer: Stran-Steel Corporation
(Product range includes commercial and industrial pre-engineered metal buildings)

System Evaluated:

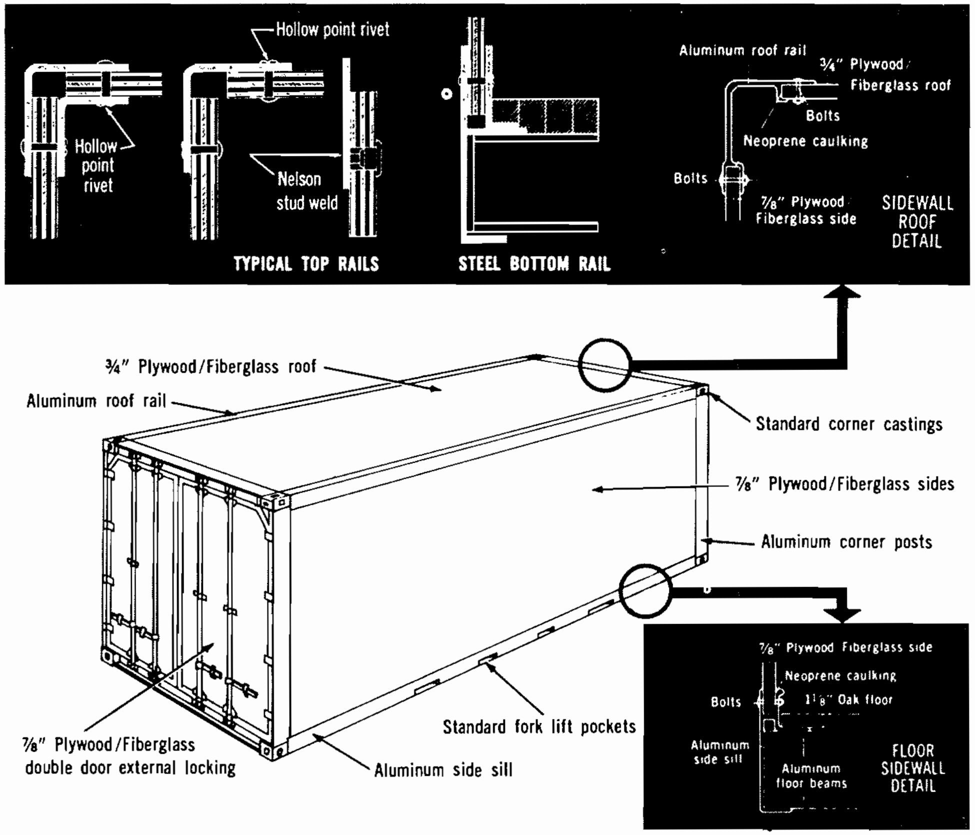
Basic Configuration: Special packaged enclosure

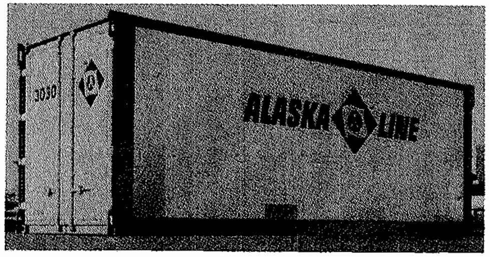
Description: See Armco Steel Corporation

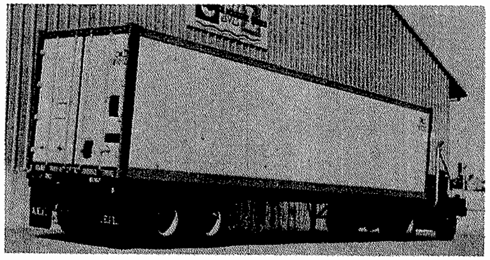
Evaluation: Stran-Steel did not furnish significant information for the study; therefore, the Armco product was pre-selected to represent the type of system produced by Stran-Steel.

Not included in cost-effectiveness analysis.

FIGURE 56
FRUEHAUF CORPORATION







FRUEHAUF DIVISION / FRUEHAUF CORPORATION

c (3-a) Commercially Available Container

Manufacturer: Fruehauf (or similar)

System Evaluated:

Basic Configuration: Two Sectional Boxes, Containerized. (Hypothetical combination of two containers outfitted for family living.)

Description: Shipping containers, standardized at 8'x8'x20'-30'-40', are made of a wide variety of materials, including metal studs with aluminum siding, fiberglass reinforced plywood, or polystyrene or paper-honeycomb sandwich panels.

Evaluation: They exhibit a wide-ranging availability on the commercial market from over 100 producers, are known for their ruggedness and are of increasing interest to the military as housing.

Included in cost-effectiveness analysis.

D. MANUFACTURERS OF SELECTED COMPONENTS

1. INTRODUCTION AND SUMMARY

According to a recent article, more than "90% of all light construction employs one or more manufactured components."*

The components industry includes manufacturers of such specialty components as mechanical cores, interior and exterior wall panels, trusses and prehung doors, and complete-line manufacturers producing complete building packages. The second group is similar to packaged home manufacturers except that complete-line manufacturers generally work to builders' plans and do not have a catalogue of models.

Two types of components are relevant to this study: mechanical cores and special foundation systems.

a. Mechanical Cores

There are two types of mechanical cores: mechanical core modules and "plug-in" mechanical cores. The modules are produced by manufactured housing companies as part of complete housing systems. They are not available as separate subsystems. The plug-in cores are truly products of the components industry and can be used to complement certain types of shelter lacking integral mechanical services.

Two basic configurations of temporary housing systems need complementary mechanical cores: core and packaged, and core and special packaged enclosure. Five mechanical core systems were evaluated. An Alcoa "service module" satisfying the Minimum Livability Standards for Temporary Housing developed for this study was pre-selected for cost-

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* "Industrialized Housing Portrait," p. 69.

effectiveness analysis in conjunction with incomplete shelter systems.

b. Special Foundation Systems

Special foundation systems for temporary housing range from concrete blocks to sophisticated jack systems. Certain elements such as tie-downs must be part of any system. The concrete block pier foundation with tie-downs was analyzed for cost-effectiveness as the least expensive and the most universally applicable system, given level pads. The study also investigated foundation systems designed for permanent housing: stilt and pole foundations of interest for construction in flood-prone areas, and an all-weather wood foundation. These systems are relevant to the Fast Delivery Permanent Home program proposed in Industry Report III-B.

2. INDUSTRY PROFILE

In the recently published "Industrialized Housing Portrait" the component manufacturer was characterized as follows:

> The component manufacturer produces individual components, and frequently, complete house packages, on a custom basis to a number of builder customers. He is primarily distinguished from the home manufacturer, whom he resembles, by the lack of a catalogue of houses, as well as a lack of auxiliary supporting services, such as design, marketing and advertising.
>
> There are several different types of component manufacturers. These manufacturers can fabricate individual components, such as mechanical cores, interior and exterior wall panels, trusses, prehung doors, etc., or they may be a complete-line manufacturer, who can provide their customers with all of the above components.
>
> Component manufacturers can be subsidiaries of lumber wholesalers and retailers, extensions of millwork companies, subsidiaries of major corporations, or none of the above. But the one thing they share in common is that they sell manufactured components, custom fabricated for their customers.*

Among the variety of building components on the market, two types were selected for discussion: mechanical cores and special foundation systems.

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* "Industrialized Housing Portrait," p. 67.

a. Mechanical Cores

The preceding report on special relocatable systems identifies several incomplete relocatable packaged housing and shelter systems. These systems must be complemented by a separate relocatable mechanical core module containing kitchen and bathroom to be evaluated as complete housing systems.

Mechanical cores generally consist of a full or partial kitchen, a bathroom and sometimes a utility room. All wiring, plumbing, heating and cooling ducts are factory installed. In addition, cores include all kitchen and bathroom fixtures and furnishings. House systems require only three connections for installations.

Mechanical cores were originally developed for use in conventional construction to cut down construction time and cost required by conventional installation of mechanical systems. Two categories of factory-built mechanical cores can be identified.

- Mechanical Core Modules: A factory-built module containing a completely installed bathroom, full or partial kitchen and, if applicable, utility room. The module can be combined on the site with a packaged panelized building system such as Wausau/Weston to form a house or it can be part of a sectional or other larger module to form part of a modular building.*

  Mechanical core modules are usually available only as part of special complete housing systems. Wausau Homes, for example, produces core modules solely for its own packaged units. Since mechanical core modules are available only as part of complete house packages they are not included in the subsequent evaluation of mechanical cores.

- Plug-in Mechanical Cores: A factory-built three-dimensional unit containing a completely installed bathroom,

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* For definitions see Appendix I.

full or partial kitchen and, if applicable, utility room. The module is marketed as a separate subsystem for use in conventional or packaged buildings without cores. Buildings must be carefully designed and construction must be precisely timed to allow easy installation of plug-in cores.

The two most prominent manufacturers of plug-in mechanical cores are Alcoa and Westinghouse. Cores are generally transported from the plant to the job site by truck and hoisted into place by crane. Manufacturers emphasize three advantages of mechanical cores: quality control, reduction of installation time and reliable servicing and warranty system.

Along with mechanical cores there are plumbing and electrical panels. They can be defined as factory-built two-dimensional components used in manufactured and conventional construction.

The plug-in mechanical core is of special interest for this study because it can complement incomplete shelter systems to make them complete housing systems. About 20 manufacturers have tried to produce plug-in mechanical cores, but only five active companies were identified. There has been no breakthrough in the application of plug-in mechanical cores for these reasons:

- Union Opposition: Trade unions, particularly plumbers and electricians, have traditionally been opposed to this facet of industrialization. However, their opposition has been gradually eroded by court decisions and by competition from non-union contractors.

- Transportation: Mechanical cores contain heavy appliances and long-distance transportation can be prohibitively expensive. So far, the market has been too weak to justify a network of plants within close reach of all major development areas.

- Inventory: With rising costs a manufacturer must insure a backlog of orders to avoid storage of completed units at the plant. The limited demand for cores and the dangers of overproduction have prevented economic large-scale production.

- Standardization of Design: Major manufacturers of mechanical cores offer a wide range of products. However, some standardization is necessary for economy. This standardization has limited the applicability of mechanical cores.

While these problems cannot be overlooked, solutions will probably evolve as industrialized construction develops. Production of mechanical cores may eventually become an important segment of the construction industry.

b. Special Foundation Systems for Temporary and Fast Delivery Permanent Housing

An important factor in disaster housing assistance -- temporary and fast delivery permanent -- is the speed of site erection. Temporary housing must be erected quickly with minimum requirements for site preparation and skilled workmen. The proposed Fast Delivery Permanent Home requires speedy preparation of suitable foundations preferably unaffected by the weather.

Almost all housing systems evaluated in this report do not include an integrated foundation system. Therefore, this report includes a discussion of existing foundation technology which could complement selected housing systems.

Unlike the mechanical cores discussed earlier, the foundation systems presented are not produced by an identifiable industry but rather represent miscellaneous technologies.

3. EVALUATION OF SELECTED COMPONENTS FOR USE IN DISASTER RELIEF MISSIONS

a. Mechanical Cores (Plug-In Cores Only)

SYNOPSIS

SYSTEM	MANUFACTURER*
(1) Service Module	Alcoa Construction Systems, Inc.
(2) CBS Module	Computerized Building Systems, Inc.
(3) Module Core	MODENCO Corp.
(4) Kitchen Module	Tappan
(5) Service Support Module (SSM)	Westinghouse Electric Corp.

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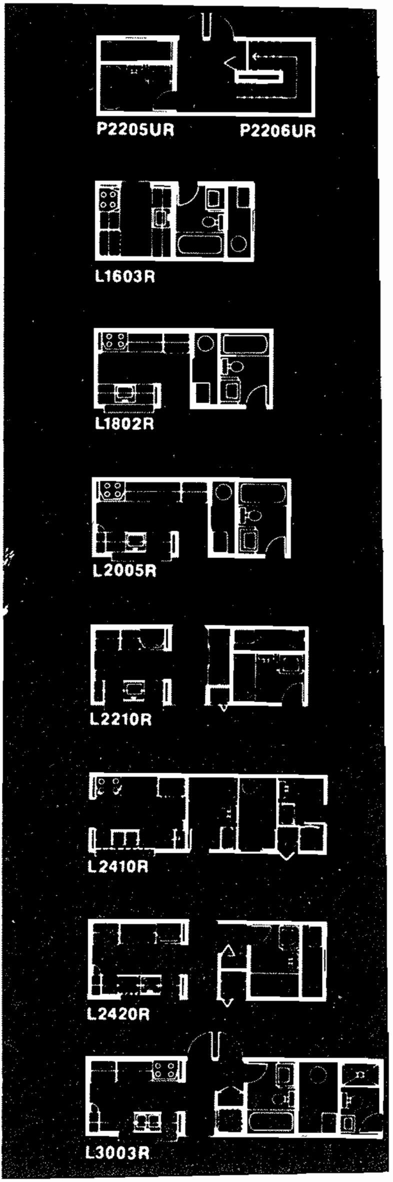
* For information on manufacturers see Appendix III-D.

FIGURE 57
ALCOA SERVICE MODULE

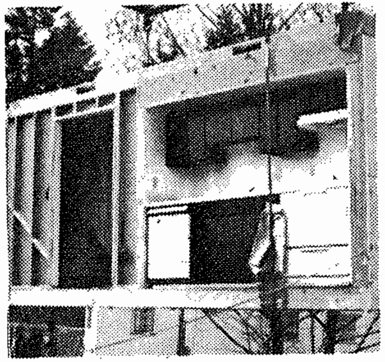


Alcoa Construction Systems, Inc., had the right idea, too, and turned it into an open non-system of housing construction which is adaptable to local requirements or desires. It's a core and panel type construction, and ACSI's key element is a three-dimensional service module.

ACSI did not arrive at the answer overnight. It took a great deal of planning. Alcoa's idea of combining the best of factory capability with the best of site capability, and working with local architects and builders to insure that the right combination would be used in a particular development, was chosen as one of the 22 winners in the U.S. Department of Housing and Urban Development's Operation BREAKTHROUGH. That was in June of 1970. Today, as a result of two years of planning and prototype work in Operation BREAKTHROUGH and associated projects in 20 states, ACSI is concentrating on service modules and other key subsystems as a means of improving the construction process while helping to control the cost of the total house.

ACSI can serve in a basic role of subsystem supplier, or, with other companies, can provide complete turnkey services. ACSI emphasizes service, both in our service module and to the architects and builders who choose us for their projects.

The ACSI non-system is responsive to local conditions and preferences. The local architect and builder head the development team, and ACSI can help to bring together the best possible team of participants to make each project successful.



An ACSI service module is lowered into place at the construction site. The service modules contain the high-value operating parts of the house and, in this one, the kitchen area can be seen. The service module delivery truck is a standard flatbed, eliminating special permits necessary for a "wide-load."

Service Modules
by Alcoa Construction Systems, Inc.
Subsidiary of Alcoa

1501 Alcoa Building
Pittsburgh, Pennsylvania 15219
Telephone: (412) 553-2300

a (1) Service Module

Manufacturer: Alcoa Construction Systems, Inc.

System Evaluated:

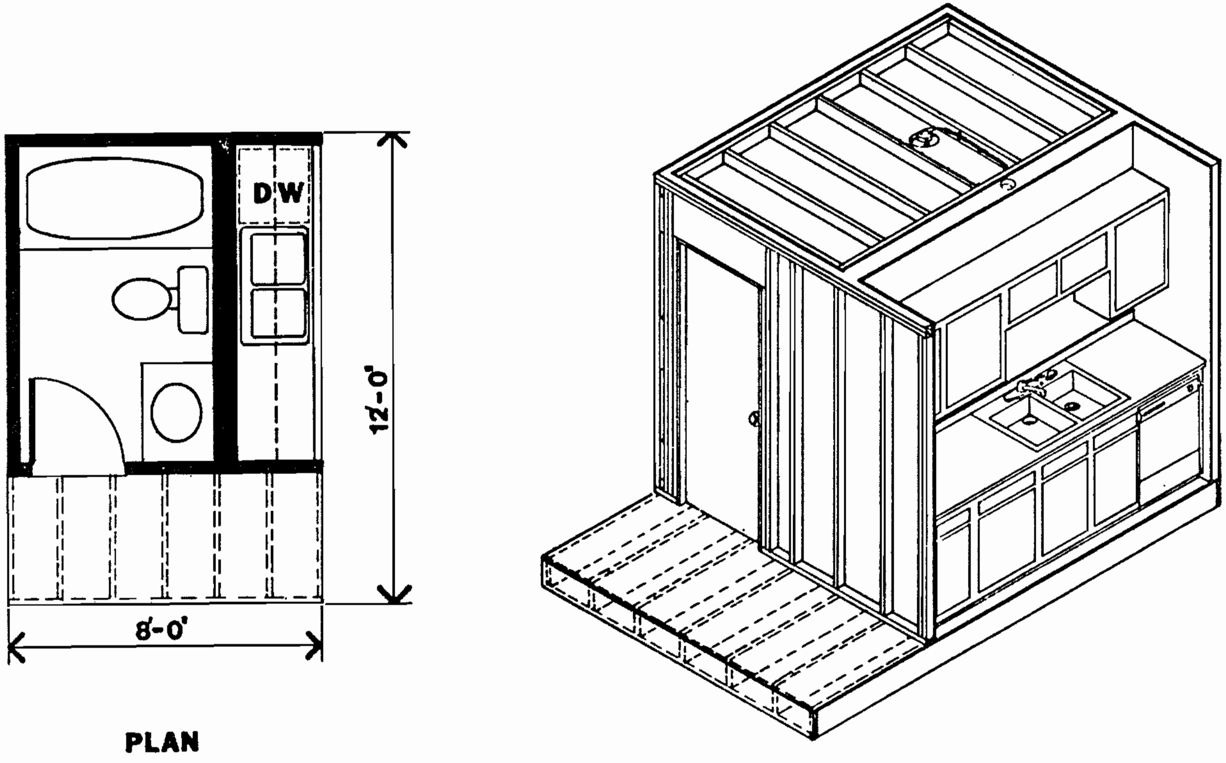
Basic Configuration: Core

Description: Alcoa's service module was originally developed in conjunction with HUD's Operation Breakthrough program; the production facilities in Tyrone, Pennsylvania, and Santa Fe, New Mexico, have been approved by HUD. Alcoa service modules are complete with kitchen, bath, HVAC and electrical distribution panels. Alcoa cores weigh from 1,200 to 2,500 pounds. Costs vary depending on the number of units, area of the country and degree of success in adapting the system to local conditions. Alcoa estimated that it would produce 500 mechanical cores in 1973.

Evaluation: The Alcoa Service Module was pre-selected for cost-effectiveness analysis as the mechanical core system best documented by the manufacturer for this study.

FIGURE 58
COMPUTERIZED BUILDING SYSTEMS, INC.

C.B.S. MODULE M 116



NOTICE:

Electrical, heating, and plumbing shown on plans are suggested layouts only and may have to be altered to meet local codes or conditions.

Plans and specifications as drawn meet general F.H.A. and code requirements, but Computerized Building Systems, Inc., can not guarantee individual interpretation on such requirements in every area. Any modifications or changes which may be necessary to meet such requirements are at the builders responsibility and expense.

COMPUTERIZED BUILDING SYSTEMS, INC.
9401 85TH AVE. N BROOKLYN PARK, MINN 55445

SCALE
DR BY
DATE
SHEET OF

a (2) CBS Module

Manufacturer: Computerized Building Systems

System Evaluated:

Basic Configuration: Core

Description: The CBS module features flexibility in design and can be produced for any layout.

The kitchen/bath modules, with factory-installed cabinets, electric boxes, wiring, heating plant, plumbing fixtures and wall finishes, are manufactured in an automated plant in Minneapolis, Minnesota.

Evaluation: The Alcoa core was pre-selected as a representative example.

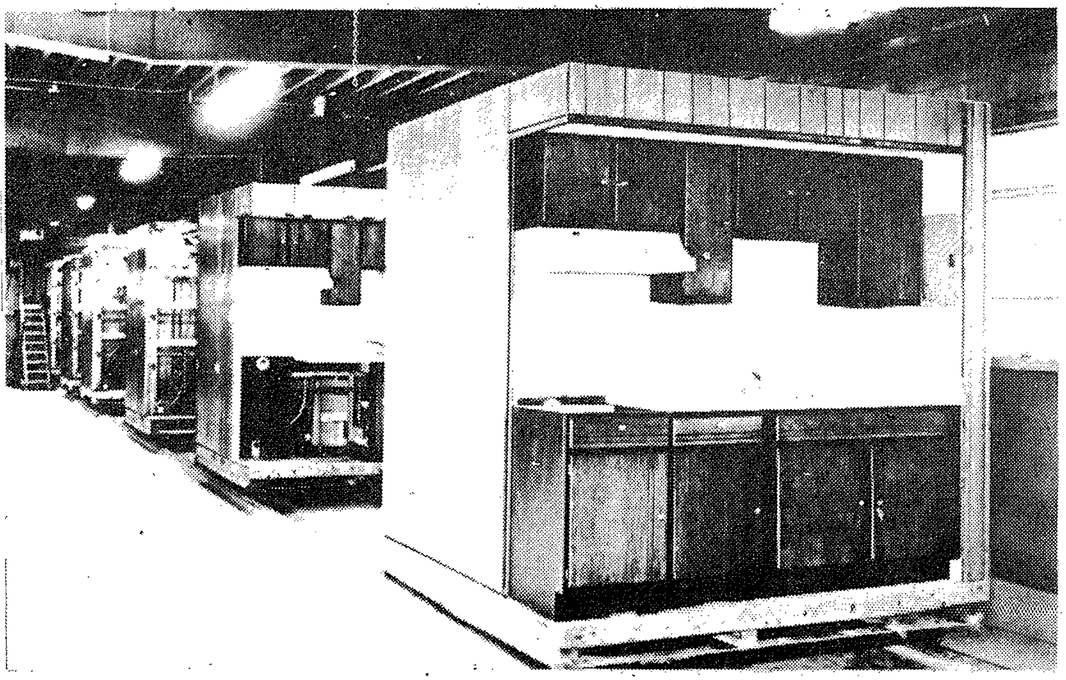
FIGURE 59
MODENCO CORPORATION

The Modenco Corporation module cores are available as combination bathroom-kitchen units with a common wet core, separate bathrooms, kitchens with a separate core or back to back bathrooms or kitchens. The modules may include electrical distribution panels, heating and air conditioning where required.

Modenco will supply the components specified by owners or architects, as well as partition materials and finishes to match other areas in the living unit. Due to the fact that the cores are floorless, there is no step up into the bathrooms after installation, nor is it necessary to recess the building floor. Floors may be included in the units where required.

Separate kitchen walls can be supplied to expand the size of the kitchens in addition to the wet core wall.

Modenco Corp.
P.O. Box 8070
Erie, Pa. 16505



MODENCO
CORPORATION

a (3) Module Core

Manufacturer: MODENCO Corp.

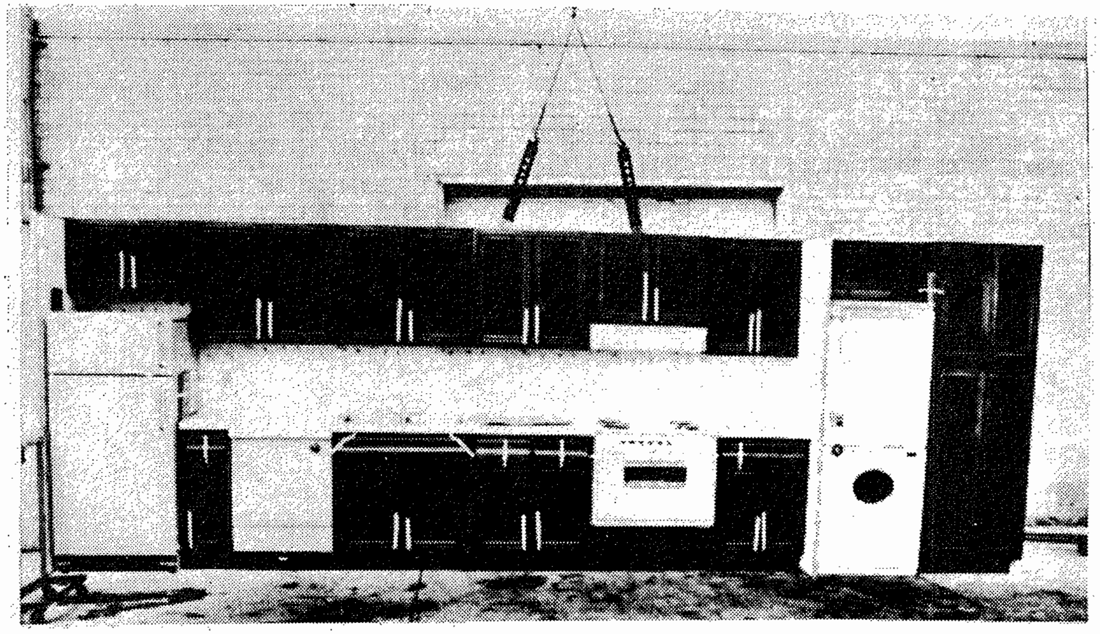
System Evaluated:

Basic Configuration: Core

Description: Modenco supplies a unit which consists of a complete bathroom and one kitchen wall incorporating the sink, counter top, upper and lower cabinets and electrical outlets. An entire kitchen with common plumbing between the bathroom and kitchen and separate loose cabinets and counter tops can be provided. The Modenco unit is floorless. Therefore it is not necessary to build a step in the bathroom after installation, nor to recess the building floor.

Evaluation: The Alcoa core was pre-selected as a representative example.

FIGURE 60
TAPPAN



Tappan has designed a versatile kitchen module containing all necessary cabinets, appliances, plumbing and utility connections which can be easily installed on the job-site by relatively unskilled labor.

The modules are available in corridor, L-shaped or U-shaped configurations and in a variety of cabinet and appliance styles. All of the systems meet FHA minimum property standards.

The module is a minimal load bearing structure constructed on a special stress wall requiring only floor support. All utilities, electricity, gas, drain and water connections, are completed and connected in the factory, requiring only quick attachment to entry services upon installation.

TAPPAN

EXECUTIVE OFFICES

TAPPAN PARK • MANSFIELD, OHIO 44901 • 419-529-4411

a (4) Kitchen Module

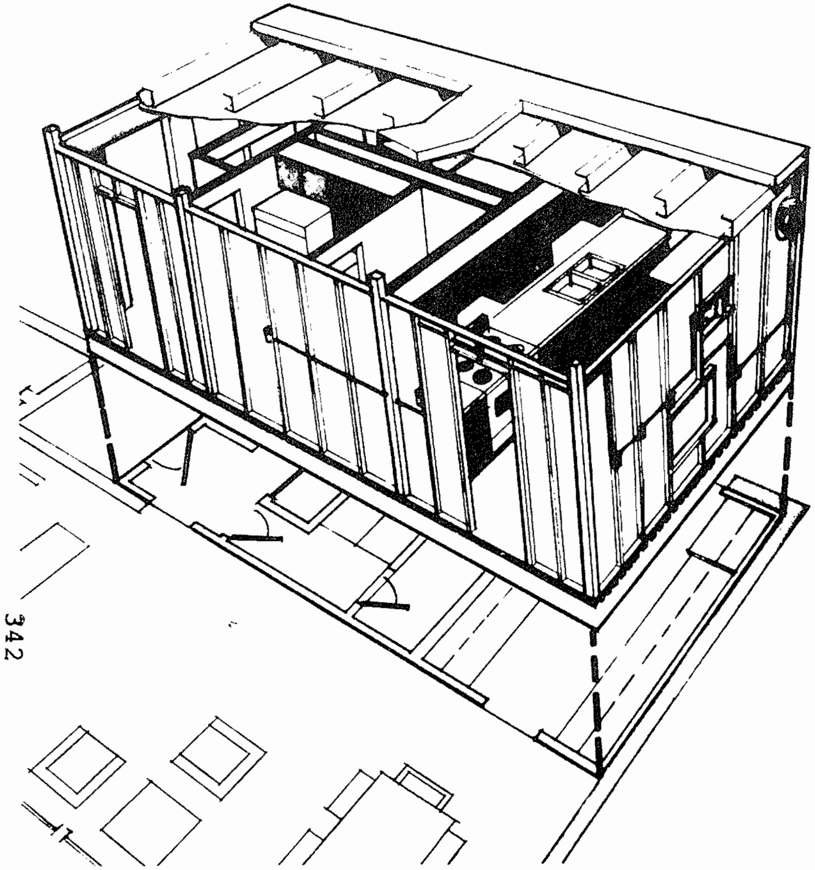
Manufacturer: The Tappan Company

System Evaluated:

Basic Configuration: Core

Description: Tappan has designed a versatile kitchen module containing all necessary cabinets, applicances, plumbing and utility connections which can easily be installed on the job-site by relatively unskilled labor. The modules are available in corridor, L-shaped or U-shaped configurations and in a variety of cabinet and appliance styles. The module is a minimal load-bearing structure constructed on a special stress wall requiring only floor support. All utilities, electricity and gas, drain and water connections are completed and connected in the factory, requiring only quick attachment to entry services upon installation. Lacking a bathroom, the system is not a complete mechanical core as defined in this study.

Evaluation: Not a complete mechanical core.



Service Support Module—(SSM)

The Service Support Module, or mechanical core, is made up of a kitchen, bath, and mechanical subsystem. It comes with finished floors, walls, and ceiling. It is completely wired and plumbed.

The SSM is available in six basic sizes with window and door openings wherever you want them.

The deluxe unit combines a large kitchen with a dinette, a full bath with tiled tub and shower, complete mechanicals, a combination half-bath and laundry room, and an entrance hall with a closet.

Other SSM's may have a kitchen, one and one-half baths, and a full mechanical subsystem—or only one bath as required.

SSM's can be installed quickly over a slab or a basement. Load-bearing walls allow them to be stacked on top of one another.

Only three connections are required to tie it in with the building plumbing and electrical systems.

The weather-proof and vandal-resistant packaging can be left on the SSM until the walls and roof of the building are in place.

Home Systems Assembly Plants can produce subsystems in whatever volume you require.

The flexibility of our manufacturing methods provide the options you want economically.

The locations of our plants put them close to large urban market centers.

FIGURE 61

Westinghouse Electric Corporation · Home Systems Department

Department Headquarters. Gateway No. 6, Pittsburgh, Pa. 15222 · (412) 255-3544 a (5) Service Support Module (SSM)

Manufacturer: Westinghouse Electric Corporation

System Evaluated:

Basic Configuration: Core

Description: The Westinghouse Service Support Module is an assembly of kitchen, bath, HVAC and electrical distribution panel. The subsystem is adapatable to any type of construction, is installed quickly and stacks four high. It requires only three connections -- water, waste and electric. Prices depend on size, accessories, specific features desired and appliance and cabinet complement. Units are manufactured at Weymouth, Massachusetts; Eaton Rapids, Michigan, and Pompano Beach, Florida.

Evaluation: The Alcoa core was pre-selected as a representative example.

b. Special Foundation Systems for Temporary and Fast Delivery Permanent Housing

SYNOPSIS

(1) Temporary Housing

- (a) Concrete block-pier foundations
- (b) Tie-downs
- (c) Skids
- (d) Jacks with adjustable pads
  - i. Stability jacks
  - ii. Leg-type jacks
  - iii. Scissor-type jacks
- (e) Soil footing

(2) Fast Delivery Permanent Housing

- (a) All-weather wood foundation
- (b) Stilt foundation

b (1-a) Concrete Block-Pier Foundation

Description:

Pier foundations - hollow core block spaced on centers determined by structural characteristics of the particular temporary housing unit. In mobile home installations, the manufacturers must provide a diagram showing number and position of piers. The concrete block pier foundation has proven the most adaptable foundation system for a wide range of temporary housing.

Continuous foundation - a continuous wall of stacked hollow core concrete block, which follows the outer walls of the housing unit. For large spans interior piers and beams may provide additional support. The continuous concrete block foundation wall is widely used for permanent housing, but it is not necessarily the quickest system.

Concrete block pier and continuous foundations require plates, shims and anchor bolts.

Footings - the actual size and depth of footings shall be determined for each building site. A footing shall be wide enough to carry expected loads; it should be placed on soil of adequate load-bearing capacity. In areas with no local building codes, footings for small buildings are generally twice as wide as the thickness that will bear on them.

Mortar - Type M mortar should be used for isolated piers and walls subject to extremely heavy loads, violent winds, earthquakes or severe frost. Elsewhere, Type N mortar may be used.

b (1-a) Concrete Block-Pier Foundation (cont'd.)

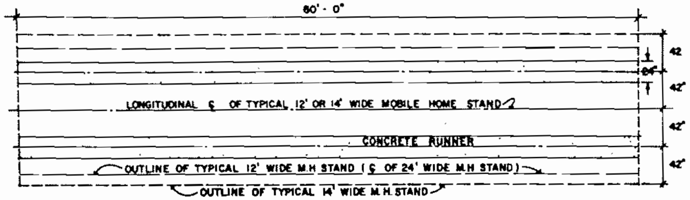
Description:
(cont'd.)

Mobile home application - the most common system is the Class A hollow core block. Blocks must be placed with their cores vertical, and the long dimension of the blocks should be placed perpendicular to the longitudinal axis of the stand. Blocks should be capped with concrete block plates.

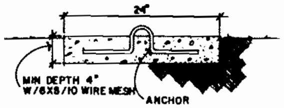
Evaluation:

As the least expensive and most applicable foundation systems for temporary housing, concrete block pier foundations were included for all pre-selected systems in the cost-effectiveness analysis.

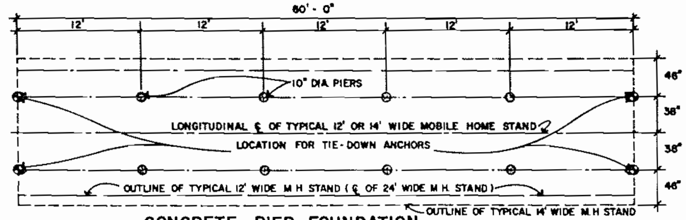
FIGURE 62
MOBILE HOME TIE-DOWNS



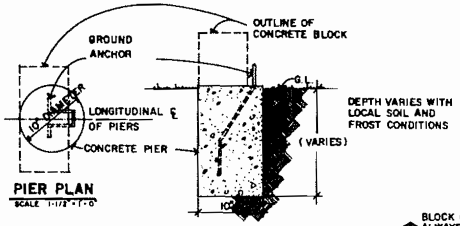
① CONCRETE RUNNER FOUNDATION
SCALE 1" = 5' - 0"



SECTION THROUGH CONCRETE RUNNER
SCALE 1-1/2" = 1' - 0"

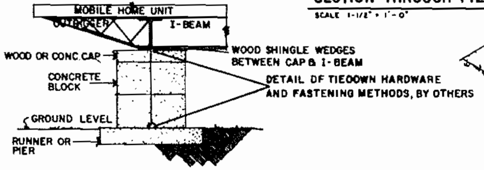


② CONCRETE PIER FOUNDATION
SCALE 1" = 5' - 0"

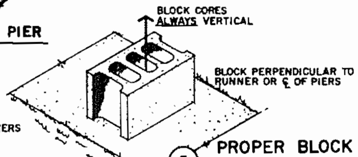


PIER PLAN
SCALE 1-1/2" = 1' - 0"

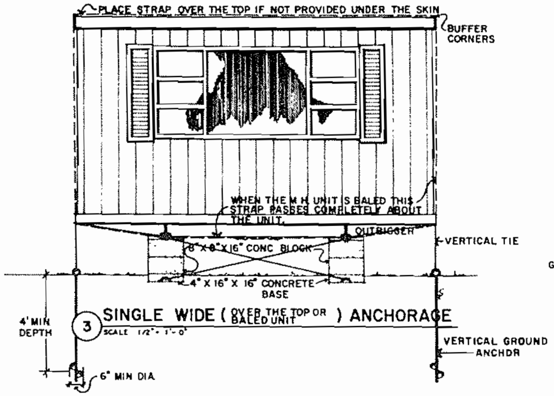
SECTION THROUGH PIER
SCALE 1-1/2" = 1' - 0"



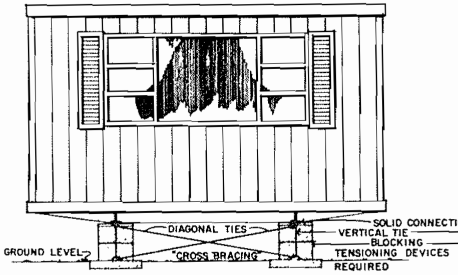
④ PROPER BLOCKING & ANCHORAGE
SCALE 1" = 1' - 0"



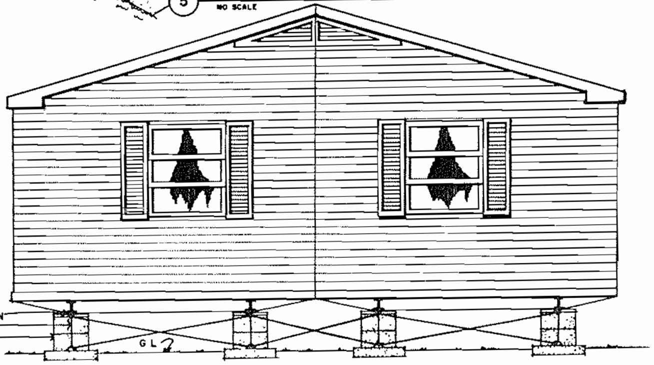
⑤ PROPER BLOCK POSITIONING
NO SCALE



③ SINGLE WIDE (OVER THE TOP OR BALED UNIT) ANCHORAGE
SCALE 1/2" = 1' - 0"



⑥ SINGLE WIDE ANCHORAGE
SCALE 1/2" = 1' - 0"



⑦ DOUBLE WIDE ANCHORAGE
SCALE 1/2" = 1' - 0"

NOTES:

ALL MOBILEHOMES SHOULD BE PROTECTED FROM DAMAGE BY HIGH WINDS. RESPONSIBILITY FOR THIS PROTECTION LIE IN 3 AREAS:

1) THE MANUFACTURER MUST PRODUCE A HOME THAT IS STRUCTURALLY CAPABLE OF WITHSTANDING WINDS OF UP TO 100 M.P.H. ROOF, SIDEWALLS, FLOOR AND UNDERCARRIAGE MUST ACT AS A UNIT.

2) THE PARK DEVELOPER MUST PROVIDE ADEQUATE FOUNDATIONS AND PROVISIONS FOR ANCHORS AS DETAILED IN 1, 2, & 3 ON THIS SHEET.

3) THE PARK MANAGEMENT MUST EXECUTE OR INSTRUCT AND INFORCE THE EXECUTION OF PROPER BLOCKING AND ANCHORAGE PROCEEDURES SUCH AS THOSE DETAILED IN 3, 4, 5, 6 & 7 ON THIS SHEET.

THE FOLLOWING GENERAL REQUIREMENTS SHOULD ALSO BE OBSERVED:

A.) ALL ANCHORAGE DEVICES SHALL BE DESIGNED SUSTAINING MINIMUM LOADS OF 3,400 LBS. (BREAKING STRENGTH 4,750 LBS.)

B.) ALL ANCHORAGE DEVICES SHALL BE CORROSIVE RESISTANT.

C.) OVER THE TOP TIES OR (BALED UNIT DETAIL 3) SHOULD BE USED FOR UNITS WHICH ARE NOT STRUCTURALLY ADEQUATE TO WITHSTAND 100 M.P.H. WINDS.

D.) SCREW AUGERS, ARROWHEAD ANCHORS OR CONCRETE DEADMEN SHOULD BE USED WHERE ADEQUATE FOOTINGS AND ANCHORS ARE NOT PROVIDED BY THE DEVELOPER.

MOBILE HOMES MANUFACTURERS ASSOCIATION	LAND DEVELOPMENT DIVISION	MOBILE HOME ANCHORAGE	HERBERT BEHRENDPE	D.M.RUTH & ASSOC. D.E. WESTPHAL	8 · 18 · 71 REV. 8 · 18 · 72	AS SHOWN	258-A

b (1-b) Tie-Downs

Description: Tie-downs were initially developed by the mobile home industry. Generally, a tie-down and anchoring system should be used when there is no permanent foundations system.

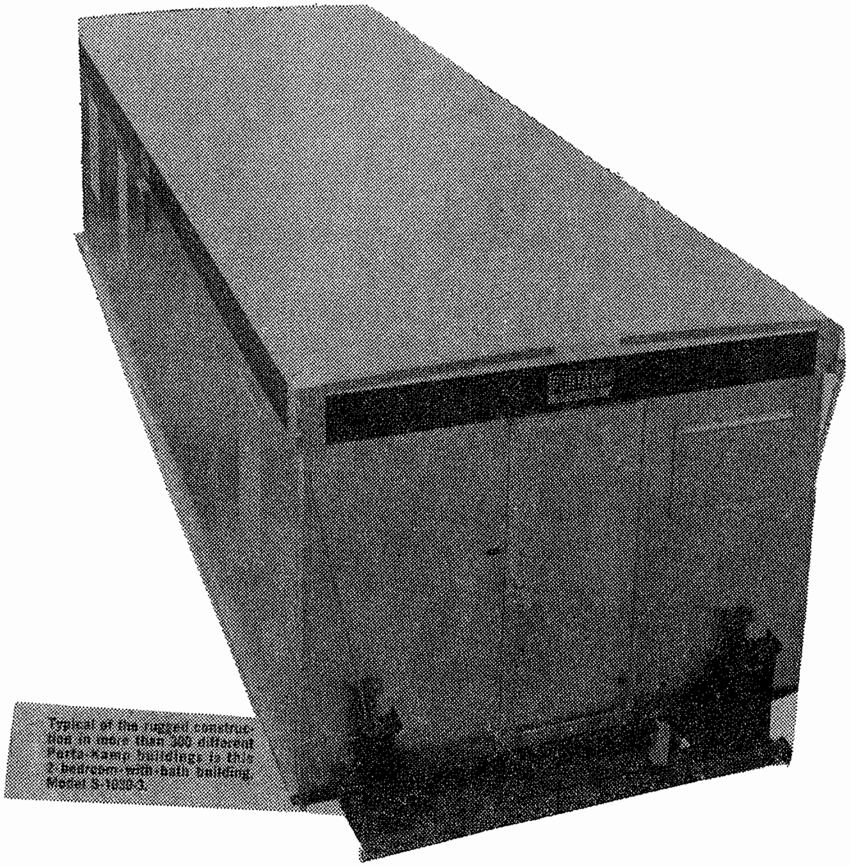
All mobile homes must have tie-downs, with provisions for distributing their load and attaching them to ground anchors to resist wind. In hurricane zones, tie-downs must be spaced every 12 feet beginning from the front wall of the mobile home. Elsewhere, every other tie-down can be omitted. The tie-down is secured to the ground by ground anchors which are of two types: an auger type anchor which spreads apart in the earth, or a concrete type anchor which is a buried block of concrete.

The mobile home rests directly on concrete runners (two rows of 24" wide, 4" thick, continuous reinforced concrete runners are sufficient for single-wide units) or on concrete piers (10" diameter, two rows spaced 12' -0 on center) which should reach the frost line,

Evaluation: Tie-downs are included in the cost-effectiveness analysis as a required safety feature.

FIGURE 63

SKIDS

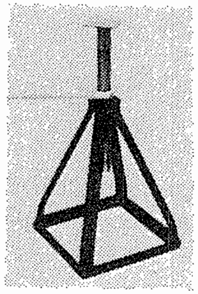
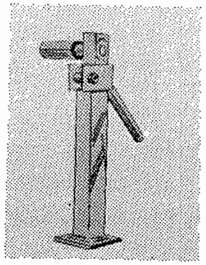
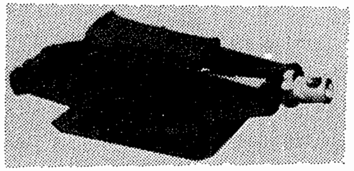


Typical of the rugged construction in more than 300 different Porta-Kamp buildings is this 2 bedroom-with-bath building. Model S-1030-3.

b (1-c) Skids

Description:	Skids were originally developed for military and camp systems, and are not generally considered a foundation system. A skid is a heavy-duty transportable frame used to transport units in knocked down or assembled positions. It consists of wood-frame sections which run the full length of the module and alternating cross members of pipe sections. The skid itself can sit on the ground and serve as a foundation only if dense or compacted soil conditions exist. Otherwise it is readily adjustable to a block or pier foundation system.
Evaluation:	As integral parts of several pre-selected systems, skids are not included as a separate subsystem in the cost-effectiveness analysis.

FIGURE 64
JACKS WITH ADJUSTABLE PADS

TYPE	MANUFACTURER	ILLUSTRATION
i. Stabilizing Jacks	Stromberg-Carlson P. O. Box 164 225 East 16th Street Traverse City, Mi. 49684	
ii. Leg-type Jacks	Liftmore 6211 Evergreen Houston, Tx. 77036	
iii. Scissor-type Jacks	Sumco Manuf. Co. 3985 East Mogadore Road Mogadore, Oh. 44260	

b (1-d) Jacks with Adjustable Pads

Description:

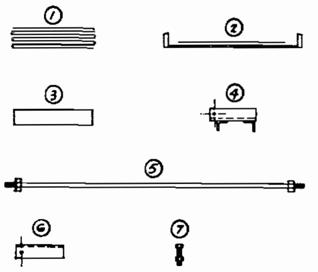
Removable or non-removable hand-operated jacks have been designed to permit leveling of the shelter before and after erection. The jack also supports the erected building.

Development of jacks in housing has primarily occurred in military shelter systems, since a military shelter must adapt to a change in slope of seven to 10 degrees.

Jacks used under expanded floor sections are installed during erection. Floor jacks are permanently installed on center sections. Concrete or steel pads are used under all jacks. Their size and thickness are variables of soil density.

Evaluation:

1. Installation of a dwelling unit will probably require skilled or semi-skilled labor to level and coordinate heights of the numerous jacks involved.
2. Jacks are expensive because of high initial costs and the need for tie-downs whenever a non-permanent foundation is used.
3. The question of safety arises since these units will be accessible to children.

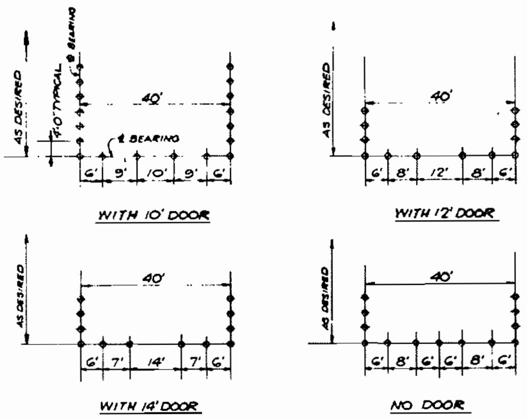


MATERIAL LIST

① (6)MIL. POLYETHYLENE BAG - (1) EACH.
② 24" A.B. CHANCE CROSS-PLATE ANCHOR - (2) EACH
③ 4 × 8 × 1'-8" WOOD BLOCK, PRESSURE TREATED (1) EACH
④ 12 [20.7 × 0'-9" WITH (2) L^s WELDED ($1\frac{1}{2}$" × $1\frac{1}{2}$" × 10"L) (1) EACH
⑤ $\frac{5}{8}$"ϕ STEEL BAR THREADED BOTH ENDS (1) EACH
⑥ ANGLE HINGES (5" × $2\frac{1}{2}$" × $\frac{1}{4}$" × 9"L) (2) EACH
⑦ $\frac{1}{2}$"ϕ FIELD BOLTS (2) EACH

NOTE:
FOR ADDITIONAL DETAILS SEE SHEET #22

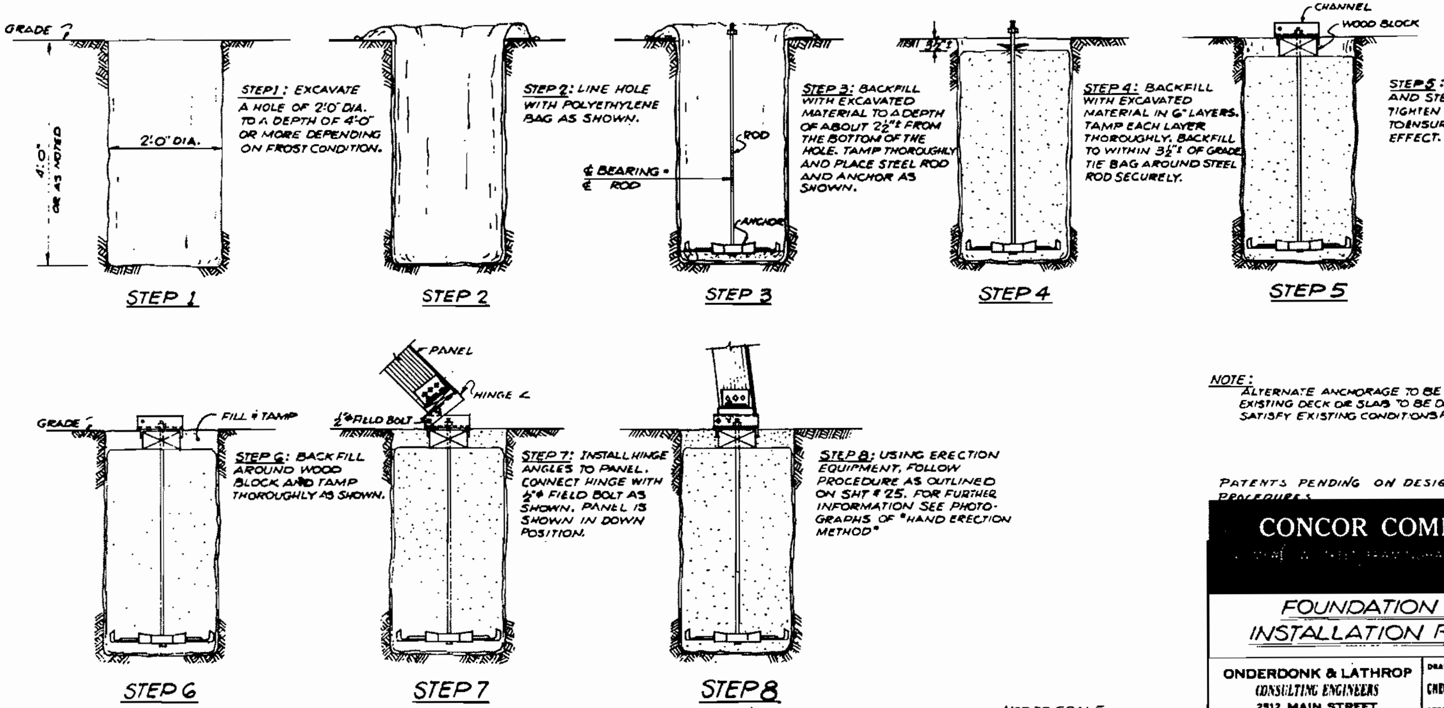
ANCHORAGE ASSEMBLY



FOOTING LAYOUT

FIGURE 65

INSTALLATION PROCEDURE FOR FOOTINGS - STEPS 1 THRU 8
TYPE A-3-4-4 FOUNDATION



STEP 1: EXCAVATE A HOLE OF 2'-0" DIA. TO A DEPTH OF 4'-0" OR MORE DEPENDING ON FROST CONDITION.

STEP 2: LINE HOLE WITH POLYETHYLENE BAG AS SHOWN.

STEP 3: BACKFILL WITH EXCAVATED MATERIAL TO A DEPTH OF ABOUT $2\frac{1}{2}$"± FROM THE BOTTOM OF THE HOLE. TAMP THOROUGHLY AND PLACE STEEL ROD AND ANCHOR AS SHOWN.

STEP 4: BACKFILL WITH EXCAVATED MATERIAL IN 6" LAYERS. TAMP EACH LAYER THOROUGHLY. BACKFILL TO WITHIN $3\frac{1}{2}$"± OF GRADE TIE BAG AROUND STEEL ROD SECURELY.

STEP 5: PLACE WOOD BLOCK AND STEEL CHANNEL AS SHOWN. TIGHTEN NUT SECURELY SO AS TO ENSURE AN EARTH SANDWICH EFFECT.

STEP 6: BACK FILL AROUND WOOD BLOCK AND TAMP THOROUGHLY AS SHOWN.

STEP 7: INSTALL HINGE ANGLES TO PANEL. CONNECT HINGE WITH $\frac{1}{2}$"ϕ FIELD BOLT AS SHOWN. PANEL IS SHOWN IN DOWN POSITION.

STEP 8: USING ERECTION EQUIPMENT, FOLLOW PROCEDURE AS OUTLINED ON SHT # 25. FOR FURTHER INFORMATION SEE PHOTOGRAPHS OF "HAND ERECTION METHOD"

NOTE:
ALTERNATE ANCHORAGE TO BE USED WITH EXISTING DECK OR SLAB TO BE DETAILED TO SATISFY EXISTING CONDITIONS FOR CUSTOMER.

NOT TO SCALE

SUBJECT TO CHANGE WITHOUT NOTICE

PATENTS PENDING ON DESIGN & INSTALLATION PROCEDURES

CONCOR COMPANY, INC.

FOUNDATION A-3-4-4
INSTALLATION PROCEDURE

ONDERDONK & LATHROP
CONSULTING ENGINEERS
2512 MAIN STREET
GLASTONBURY, CONN.

DRAWN BY RJP
CHECKED BY
APPROVED
DATE 7-20-62

DRAWING NO
M 7

b.(1)(e) Soil Footing

Nov. 8, 1966 N. R. TOFFOLON **3,283,518**

SOIL FOOTING

Filed April 15, 1965 2 Sheets-Sheet 1

FIG. 1

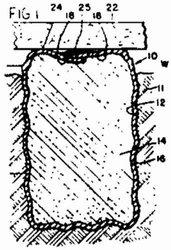


FIG. 2

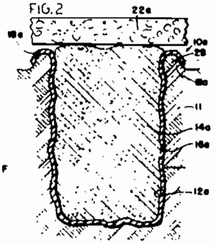
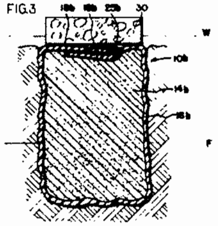


FIG. 3



INVENTOR
NORMAN R. TOFFOLON
BY
McCormick, Paulding & Huber
ATTORNEY

Nov. 8, 1966 N. R. TOFFOLON 3,283,518

SOIL FOOTING

Filed April 15, 1965 2 Sheets-Sheet 2

FIG. 4

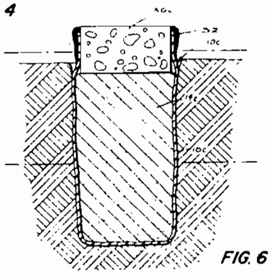
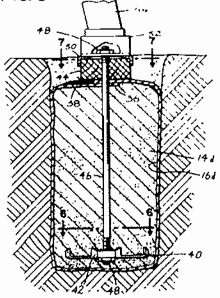


FIG. 6

FIG. 5



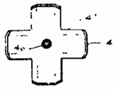
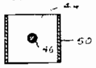
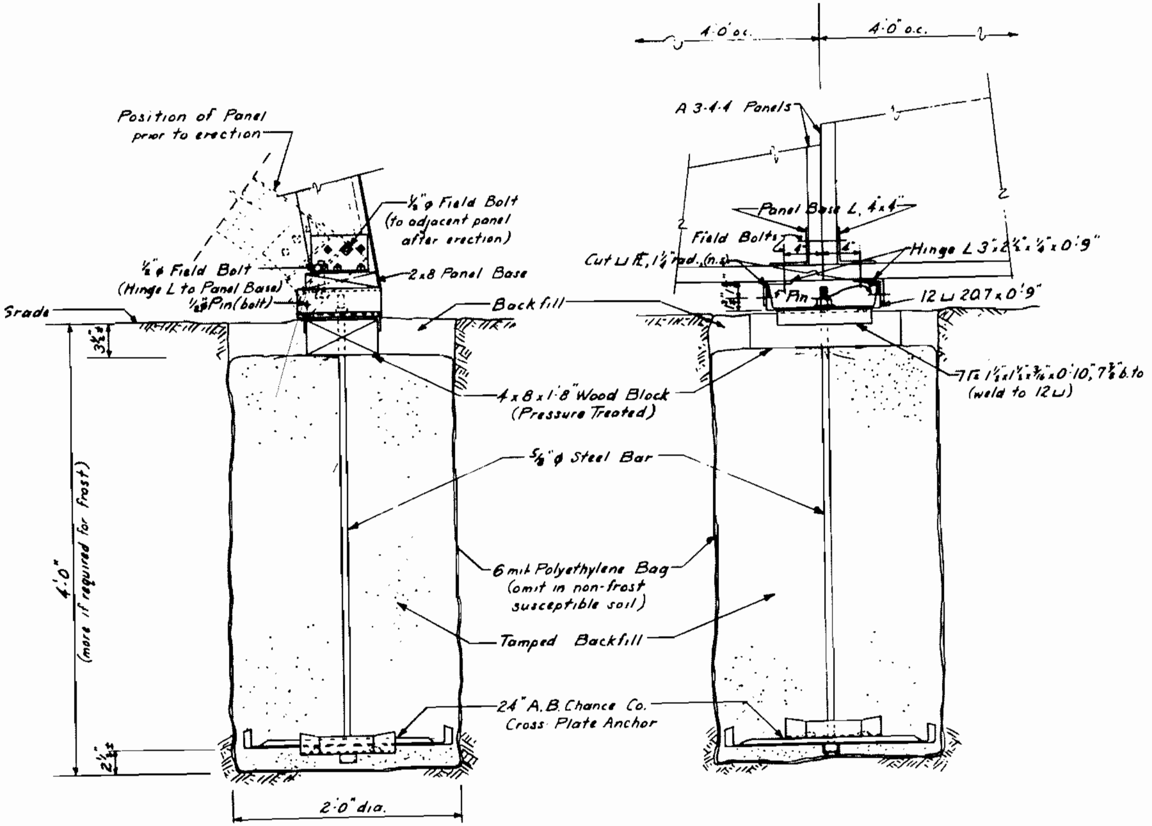


FIG. 7





SIDE ELEVATION
Scale: 1 1/2" = 1'-0"

INTERIOR ELEVATION
Scale: 1 1/2" = 1'-0"

CONCOR COMPANY, INC.
145 MEADOW STREET FRAMINGHAM MASSACHUSETTS 01701

TYPE A-3-4-4 FOUNDATION

ONDERDONK & LATHROP
CONSULTING ENGINEERS
2512 MAIN STREET
GLASTONBURY, CONN.

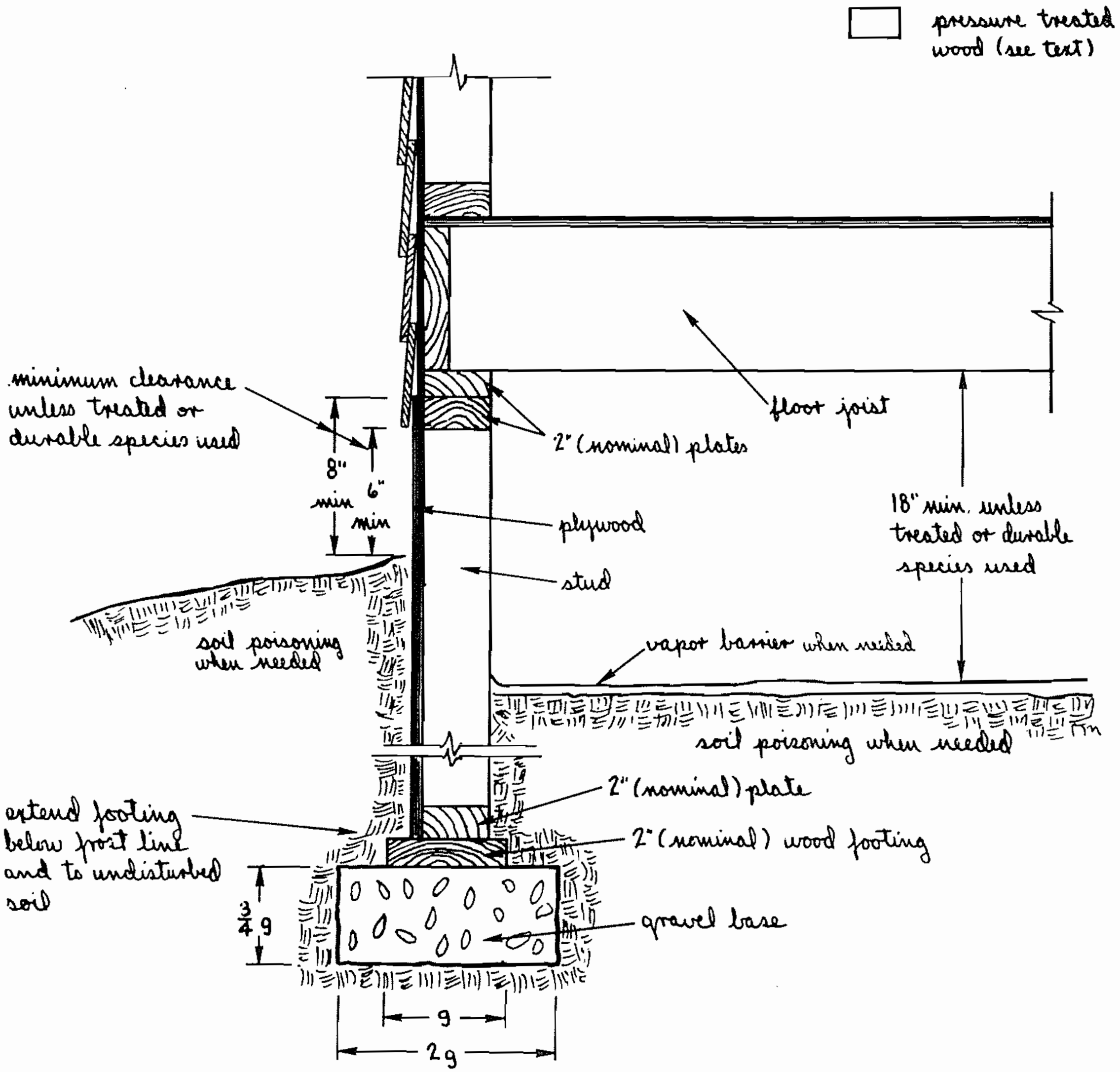
DRAWN BY R.P.L.
CHECKED BY R P L
APPROVED
DATE July 10, 1962

DRAWING NO.
22

FIGURE 66

All Weather Wood Foundation

Crawl Space Construction



b (2-a) All-Weather Wood Foundations

Description:

Developed 10 years ago to provide an economical and dry construction method for foundations, the all-weather wood foundation was a cooperative project of the American Forest Products Association, the American Wood Preservers Institute (AWPI) and the Economics and Marketing Division of the U.S. Forest Service. Studies by the NAHB Research Foundation show that the system could greatly reduce costs, erection time and construction delays due to poor weather.

The all-weather wood foundation is made of pressure-treated lumber and plywood, which fully protects the wood from termites and decay and meets AWPI Standard LP-22. All parts of the supporting element for the house are included in the foundation system.

Foundation sections of nominal 2" lumber framing and plywood sheathing may be factory built. This eliminates costly delays due to poor weather.

Footing plates for the foundations are nominal 2" pressure-treated wood planks. The system can be used for basement and crawl space construction. The exterior of the foundation wall below grade is covered with a plastic membrane bonded to the plywood. Joints are capped and sealed with an asphalt adhesive, and the whole membrane serves as a moisture barrier. For crawl space construction, trenches are dug to the required depth and gravel is placed as a base for the footing plates.

Evaluation:

Since this system is applicable only to permanent housing, it was not considered in the cost-effectiveness analysis for temporary housing.

FIGURE 67

STILT FOUNDATIONS

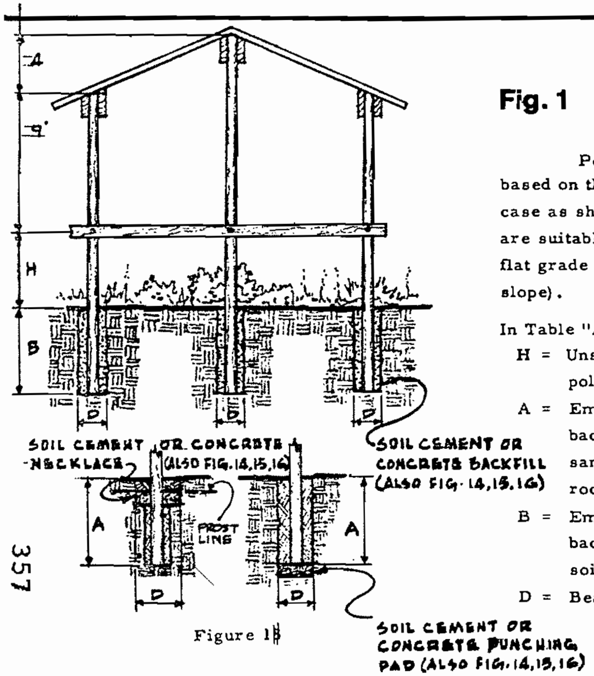
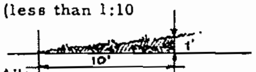


Figure 1B

Fig. 1

Pole frame buildings based on the criteria of this case as shown in Table "A", are suitable on sites with a flat grade (less than 1:10 slope).



In Table "A":

H = Unsupported height of poles

A = Embedment depth using backfill of tamped earth, sand, gravel, or crushed rock

B = Embedment depth using backfill of concrete or soil cement

D = Bearing Diameter

TABLE "A"

"H"	Pole Spacing	Good Soil				Average Soil				Below Average Soil			
		Embedment Depth		"D"	Tip Size	Embedment Depth		"D"	Tip Size	Embedment Depth		"D"	Tip Size
		A	B			A	B			A	B		
1-1/2'	8'	5.0'	4.0'	18"	6"	6.5'	5.0'	24"	6"	---	6.0'	36"	6"
to	10'	5.5'	4.0'	21"	7"	7.0'	5.0'	30"	7"	---	6.5'	42"	7"
3'	12'	6.0'	4.5'	24"	7"	7.5'	5.5'	36"	7"	---	7.0'	48"	7"
3'	8'	6.0'	4.0'	18"	7"	7.5'	5.5'	24"	7"	---	7.0'	36"	7"
to	10'	6.0'	4.5'	21"	8"	8.0'	6.0'	30"	8"	---	7.5'	42"	8"
8'	12'	6.5'	5.0'	24"	8"	---	6.0'	36"	8"	---	8.0'	48"	8"

--- Embedment depth required is greater than 8 feet, and considered excessively expensive.

SOURCE: AMERICAN WOOD PRESERVERS INSTITUTE

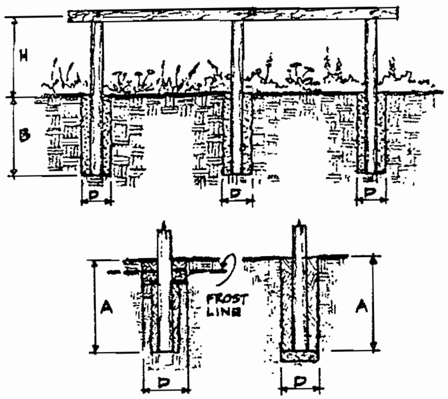


Figure ~~15~~ 2

Fig. 2

Pole platform buildings based on the criteria of this case, as shown in Table "D" are suitable on sites with a flat grade (less than 1:10 slope).

In Table "D":

H = Unsupported height of poles

A = Embedment depth using backfill of tamped earth, sand, gravel, or crushed rock

B = Embedment depth of poles using backfill of concrete or soil cement

D = Bearing Diameter

TABLE "D"

"H"	Pole Spacing	Good Soil				Average Soil				Below Average Soil			
		Embedment Depth		"D"	Tip Size	Embedment Depth		"D"	Tip Size	Embedment Depth		"D"	Tip Size
		A	B			A	B			A	B		
1-1/2'	8'	4.0'	4.0'	18"	5"	5.5'	4.0'	24"	5"	7.0'	5.0'	36"	5"
to	10'	4.5'	4.0'	21"	5"	6.0'	4.0'	30"	5"	8.0'	5.5'	42"	5"
3'	12'	5.0'	4.0'	24"	5"	6.5'	4.5'	36"	5"	---	5.5'	48"	5"
3'	8'	5.0'	4.0'	18"	6"	6.5'	4.5'	24"	6"	---	6.0'	36"	6"
to	10'	5.5'	4.0'	21"	7"	7.0'	5.0'	30"	7"	---	6.5'	42"	7"
8'	12'	6.0'	4.5'	24"	7"	7.5'	5.5'	36"	7"	---	7.0'	48"	7"

--- Embedment depth required is greater than 8 feet, and considered excessively expensive.

TABLE 38

APPLICABILITY OF SPECIAL FOUNDATION SYSTEMS IN RELATION TO BASIC CONFIGURATION TYPES

FOUNDATION SYSTEM / BASIC CONFIGURATION	Concrete Block Piers	Tie-Downs	Skids	Stabilizing Jacks	Leg-Type Jacks	Scissor-Type Jacks
One Box on Wheels (single-wide mobile home)	x	x				
One Box - general	x	x	x			
Containerized	x	x	x	x	x	x
Expandable Box	x	x				
Containerized	x	x	x	x	x	x
Two or More Sectional Boxes - general	x	x	x			
Containerized	x	x	x	x	x	x
Sectional Box & KD	x	x	x			
Core & Panelized	x	x				
Core & Special Enclosure	x	x				

b (2-b) Stilt Foundations

Description:

Stilt foundations can easily adapt to many terrains where conventional construction methods are prohibitively expensive or physically impossible. The stilt foundation is frequently the best -- and sometimes the only -- way to use problem site and soil conditions for residential use.

The stilt foundation is also used in flood-prone areas to raise the living area of buildings without creating flood waters.

Pressure-treated wood conforming to the AWPI standards and secure anchorage and fastenings are used for this system. Poles and lumber will last for 40 or 50 years when properly pressure preserved in accordance with standard specifications.

The stilt foundation can be a pole frame, in which a continuous pole from foundation to roof helps to brace the structure (see Figure 1), or a stilt platform (see Figure 2).

Evaluation:

Since stilt foundations are usable only for permanent housing, they were not included in the cost-effectiveness analysis for temporary housing but were included in the analysis for the Fast Delivery Permanent Home program.

IV DOCUMENTATION OF TEMPORARY HOUSING SYSTEMS PRE-SELECTED FOR COST-EFFECTIVENESS ANALYSIS IN TASK II

A. INTRODUCTION

Part IV of this report presents the evaluation of 13 systems pre-selected for detailed cost-effectiveness analysis. One system, the single-wide standard mobile home, was selected as presently marketed*; the other 12 systems were pre-selected with floor plans specially adapted to meet the Minimum Livability Standards for Temporary Housing in Part II of this report.

Part IV concludes the evaluation of applicable housing systems technology with a standardized description of the 12 specially adapted systems. Figure 71 presents an overview of the pre-selected systems in the context of all temporary housing and shelter systems evaluated in Part III. The identification numbers of the pre-selected systems correspond with the sequence of the standardized descriptions in the following section.

This part also includes an evaluation of alternative mechanical subsystems for temporary housing leading to conclusions about the most cost-effective approach.

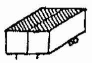
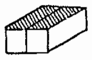
The standardized systems descriptions and mechanical subsystems evaluation constitute a basis for the life cycle cost analysis performed in Task II.

---

* In compliance with ANSI A119.1 and the HUD/EPS Level I retention criteria for mobile homes.

FIGURE 68

PRE-SELECTED TEMPORARY HOUSING SYSTEMS BY INDUSTRY SEGMENT AND BASIC CONFIGURATION

BASIC CONFIGURATION / INDUSTRY SEGMENT	ONE BOX		EXPANDABLE BOX		TWO OR MORE SECTIONAL BOXES		SECTIONAL BOX(ES) AND KNOCK-DOWN(S)	CORE AND PANELIZED	CORE & SPECIAL PACKAGED ENCL.
	ON WHEELS	GENERAL	ON WHEELS	GENERAL	ON WHEELS	GENERAL			
	 1	 2	 3	 4	 5	 6	 7	 8	 9
A. MOBILE HOME INDUSTRY	*Single-Wide Standard M.H.^{2} 0 Ruggedized Standard M.H.^{2} **Special Design Mobile Home^{2} 1 Travel Trailer^{2}		Expando Mobile Home^{2} Expandable **Guerdon M.H.^{2} 2		Double-Wide Standard M.H.^{2}				
B. MANUFACTURED HOUSING INDUSTRY:	Evaluated for "fast delivery permanent home" program. Manufacturers of marketed relocatable housing systems included under C.b below.								
C. MANUFACTURERS OF SPECIAL RELOCATABLE SYSTEMS									
a. Military									
(1) Air Force				**USA Home^{2} Goodyear ES/C^{2} 3				**Goodyear MPASS^{1} 7	Goodyear Personnel Shelter EXP^{1}
(2) Army								AFCS^{1} Transportable Rec. Shelter^{1C}	MUST Air-Supported Shelter^{1}
(3) Navy				N. Am. Rockwell TACOSS^{2C}		N. Am. Rockwell Quick Camp^{2C}	Northrop USMC^{2C}		
b. Private Market Housing Systems									
(1) Camp Systems	(Atco Ind. Ltd.^{2}) (Atlantic Int'l.^{2}) (Elder Int'l.^{2}) (Porta-Kamp^{2})					(Atco Ind. Ltd.^{2}) (Atlantic Intl.^{2}) (Elder Int'l.^{2}) (Porta-Kamp^{2})	(Atco Ind. Ltd^{2}) **Atlantic Int'l^{2} 6 (Elder Int'l.^{2}) Porta-Kamp^{2}	**Atco Ind. Ltd.^{2} 8	
(2) Honeycomb Panel Systems								Endure Prod.^{1} **Panelfab Intl.^{2} 9	
(3) Dome Systems									Circle^{1} Dome E.^{1} **Geodesic^{1} 10 O'Dome^{1}
(4) Miscellaneous Systems		Atlas Portable^{2}		**Altair Ind.^{2} 4 Interdesign Inc^{2}					Univ. Hsg. Syst.^{2} A.G. Windfield^{2}
c. Other Commercial Relocatable Shelter Systems									
(1) Air Structures									Air-O-Struct.^{1} Birdair Struct.^{1}
(2) Metal Structures									**Armco^{1} 11 **Concor^{1} 12 Stransteel^{1}
(3) Container Vans						**Fruehauf or similar^{1C} 5			

C - Containerized System

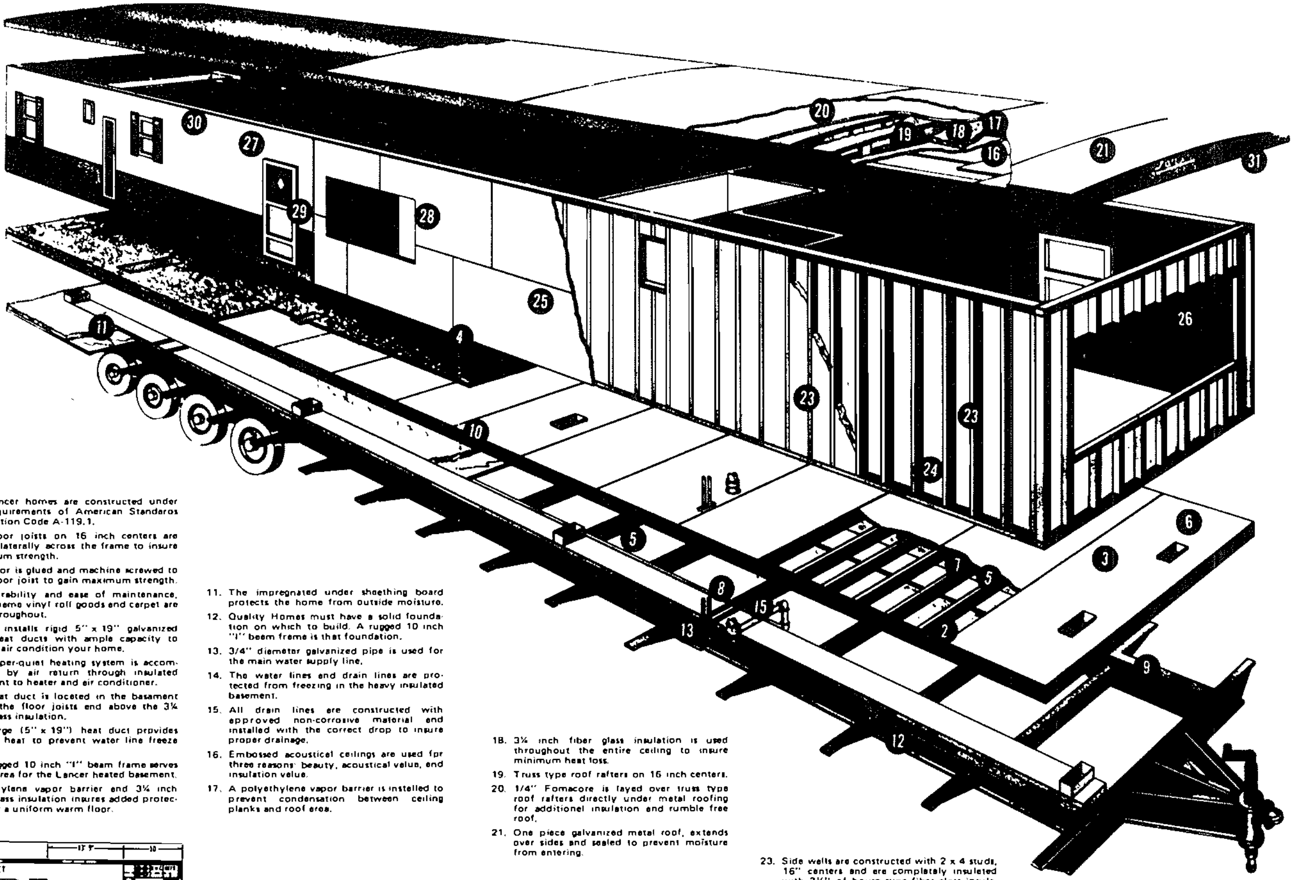
1 - Existing technology without integral mechanical core.
2 - Existing technology with potential integral mechanical core.
* - Included in cost-effectiveness analysis as marketed (meeting HUD/EPS Level I retention criteria).
**- Included in cost-effectiveness analysis with a floor plan specially adapted to meet the Minimum Livability Standards for Temporary Housing established for this study.
( ) The systems produced by the manufacturer in this category ("Basic Configuration) are not specifically evaluated in the report.

B. STANDARDIZED DESCRIPTION OF 12 PRE-SELECTED HOUSING SYSTEMS SPECIALLY ADAPTED TO MINIMUM LIVABILITY STANDARDS

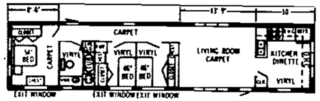
The format for the following standardized descriptions is structured in accordance with the HUD evaluation criteria. It was developed in conjunction with McKee-Berger-Mansueto, Inc., the subcontractor responsible for cost estimates in Task II, with the objective of covering all major aspects of the systems that bear on life-cycle cost effectiveness.*

---

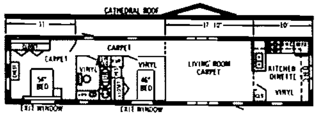
* While maintenance is a significant criterion, the Joint Venture found no meaningful way to include it in this description. However, estimated maintenance costs are included as an important element in the Task II analysis.



1. All Lancer homes are constructed under the requirements of American Standaros Association Code A-119.1.
2. The floor joists on 16 inch centers are placed laterally across the frame to insure maximum strength.
3. The floor is glued and machine screwed to each floor joist to gain maximum strength.
4. For durability and ease of maintenance, brand name vinyl roll goods and carpet are used throughout.
5. Lancer installs rigid 5" x 19" galvanized steel heat ducts with ample capacity to heat or air condition your home.
6. A whisper-quiet heating system is accomplished by air return through insulated basement to heater and air conditioner.
7. The heat duct is located in the basament below the floor joists and above the 3¼ fiber glass insulation.
8. The large (5" x 19") heat duct provides radiant heat to prevent water line freeze up.
9. The rugged 10 inch "I" beam frame serves as the area for the Lancer heated basement.
10. Polyethylene vapor barrier and 3¼ inch fiber glass insulation insures added protection for a uniform warm floor.
11. The impregnated under sheething board protects the home from outside moisture.
12. Quality Homes must have a solid foundation on which to build. A rugged 10 inch "I" beam frame is that foundation.
13. 3/4" diameter galvanized pipe is used for the main water supply line.
14. The water lines and drain lines are protected from freezing in the heavy insulated basement.
15. All drain lines are constructed with approved non-corrosive material and installed with the correct drop to insure proper drainage.
16. Embossed acoustical ceilings are used for three reasons: beauty, acoustical value, and insulation value.
17. A polyethylene vapor barrier is installed to prevent condensation between ceiling planks and roof area.
18. 3¼ inch fiber glass insulation is used throughout the entire ceiling to insure minimum heat loss.
19. Truss type roof rafters on 16 inch centers.
20. 1/4" Fomacore is layed over truss type roof rafters directly under metal roofing for additional insulation and rumble free roof.
21. One piece galvanized metal roof, extends over sides and sealed to prevent moisture from entering.
23. Side walls are constructed with 2 x 4 studs, 16" centers and are completely insulated with 3¼" of house type fiber glass insulation.
24. Side walls are set on top of the floor and lag screwed to the floor.
25. Maximum strength is achieved by double wall construction using 5/16 solid olywood sheets from the bottom of the floor to the top of the roof rail.
26. 1/4 inch hardwood plywood paneling is glued and bonded to the sidewalls.
27. The color-weld pre finished aluminum exterior is installed with a water-proof lock seam.
28. Lancer Homes features aluminum house type double hung windows, eliminating the unsatisfactory roll-in, roll-out type mobile home windows.
29. The front entrance has a house type door with combination storm and screen.
30. All windows are framed with color co-ordinated aluminum shutters.
31 All Lancer Homes have a perimeter drip cap to help keep the exterior clean.
32 All electrical installations meet or exceed code requirements.
33 The water heater compartment is sealed off from the interior of the home with access to it from the exterior with a hinged door and lock.



865D Model—60′ x 12′ ● 3 Bedrooms ● Front Kitchen ● Center Living Room



MOBILE HOME

.SYSTEMS DESCRIPTION 20

THE MANUFACTURER

SINGLE WIDE
STANDARD
MOBILE HOME

I. DESCRIPTION OF THE SYSTEM

A. GENERAL DESCRIPTION	B. OUTLINE SPECIFICATIONS		
Current Product Range	Structural Components	Foundations	- concrete block and steel chassis
standard mobile homes		- Floors	- 2" x 6" wood joist
		- Walls	- 2" x 4" wood stud
	Connections	- Roof	- bowstring truss
	Design Loads		
Standard Sizes		- Snow	30 lb./sq. ft.
12' x 44' to 14' x 70'		- Wind	30 lb./sq. ft.
	Surface Materials	- Floor	linoleum
		- Ext. Walls	.019 aluminum
Services	U-factor	- Roof	30 ga. steel
	Fire Rating		
	HVAC	- central w/ducts	
Yrs. of Ind. Bldg. Exp.	Plumbing	- under floor	
Code Compliance ANSI A119.1	Electric	- in wall	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	standard	12' x 60'	720	12' x 60'
3 BR				
MOTEL UNIT				

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	standard toter	1.0	units not manufactured for constant transportation

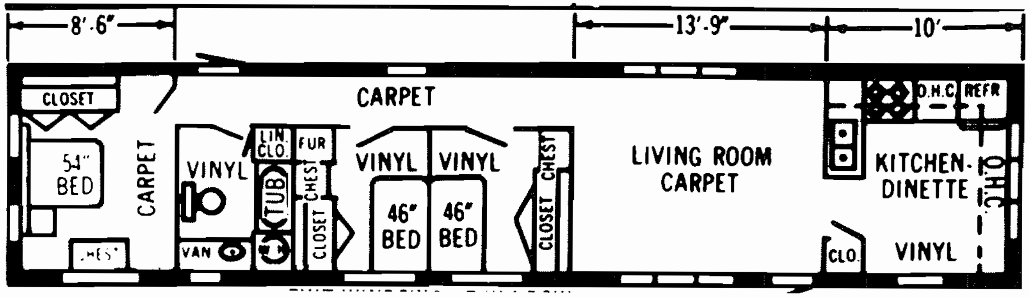
C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
				50	

D. SITE ERECTION/ DISMANTLING	1. ERECTION		2. DISMANTLING	
	Site prep. reqd.	grading		
	Special tools reqd.		Special tools reqd.	
	Heavy equipment		Heavy equipment	
	Wt. of heaviest piece			
	Labor skill reqd.	- utility installation requires skilled labor		
	Min. no. of men	- 2	Min. no. of men	- 2
	Man-hours	- 7	Man-hours	- 5

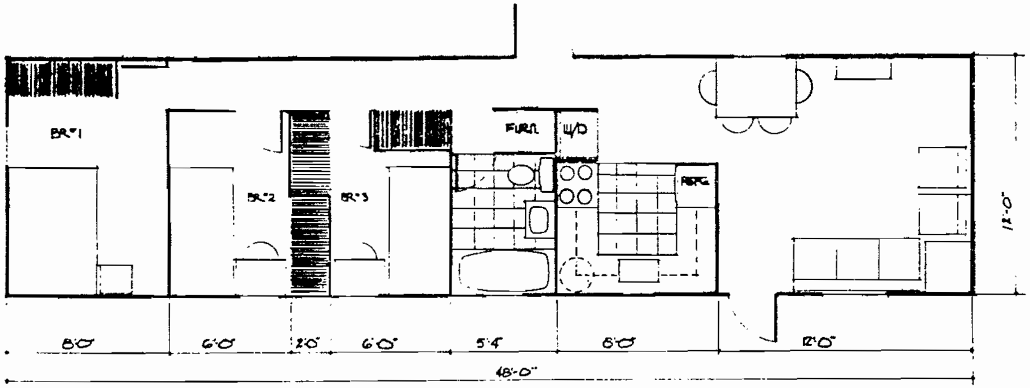
F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100	
1000-1500	
1500-2000	

1

SPECIAL DESIGN MOBILE HOME



UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

SYSTEMS DESCRIPTION 21

I. DESCRIPTION OF THE SYSTEM		THE MANUFACTURER
A. GENERAL DESCRIPTION	B. OUTLINE SPECIFICATIONS	SPECIAL DESIGN MOBILE HOME
Current Product Range standard mobile home	Structural Components Foundations concrete block and steel chassis	
	- Floors - wood joist	
	- Walls - wood stud	
	Connections - Roof - bowstring truss	
	Design Loads	
Standard Sizes	- Snow - 30 lb./sq. ft.	
	- Wind - 30 lb./sq. ft.	
	Surface Materials - Floor - linoleum or carpet	
	- Ext. Walls - aluminum	
Services	U-factor - Roof - steel	
	Fire Rating	
	HVAC - central w/ducts	
Yrs. of Ind. Bldg. Exp.	Plumbing - under floor	
Code Compliance ANSI A119.1	Electric - in wall	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	(sp. adapt.)	12' x 42'	504	12' x 42'
3 BR	(sp. adapt.)	12' x 48'	576	12' x 48'
MOTEL UNIT				

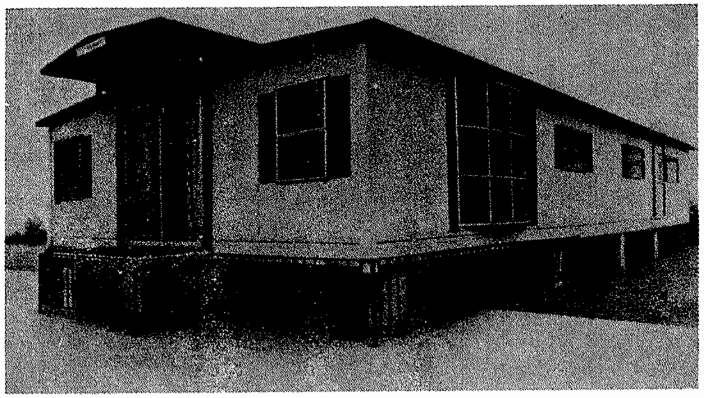
B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	standard toter	1.0	

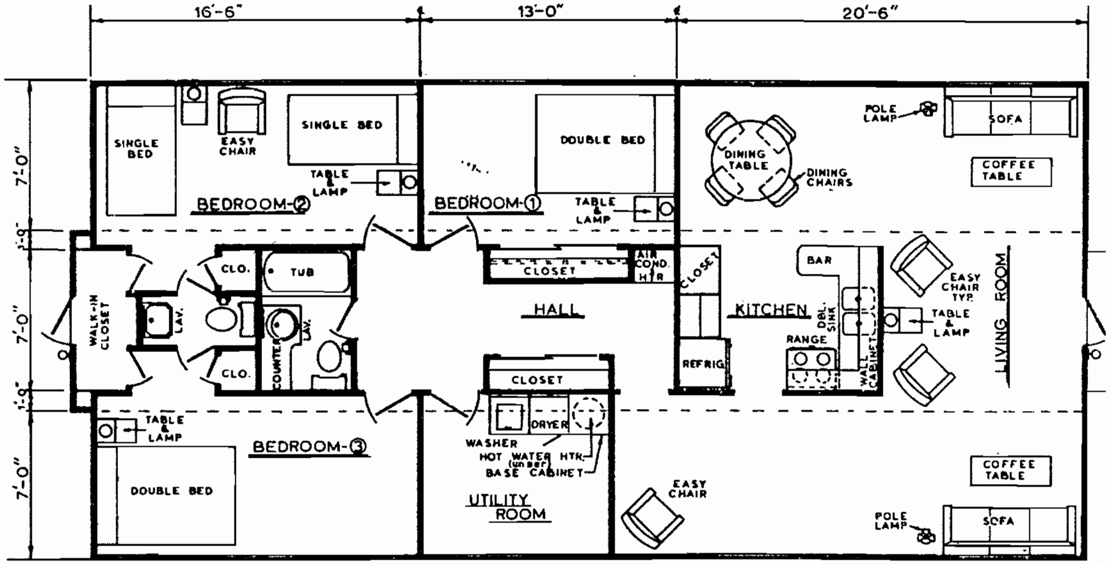
C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
				50	

D. SITE ERECTION/ DISMANTLING	1. ERECTION	2. DISMANTLING
	Site prep. reqd. - grading	
	Special tools reqd.	Special tools reqd.
	Heavy equipment	Heavy equipment
	Wt. of heaviest piece	
	Labor skill reqd. - skilled for utility installation	
	Min. no. of men - 2	Min. no. of men - 2
	Man-hours - 7	Man-hours - 5

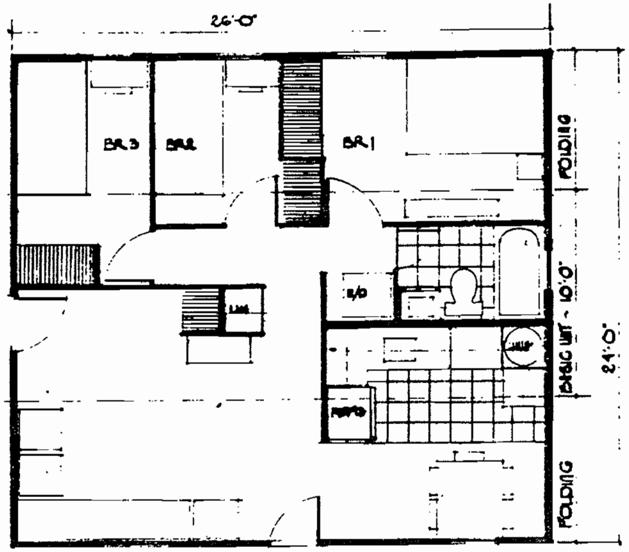
F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100	
1000-1500	
1500-2000	

2
EXPANDABLE MOBILE HOME





UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

SYSTEMS DESCRIPTION 22

I. DESCRIPTION OF THE SYSTEM		THE MANUFACTURER
A. GENERAL DESCRIPTION	B. OUTLINE SPECIFICATIONS	EXPANDABLE MOBILE HOME BY GUERDON
Current Product Range	Structural Components Foundations concrete block and steel chassis	
standard mobile homes	- Floors	
expandable mobile homes	- Walls	
	Connections - Roof	
	Design Loads	
Standard Sizes	- Snow 30 lb./sq. ft.	
12' x 50' to 24' x 54'	- Wind 30 lb./sq. ft.	
	Surface Materials - Floor - carpet	
	- Ext. Walls - aluminum	
Services	U-factor - Roof - steel	
	Fire Rating	
	HVAC - central w/ducts	
Yrs. of Ind. Bldg. Exp.	Plumbing - in floor	
Code Compliance ANSI A119.1	Electric - in wall	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

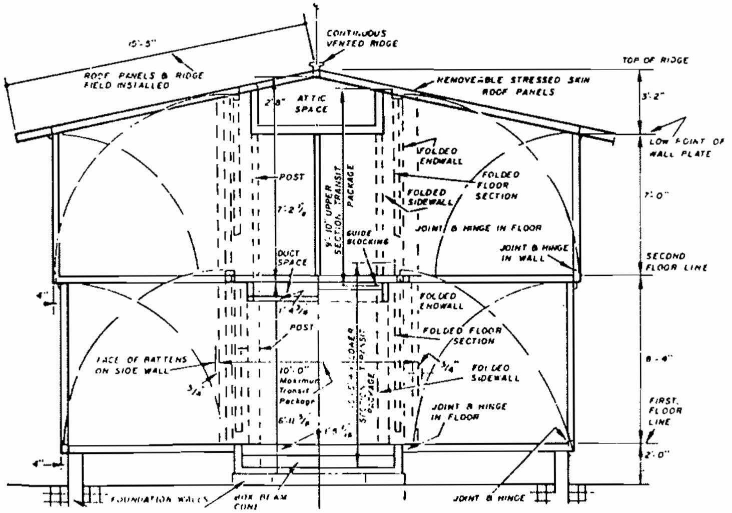
A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	(sp. adapt.)	24' x 22'	528	10' x 22
3 BR	(sp. adapt.)	24' x 26'	624	10' x 26
MOTEL UNIT				

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	standard toter	1.0 - 2.0	

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
				75	interior inaccessible

D. SITE ERECTION/ DISMANTLING	1. ERECTION		2. DISMANTLING	
	Site prep. reqd.	grading		
	Special tools reqd.		Special tools reqd.	
	Heavy equipment		Heavy equipment	
	Wt. of heaviest piece			
	Labor skill reqd.	semi-skilled		
	Min. no. of men	6	Min. no. of men	6
	Man-hours	10	Man-hours	8

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100 1000-1500 1500-2000	



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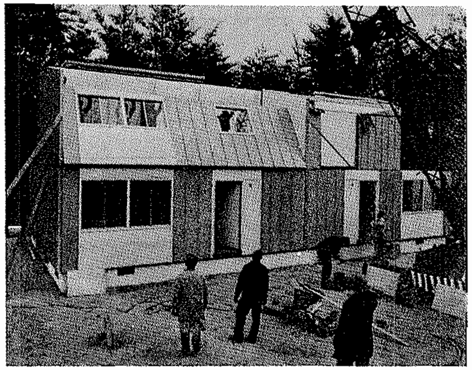
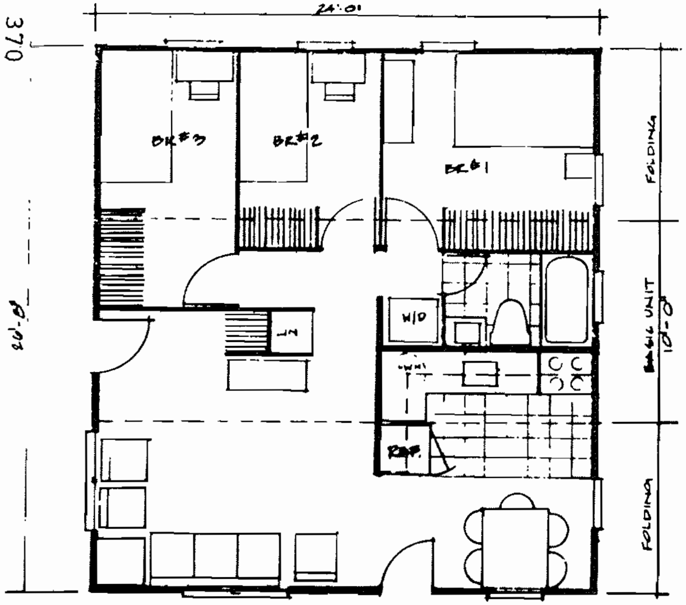


3

USA HOME



SPECIALLY ADAPTED PLAN

SYSTEMS DESCRIPTION 23

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM		THE MANUFACTURER
A. GENERAL DESCRIPTION	B. OUTLINE SPECIFICATIONS	USA HOME PROGRAM (U.S.A.F.)
Current Product Range	Structural Components Foundations permanent block	
contractor built for U.S.A.F.	- Floors 2"x 6" wd joists - 16"o.c.	
	- Walls 2"x 4" wd studs - 16" o.c.	
	Connections - Roof stressed skin panels 4'0" wide (2x4s)	
	nailed and glued	
Standard Sizes	Design Loads - Snow	
	- Wind	
	Surface Materials - Floor	
	- Ext. Walls wood	
	U-factor - Roof rolled or shingles - field applied	
	Fire Rating	
	HVAC central w/ducts in mech. core	
Yrs. of Ind. Bldg. Exp.	Plumbing under floor, factory installed	
	Electric w/in wall	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

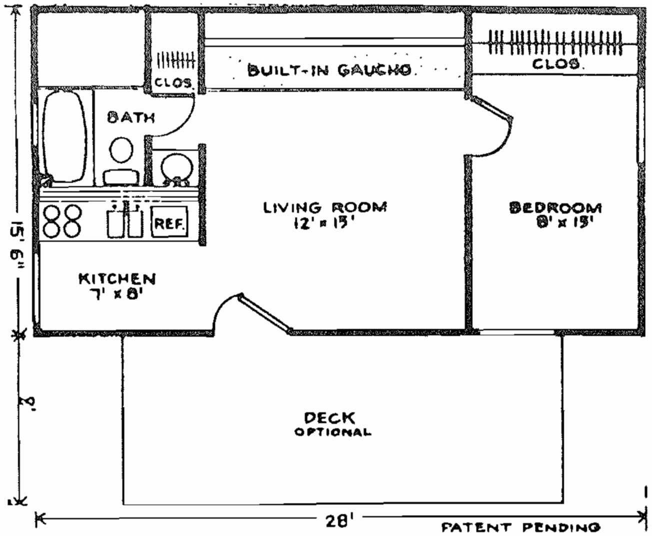
A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	(sp. adapt.)	20'x 26'8"	532	10' x 20'
3 BR	(sp. adapt.)	24'x 26'8"	638	10' x 24'

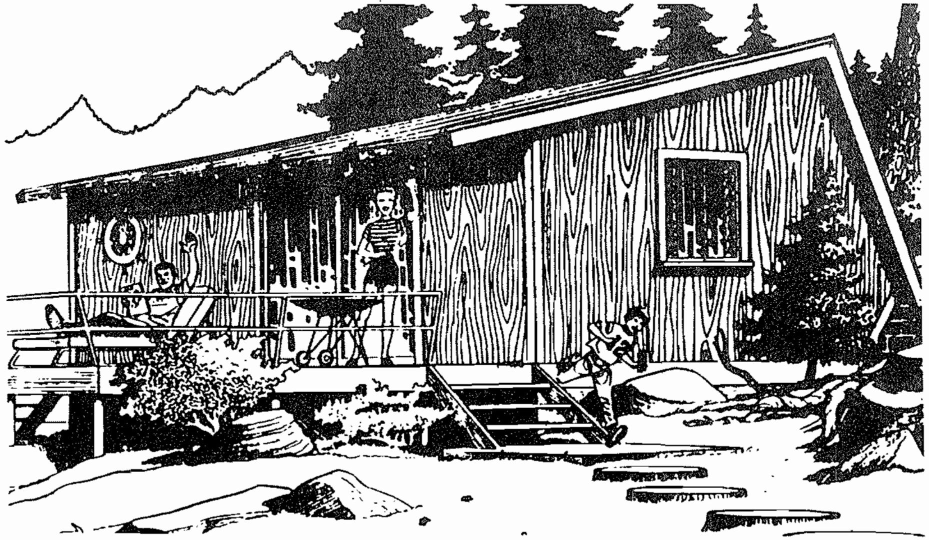
B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck, train, ship	1.0 - 2.0	spare parts availability may be a problem

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	polyethylene	lifting device		111	homes have been relocated only once.

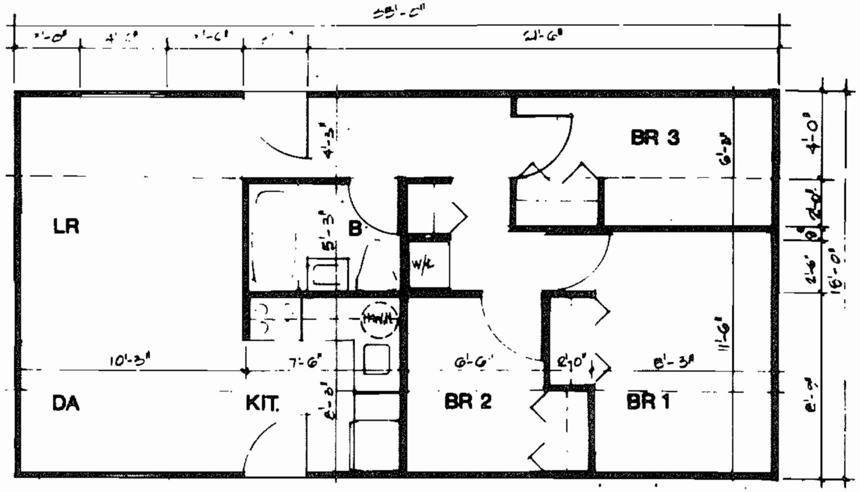
D. SITE ERECTION/ DISMANTLING	1. ERECTION		2. DISMANTLING	
	Site prep. reqd.	perimeter foundation & footings		
	Special tools reqd.		Special tools reqd.	
	Heavy equipment	lifting device	Heavy equipment	lifting device
	Wt. of heaviest piece			
	Labor skill reqd.	requires skilled supervision		
	Min. no. of men	6	Min. no. of men	6
	Man-hours	88	Man-hours	88

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100 1000-1500 1500-2000	





UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

4

ALTAIR INDUSTRIES, INC.
255 CHANNEL STREET • SAN FRANCISCO, CALIFORNIA 94107

SYSTEMS DESCRIPTION 24

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM

THE MANUFACTURER

ALTAIR INDUSTRIES INC.
255 Channel Street
San Francisco, Ca. 94107

A. GENERAL DESCRIPTION

Current Product Range
folding units for specific application to disaster situations

Standard Sizes 10'w x 28'l x 48" high (when compacted)

Yrs. of Ind. Bldg. Exp. 1968

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	piers - 2"x 8" joists
	- Floors	3/4" plywood & foam core
	- Walls	3/8" plywood & foam core panel
Connections	- Roof	1/2" ply both sides & 4" foam core
Design Loads	- Snow	
	- Wind	
Surface Materials	- Floor	plywood, vinyl covered
	- Ext. Walls	ext. grade plywood
U-factor	- Roof	alum. clad ext. grade plywood
Fire Rating		
HVAC	forced air heating	
Plumbing	factory installed	
Electric		

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	sp. adapted	18' x 28'	504	10'0" x 28'0"
3 BR	sp. adapted	18' x 32'	576	10'0" x 32'0"

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	flatbed trailer	2.0 - 4.0	

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	can be stacked polyethylene covered	lifting device		86	

D. SITE ERECTION/ DISMANTLING

1. ERECTION		2. DISMANTLING	
Site prep. reqd.			
Special tools reqd.		Special tools reqd.	
Heavy equipment		Heavy equipment	
Wt. of heaviest piece			
Labor skill reqd.	3 unskilled, 1 skilled		
Min. no. of men	4	Min. no. of men	4
Man-hours	40	Man-hours	40

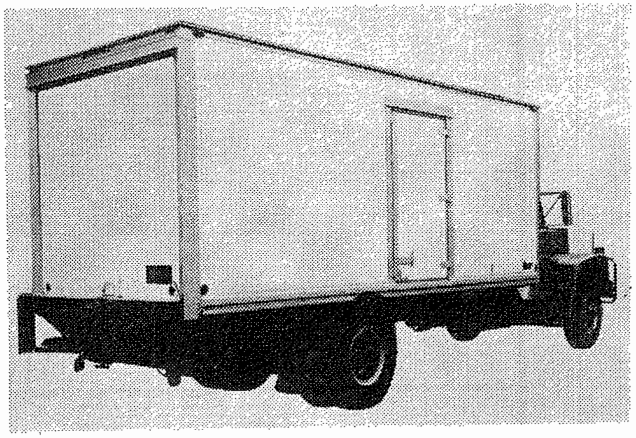
F. DELIVERY TIME

1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION

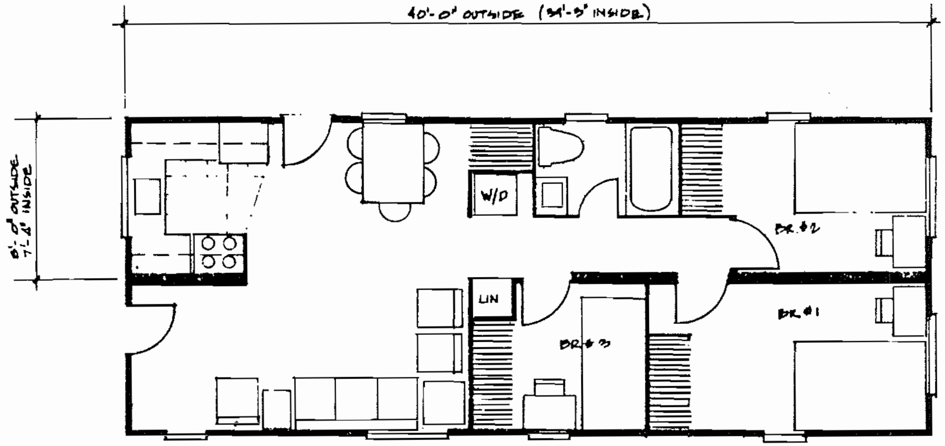
100	4 months/300 units
1000-1500	
1500-2000	

Production rate 10/week

FRP Plywood Truck



UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

FRUEHAUF DIVISION / FRUEHAUF CORPORATION

5

SYSTEMS DESCRIPTION 25

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM		THE MANUFACTURER
A. GENERAL DESCRIPTION	B. OUTLINE SPECIFICATIONS	COMMERCIAL VAN
Current Product Range container van	Structural Components Foundations	
	- Floors fiberglas reinf. plywood	
	- Walls " " "	
	Connections - Roof " " "	
Standard Sizes 8 x 20, 8 x 30, 8 x 40	Design Loads - Snow	
	- Wind	
	Surface Materials - Floor	
	- Ext. Walls FRP	
	U-factor - Roof FRP	
	Fire Rating	
	HVAC baseboard	
Yrs. of Ind. Bldg. Exp.	Plumbing modular core	
	Electric	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

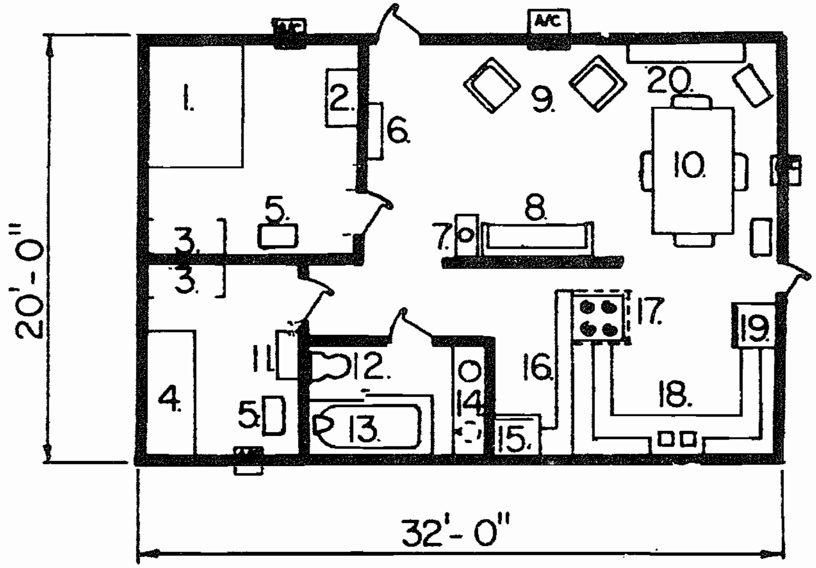
A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	sp. adapt. 8'x40' & 8'x20' van	16' x 40'	480	1 - 8'x 40'x 8'; 1 - 8'x 20'x 8'
3 BR	sp. adapt. 2-8'x 40' vans	16' x 40'	640	2 - 8'x 40'x 8'

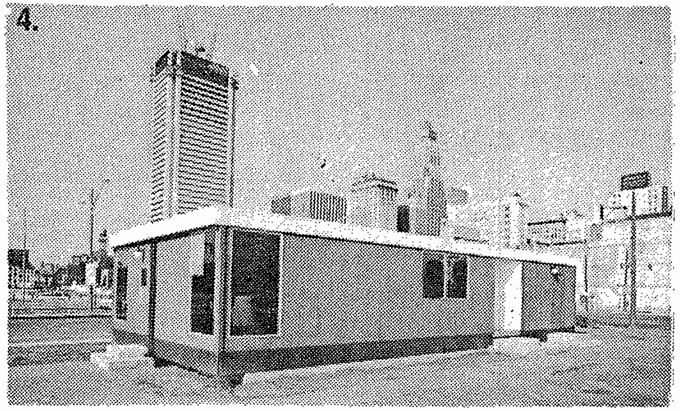
B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck	.50	

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
				25 stacked 2 high	

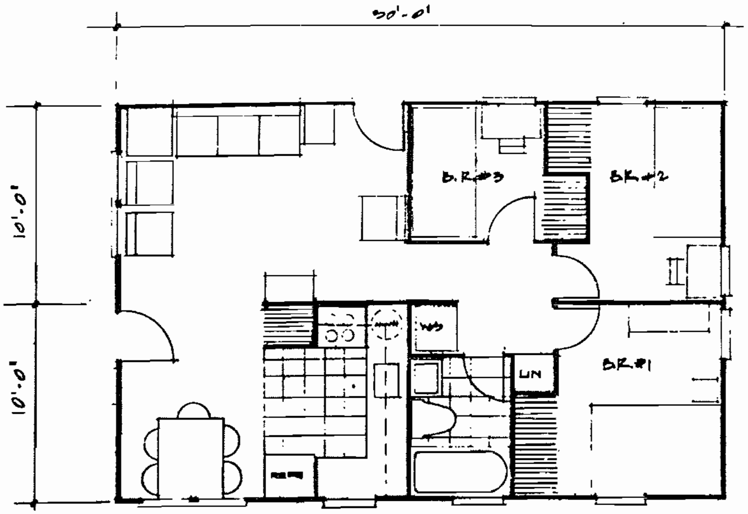
D. SITE ERECTION/ DISMANTLING	1. ERECTION		2. DISMANTLING	
	Site prep. reqd.			
	Special tools reqd.		Special tools reqd.	
	Heavy equipment	forklift, crane	Heavy equipment	
	Wt. of heaviest piece			
	Labor skill reqd.	unskilled		
	Min. no. of men	2	Min. no. of men	2
	Man-hours	24	Man-hours	24

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100 1000-1500 1500-2000	





UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

6

Atlantic International

DIVISION OF ATLANTIC MOBILE CORPORATION 301-666-3060
P.O. BOX 412, HUNT VALLEY, MARYLAND 21030 USA Telex: 87562

SYSTEMS DESCRIPTION 26

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

THE MANUFACTURER

ATLANTIC INTERNATIONAL
Div. of Atlantic Mobile
Corp.
P.O. Box 412
Cockeysville, Md. 21030

I. DESCRIPTION OF THE SYSTEM

A. GENERAL DESCRIPTION

Current Product Range mobile homes, general rigid and knock down boxes for field camps

Standard Sizes 8', 10', 12', 14' wide
any lengths

Yrs. of Ind. Bldg. Exp. 12 years

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	
	- Floors	2" x 4" wood joists 16" o.c. skid mount.
	- Walls	2" x 4" wood studs 16" o.c.
Connections	- Roof	2" x 4" wood rafters (flat) 16" o.c.
		nailed and screwed
Design Loads	- Snow	40 p.s.f.
	- Wind	
Surface Materials	- Floor	
	- Ext. Walls	Lt. gauge metal siding
U-factor	- Roof	sprayed and chopped fiberglas
Fire Rating		
HVAC	thru-wall individual units	
Plumbing	factory installed	
Electric	wall mounted or within wall assembly	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	spec. adapt. general rigid	20' x 26'	520	rigid box (10'x26'x9½')KD Box (10'x26'x2½')
3 BR	box and knock down box	20' x 30'	600	rigid box (10'x30'x9½')KD Box (10'x30'x2½')

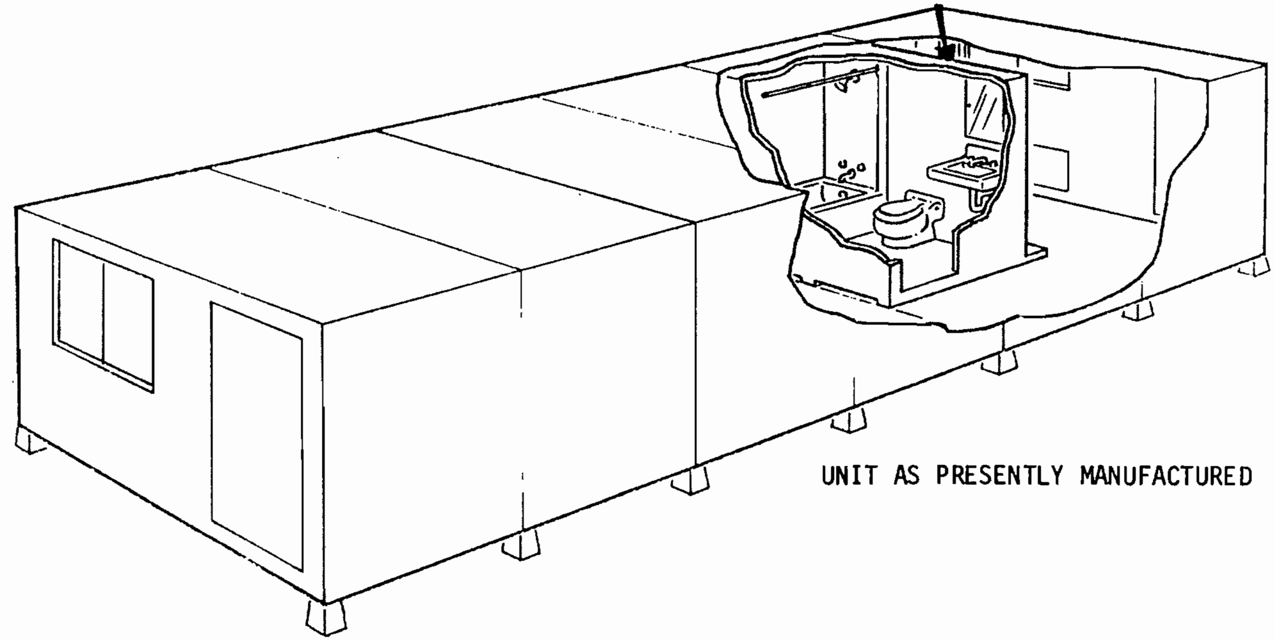
B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck, train	1.33	rigid box must be braced and covered by plastic sheathing

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	stored outside with polyethylene covering	crane		60	

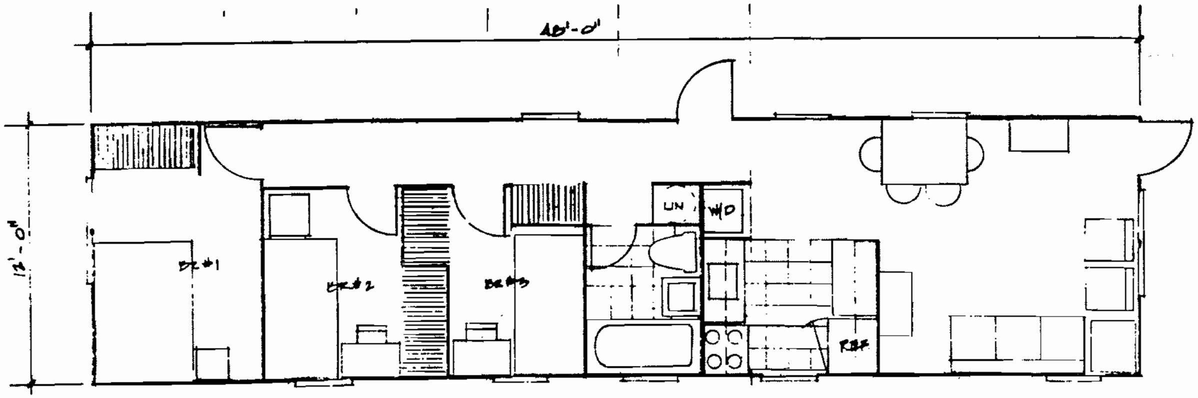
D. SITE ERECTION/ DISMANTLING

1. ERECTION		2. DISMANTLING	
Site prep. reqd.	level site		
Special tools reqd.		Special tools reqd.	
Heavy equipment	lifting device	Heavy equipment	lifting device
Wt. of heaviest piece			
Labor skill reqd.	unskilled		
Min. no. of men	4	Min. no. of men	4
Man-hours	40	Man-hours	40

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100 1000-1500 1500-2000	30 - 45 days Productior at 15/week using 3 factories



UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

GOODYEAR AEROSPACE
CORPORATION

ARIZONA DIVISION
LITCHFIELD PARK, ARIZONA 85340

7

MODULAR PROCESSING AND SUPPORT SYSTEMS

SYSTEMS DESCRIPTION 27

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

THE MANUFACTURER

GOODYEAR AEROSPACE CORP.
Arizona Division
Litchfield Park, Arizona
85340

I. DESCRIPTION OF THE SYSTEM

A. GENERAL DESCRIPTION

Current Product Range military shelter system including U.S.A.F. Bare Base and MPASS program

Standard Sizes

Yrs. of Ind. Bldg. Exp.

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	conc. block & steel beam
	- Floors	Paper honeycomb core w/bonded
	- Walls	steel faces: redwood edge member
Connections	- Roof	Roto-Lock or tape @ joints
Design Loads	- Snow	40 p.s.f.
	- Wind	60 knots, guyed
Surface Materials	- Floor	80 p.s.f.
	- Ext. Walls	vinyl coated steel
U-factor .35	- Roof	vinyl coated steel
Fire Rating		
HVAC		
Plumbing	modular core	
Electric	raceways and insert mounting	

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR		12' x 42'	504	
3 BR		12' x 48'	576	36 panels

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck, train		

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	stored indoors			n.a.	

D. SITE ERECTION/ DISMANTLING

1. ERECTION

Site prep. reqd.	level
Special tools reqd.	offset - handle Allen wrench
Heavy equipment	
Wt. of heaviest piece	182 lbs
Labor skill reqd.	unskilled
Min. no. of men	4
Man-hours	86

2. DISMANTLING

Special tools reqd.	offset-handle Allen wrench
Heavy equipment	
Min. no. of men	4
Man-hours	86

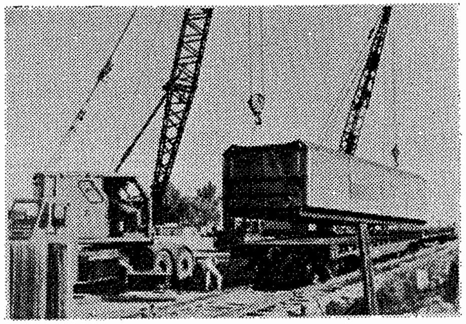
F. DELIVERY TIME

100
1000-1500
1500-2000

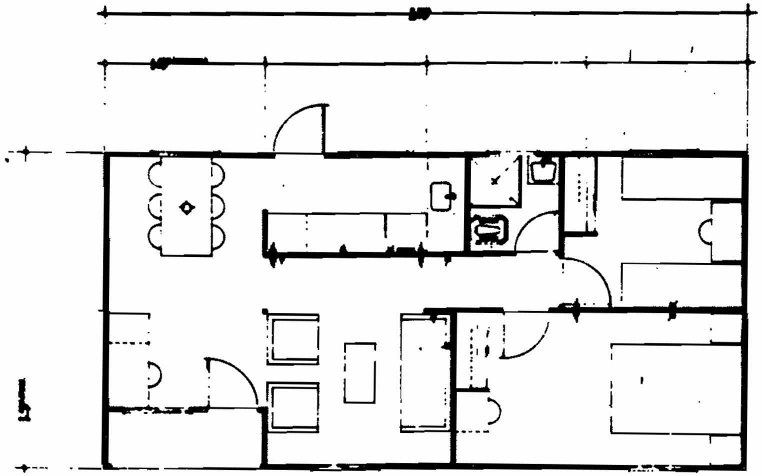
1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION

2 - 15 months - estimate prior to prototype

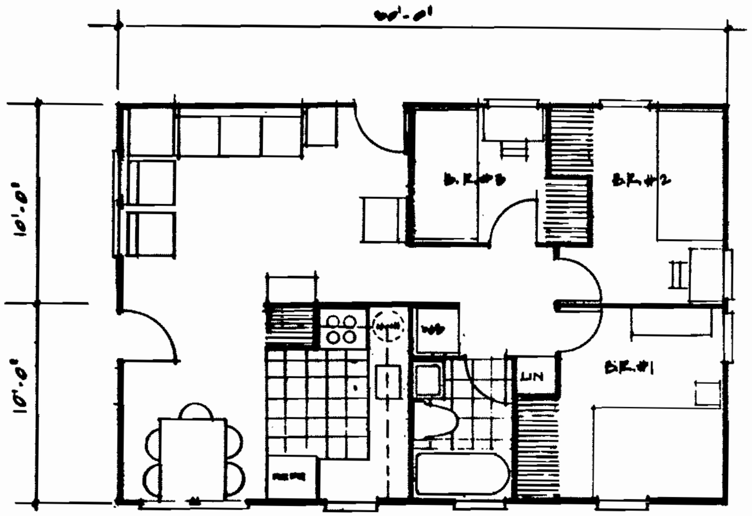
Production: 25/week



Knockdown packages were developed by ATCO to save shipping space and freight costs. When erected, they are identical to the ready-built standard cubes.



UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

ATCO

INDUSTRIES LTD.

8

SYSTEMS DESCRIPTION 28

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM

THE MANUFACTURER

ATCO INDUSTRIES LTD.
1243 McKnight Blvd.
Calgary, Alberta,
Canada

A. GENERAL DESCRIPTION

Current Product Range mobile homes, panel systems, permanent modular units

Standard Sizes

Yrs. of Ind. Bldg. Exp. 28

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	woodsill
	- Floors	2" x 3" wd joists 16" o.c.
	- Walls	2" x 3" wd studs 16" o.c.
Connections	- Roof	2" x 4" wd rafters 16" o.c.
Design Loads	- Snow	
	- Wind	
Surface Materials	- Floor	
	- Ext. Walls	
U-factor	- Roof	
Fire Rating		
HVAC		electric baseboard; thru wall A.C.
Plumbing		plastic pipe
Electric		120/220 v. single phase; within partitions

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	panelized	20' x 26'	520	30 sections/unit
3 BR	panelized	20' x 30'	600	

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck, train		sections are nailed

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	must be stored indoors or containerized	lifting device		n.a.	

D. SITE ERECTION/ DISMANTLING

1. ERECTION		2. DISMANTLING	
Site prep. reqd.	level		
Special tools reqd.		Special tools reqd.	
Heavy equipment	forklift	Heavy equipment	forklift
Wt. of heaviest piece			
Labor skill reqd.	4 unskilled, 1 skilled		
Min. no. of men	4	Min. no. of men	5
Man-hours	178	Man-hours	178

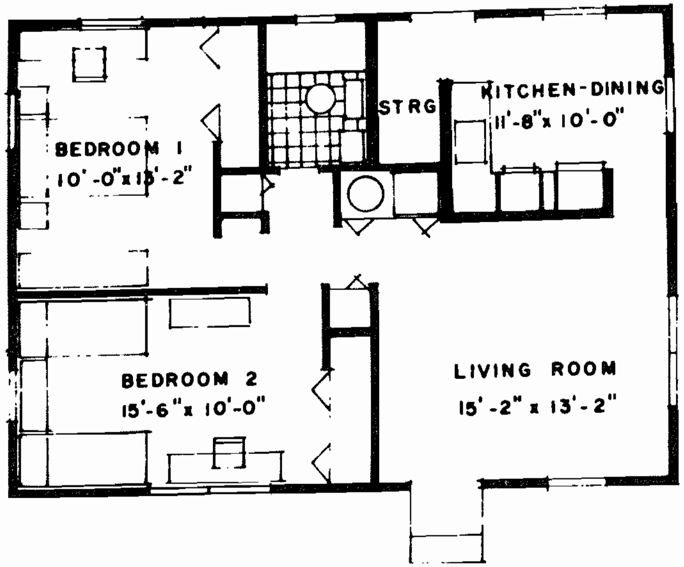
F. DELIVERY TIME

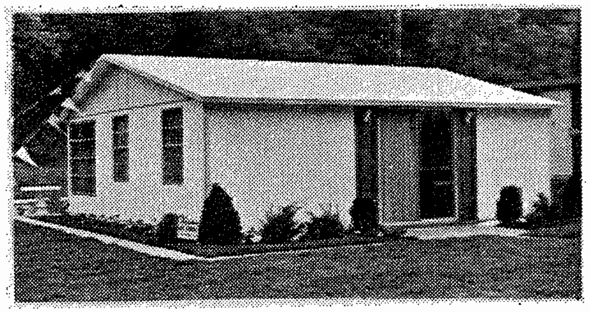
1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION

100
1000-1500
1500-2000

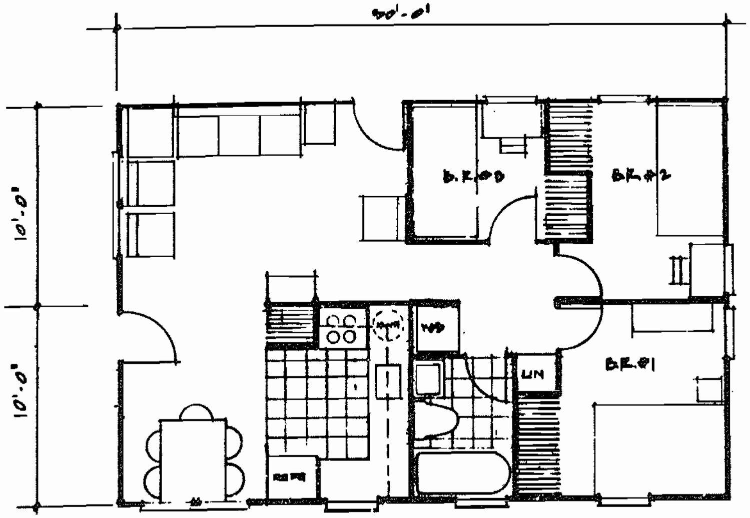
6 weeks/300 units

Production 35 units/week





UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

9

panelfab International Corporation
1600 N.W. LE JEUNE RD. • MIAMI, FLORIDA 33126

SYSTEMS DESCRIPTION 29

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM

THE MANUFACTURER

PANELFAB INTERNATIONAL CORP
1600 N.W. LeJeune Road
Miami, Fla. 33126

A. GENERAL DESCRIPTION

Current Product Range
panelized, and rigid systems for housing and motels

Standard Sizes panels: 36", 40", 48" wide
2 - 3" thick

Yrs. of Ind. Bldg. Exp. 20 years

B. OUTLINE SPECIFICATIONS

Structural Components Foundations
- Floors } 2" thick Kraft paper honeycomb
- Walls } w/28 ga. steel pressure bonded each side
- Roof }

Connections
alum. base channel & corner posts

Design Loads - Snow
- Wind

Surface Materials - Floor
- Ext. Walls baked enamel
- Roof

U-factor
Fire Rating
HVAC
Plumbing mechanical core
Electric

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	40" wide panelized	20' x 26'	520	8' x 4' panels in 20' or 40' containers
3 BR	40" wide panelized	20' x 30'	600	(33 sections)

B. TRANSPORTABILITY

1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
150 container van		33 sections per d.u.

C. STORABILITY

1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
stored indoors	lifting device		n.a.	

D. SITE ERECTION/ DISMANTLING

1. ERECTION

Site prep. reqd.	
Special tools reqd.	
Heavy equipment	forklift or crane
Wt. of heaviest piece	
Labor skill reqd.	unskilled
Min. no. of men	6
Man-hours	120

2. DISMANTLING

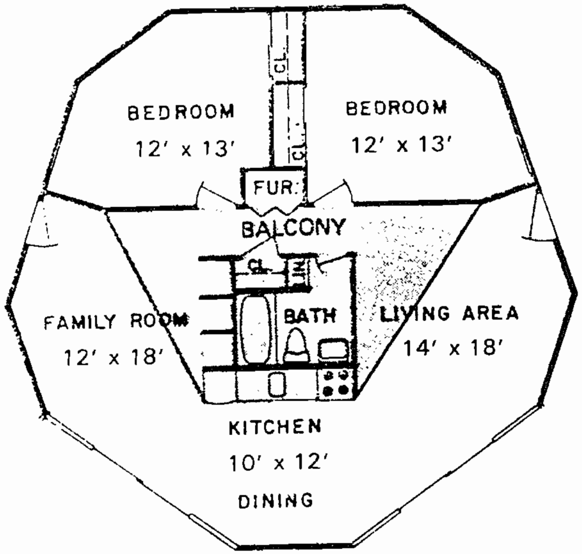
Special tools reqd.	
Heavy equipment	forklift or crane
Min. no. of men	6
Man-hours	120

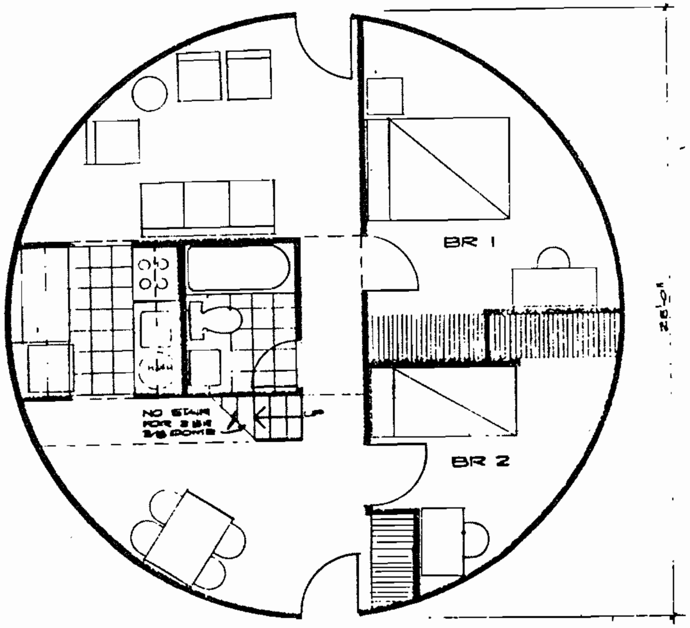
F. DELIVERY TIME

100
1000-1500
1500-2000

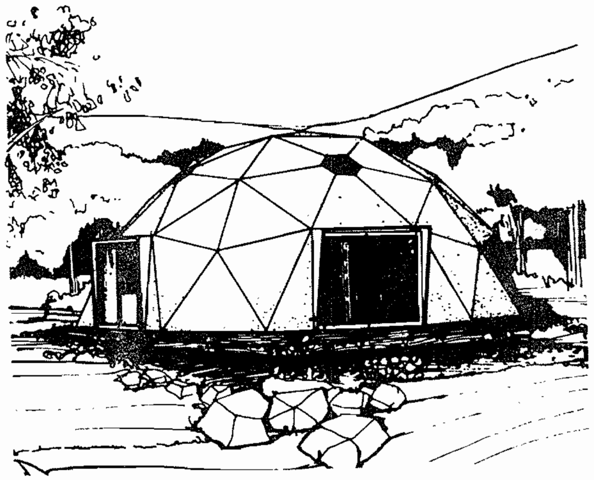
1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION

60 days after firm order





SPECIALLY ADAPTED PLAN



UNIT AS PRESENTLY MANUFACTURED

10

Geodesic Structures, Inc.
P. O. Box 176 • Hightstown, New Jersey 08520

SYSTEMS DESCRIPTION 30

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM

THE MANUFACTURER

GEODESIC STRUCTURES
P.O. Box 176
Hightstown, N.J. 08570

A. GENERAL DESCRIPTION

Current Product Range geodesic domes

Standard Sizes 26', 30', 39', 45', 59' diam.

Yrs. of Ind. Bldg. Exp.

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	piers, poles
	- Floors	radial beams w/wedge shaped panels
	- Walls	panelized 2" x 3" sections
Connections	- Roof	panelized 2" x 3" sections
Design Loads	- Snow	
	- Wind	
Surface Materials	- Floor	
	- Ext. Walls	exterior grade plywood and hypalon
U-factor	- Roof	
Fire Rating		
HVAC		
Plumbing	modular core	
Electric		

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	3/8 sphere - 1 level	28'0" diam.	615	60 sections
3 BR	1/2 sphere - 2 levels	28'0" diam.	723	65 sections

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck, train		65 sections per unit

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	must be stored indoors	lifting device		n.a.	

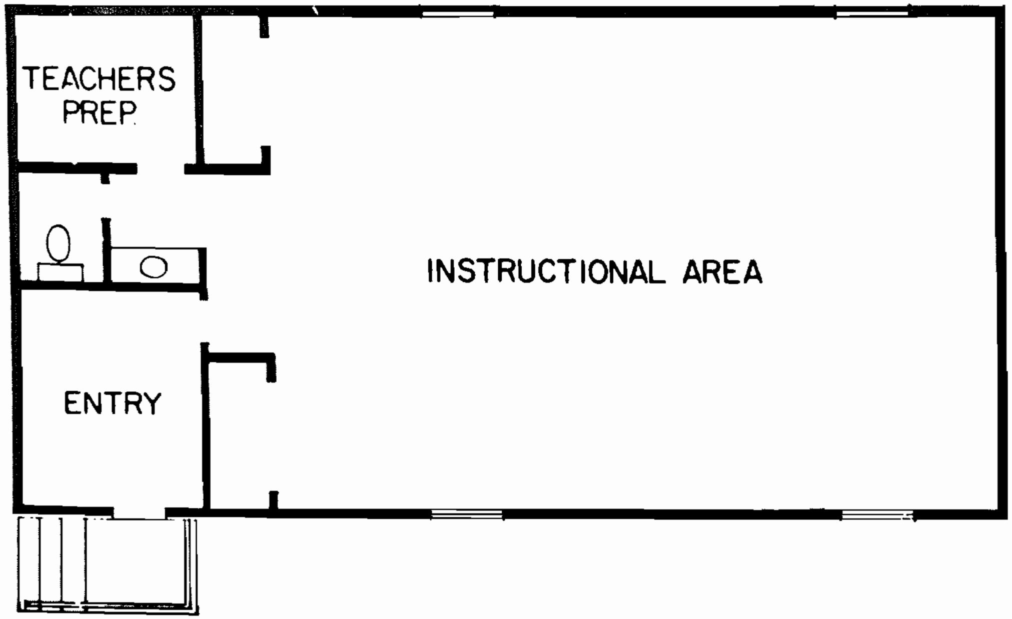
D. SITE ERECTION/ DISMANTLING

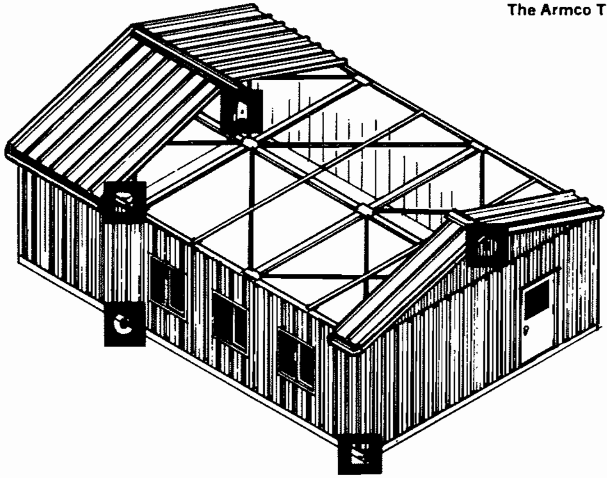
needs temporary staging while being erected.

1. ERECTION		2. DISMANTLING	
Site prep. reqd.	level site		
Special tools reqd.		Special tools reqd.	
Heavy equipment	forklift (mechanical core)	Heavy equipment	
Wt. of heaviest piece			
Labor skill reqd.	unskilled		
Min. no. of men	4	Min. no. of men	4
Man-hours	236	Man-hours	236

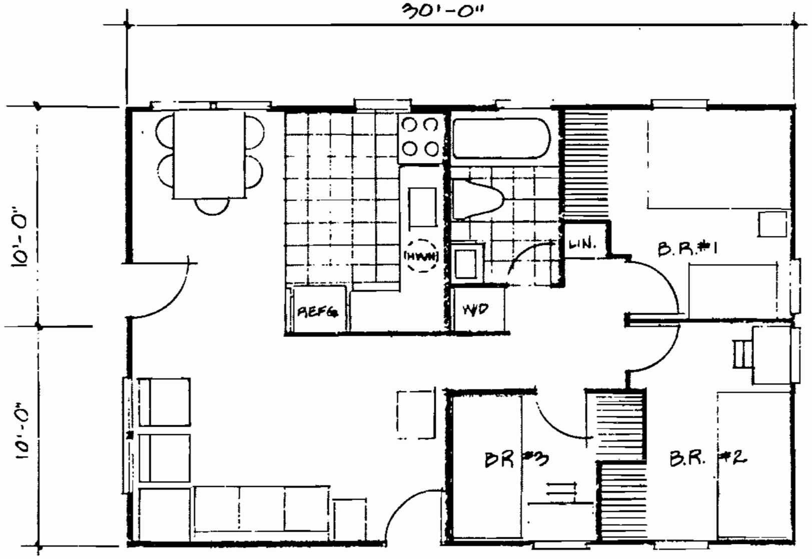
F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100 1000-1500 1500-2000	8 - 12 weeks Production 20/per week

The Armco Triangle,





UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

11

Manufactured by Armco Steel Corporation, Metal Products Division, Middletown, Ohio, and Armco Canada Ltd., Guelph, Ontario

SYSTEMS DESCRIPTION 31

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM

A. GENERAL DESCRIPTION

Current Product Range pre-fabricated commercial and industrial metal buildings

Standard Sizes

Yrs. of Ind. Bldg. Exp.

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	8"x 4" st/tube on concrete block
	- Floors	steelox floor panels w/foam insulation
	- Walls	insulated liner panels
Connections	- Roof	" " "
Design Loads	- Snow	
	- Wind	
Surface Materials	- Floor	Vat on insulated steel panels
	- Ext. Walls	painted steel wall panels
U-factor	- Roof	insul. steel panels
Fire Rating		
HVAC		
Plumbing	modular core	
Electric		

THE MANUFACTURER

ARMCO STEEL CORP.
P.O. Box 1268
Englewood Cliffs, N.J.
07632

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR		20' x 26'	520	
3 BR		20' x 30'	600	

B. TRANSPORTABILITY	1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
	truck		structure does not have sectional type assembly

C. STORABILITY	1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
		lifting devices		n.a.	unit must be completely dismantled to nuts & bolts

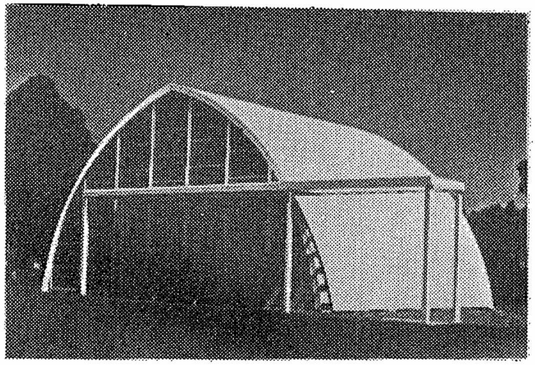
D. SITE ERECTION/ DISMANTLING

1. ERECTION		2. DISMANTLING	
Site prep. reqd.			
Special tools reqd.		Special tools reqd.	
Heavy equipment	lifting devices	Heavy equipment	
Wt. of heaviest piece			
Labor skill reqd.	skilled workers preferred		
Min. no. of men		Min. no. of men	
Man-hours	264	Man-hours	264

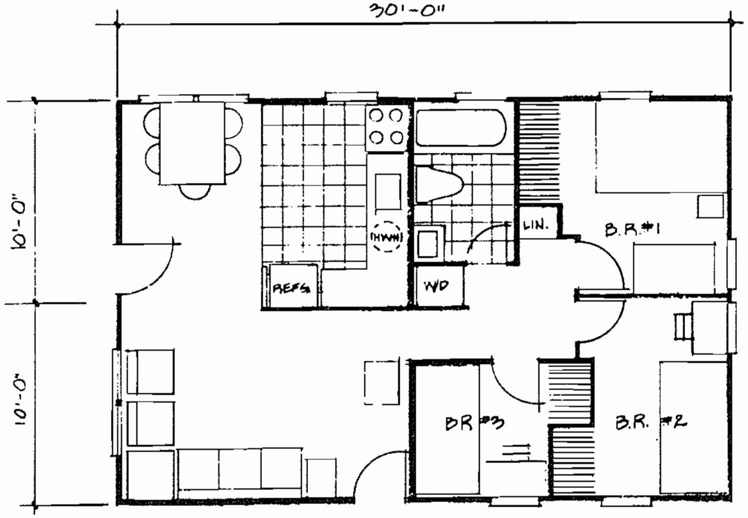
F. DELIVERY TIME

1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION

100	7 weeks/300 units
1000-1500	
1500-2000	Production rate 6/week



UNIT AS PRESENTLY MANUFACTURED



SPECIALLY ADAPTED PLAN

12

CONCOR
COMPANY INC BUILDING RENTALS

Write to:
CONCOR CO., INC.
145 MEADOW STREET
P.O. BOX NO. 3297
FRAMINGHAM,
MASSACHUSETTS 01701

SYSTEMS DESCRIPTION 32

RELOCATABLE HOUSING AND SHELTER INDUSTRY - SPECIALLY ADAPTED SYSTEMS

I. DESCRIPTION OF THE SYSTEM

THE MANUFACTURER

CONCOR COMPANY INC.
145 Meadows Street
P.O. Box 3297
Framingham, Mass. 01701

A. GENERAL DESCRIPTION

Current Product Range	prefabricated commercial and industrial metal buildings
Standard Sizes	
Yrs. of Ind. Bldg. Exp.	

B. OUTLINE SPECIFICATIONS

Structural Components	Foundations	'dissolvable footings'
	- Floors	
	- Walls	steel panel exterior, wood interior
Connections	- Roof	
Design Loads	- Snow	
	- Wind	
Surface Materials	- Floor	
	- Ext. Walls	
U-factor	- Roof	
Fire Rating		
HVAC	electric baseboard	
Plumbing	modular core	
Electric		

II. THE SYSTEM IN RELATION TO THE HUD EVALUATION CRITERIA

A. HOUSING TYPE (LIVABILITY)

A. HOUSING TYPE (LIVABILITY)	1. TYPE SELECTED FOR ANALYSIS	2. OUTSIDE DIMENSIONS	3. FLOOR AREA GROSS SQ. FT.	4. MODULE/ PACKAGE SIZE
2 BR	frameless metal arch	20' x 26'	520	
3 BR	frameless metal arch	20' x 30'	600	

B. TRANSPORTABILITY

1. TRANSPORTATION EQUIPMENT NORMALLY USED	2. D.U.s PER TRUCK	3. DURABILITY/SPECIAL PROBLEMS
standard carrier		

C. STORABILITY

1. STORAGE REQUIREMENTS	2. SPECIAL EQUIPMENT	3. SPECIAL PREPARATION	4. D.U.s/ ACRE STOR.	5. SPECIAL PROBLEMS
	lifting device		n.a.	

D. SITE ERECTION/ DISMANTLING

1. ERECTION		2. DISMANTLING	
Site prep. reqd.			
Special tools reqd.		Special tools reqd.	
Heavy equipment	lifting device	Heavy equipment	
Wt. of heaviest piece			
Labor skill reqd.	supervision required		
Min. no. of men	4	Min. no. of men	4
Man-hours	188	Man-hours	188

F. DELIVERY TIME

F. DELIVERY TIME	1. ESTIMATE OF TYPICAL LEAD TIME REQUIRED FROM DATE PURCHASE ORDER IS PLACED TO COMPLETION
100 1000-1500 1500-2000	4 months/40 units Production 10/week

C. MECHANICAL SUBSYSTEMS REPORT

1. PURPOSE AND SCHEMES CONSIDERED

The purpose of this report is to analyze the operating and installation costs for heating, cooling and water heating systems for pre-selected temporary housing units and to compare the costs under several alternate schemes.

Three schemes were considered:

- Scheme 1 -- All Electric. Mechanical Scheme 1 contains individually controlled electric resistance baseboard heaters, wall and ceiling mounted electric forced air heaters and an electric hot water heater. (Electric cooling can be adapted where required.)

- Scheme 2 -- All Propane. Mechanical Scheme 2 contains one central propane fired furnace with minimal ductwork and a thermostatic control and a propane cooking range and hot water heater.

- Scheme 3 -- Propane Heating, Electric Cooking and Water Heating. Mechanical Scheme 3 contains one central propane fired furnace with a thermostatic control and minimal ductwork and electric cooking and hot water heating.

2. EVALUATION

The evaluation of the various mechanical schemes was based on three elements: installation costs, operating costs (i.e., the actual cost of the utility) and maintenance factors based on the inherent characteristics of the equipment used in each scheme.

Disasters, by nature, are unpredictable in terms of potential damage and location. To compensate for the variable location factor, operating costs for the schemes were calculated for the following locations: Wilkes-Barre, Pennsylvania; Miami, Florida; Baton Rouge, Louisiana; Oklahoma City, Oklahoma; and San Jose, California. The costs of both electricity and propane gas were obtained from suppliers in these areas.

All heating costs were calculated on a per housing unit basis.* The cost of using natural gas in place of bottled gas, when readily available, was also considered. The operating cost of such a system was computed for the Wilkes-Barre area and applied to the One Box on Wheels configuration -- the unit with the higher heat loss. The operating cost table for this system is part of Appendix V. The evaluation below is stated in terms of advantages and disadvantages of the various schemes. The schemes are presented in Figures 69 to 72, and show the plans of the schemes applied to two different three bedroom pre-selected temporary housing systems.

- Advantages and Disadvantages of Scheme 1 -- All Electric (Figures 69 and 70)

Advantages

In most areas of the United States the cost of

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* For data and calculations, see Appendix V.

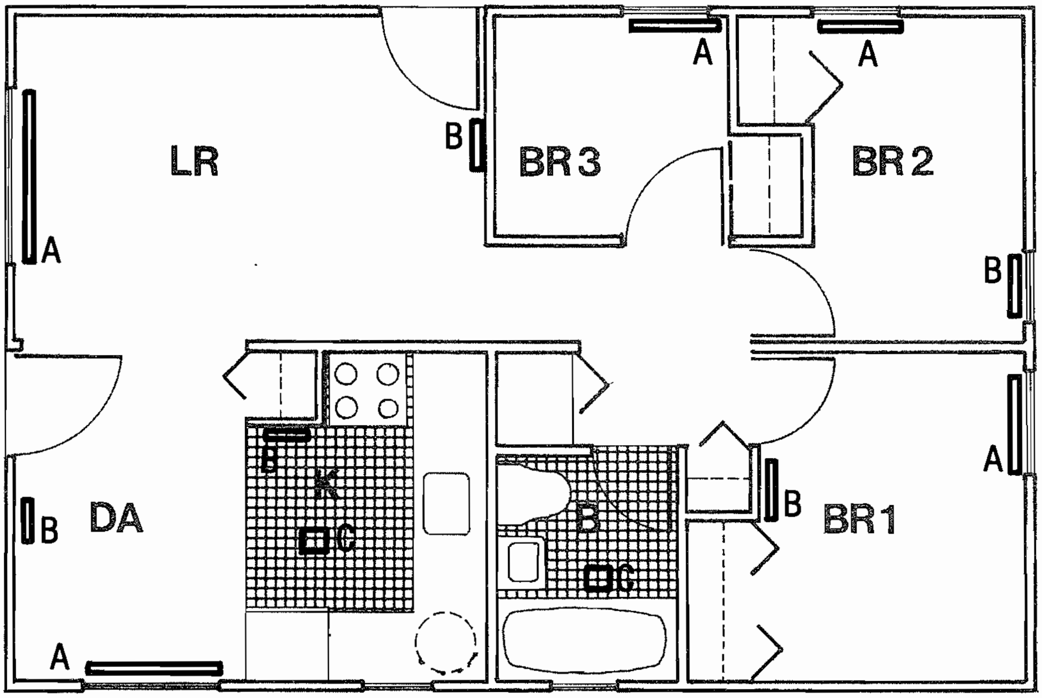
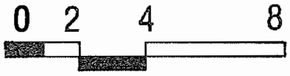


FIGURE 69

Mechanical Scheme 1.
(All Electric)

A Electric Baseboard Heater
B Electric Forced Air Heater (Wall Mounted)
C Electric Forced Air Heater (Ceiling Mounted)

4. Sectional Box
And Knock Down
(Atlantic International)
3BR 600 sq. ft.



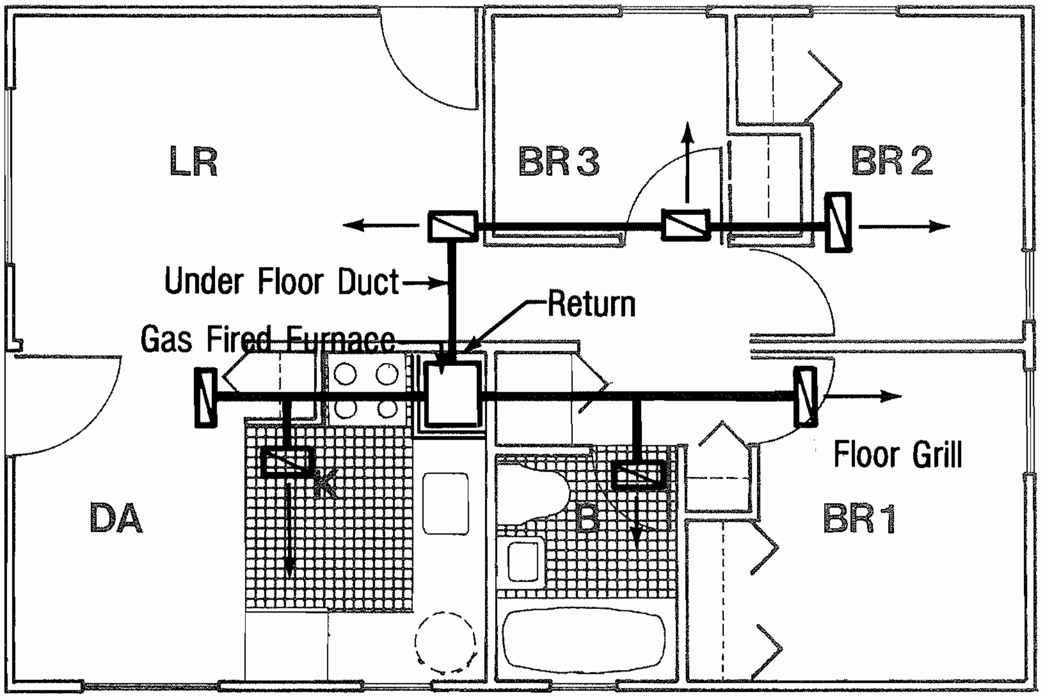
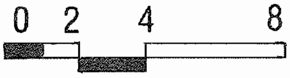


FIGURE 70

Mechanical Scheme 2.
(All Propane)

4. Sectional Box
And Knock Down
(Atlantic International)
3 BR 600 sq. ft.



operating an all electric system is less than that for a propane system.

Under extreme winter conditions encountered in the northern United States the baseboard system is able to counteract downdraft more efficiently.

In warmer climates baseboard units may be completely eliminated.

Through the wall air-conditioning may be added in warmer climates by using outlets and wiring provided for electrical heating.

Individual heating unit control.

Less equipment susceptible to in transit damage.

Malfunctioning units can be easily repaired or replaced.

Disadvantages

Approximately a $300 higher installation cost than propane systems (based on information obtained from mobile home manufacturers).

Each baseboard unit has a separate thermostat which is a potential maintenance problem.

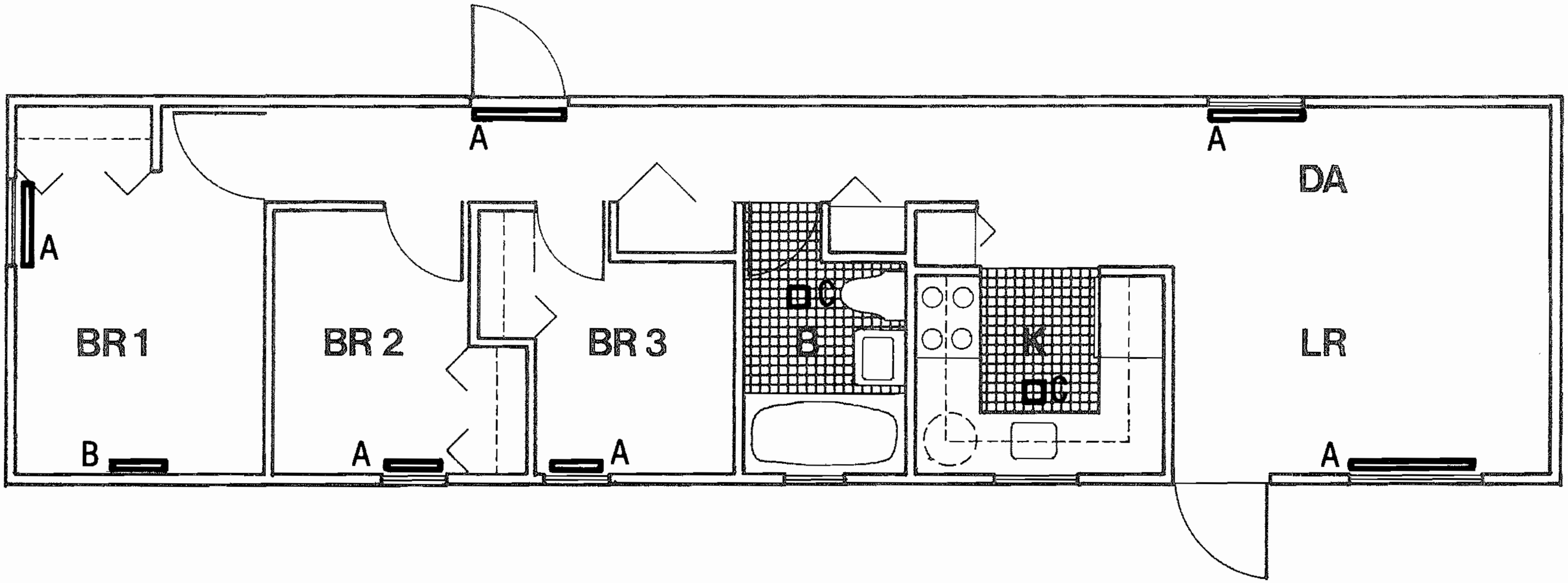
- Advantages and Disadvantages of Scheme 2 -- All Propane (Figures 71 and 72)

Advantages

Lower installation cost than the all electric system.

Adaptable for natural gas operation.

One set of control contacts.



A Electric Baseboard Heater
B Electric Forced Air Heater (Wall Mounted)
C Electric Forced Air Heater (Ceiling Mounted)

FIGURE 71
Mechanical Scheme 1.
(All Electric)

1. One Box On Wheels
(Special Design Mobile Home)
3 BR 576 sq. ft.

0 2 4 8

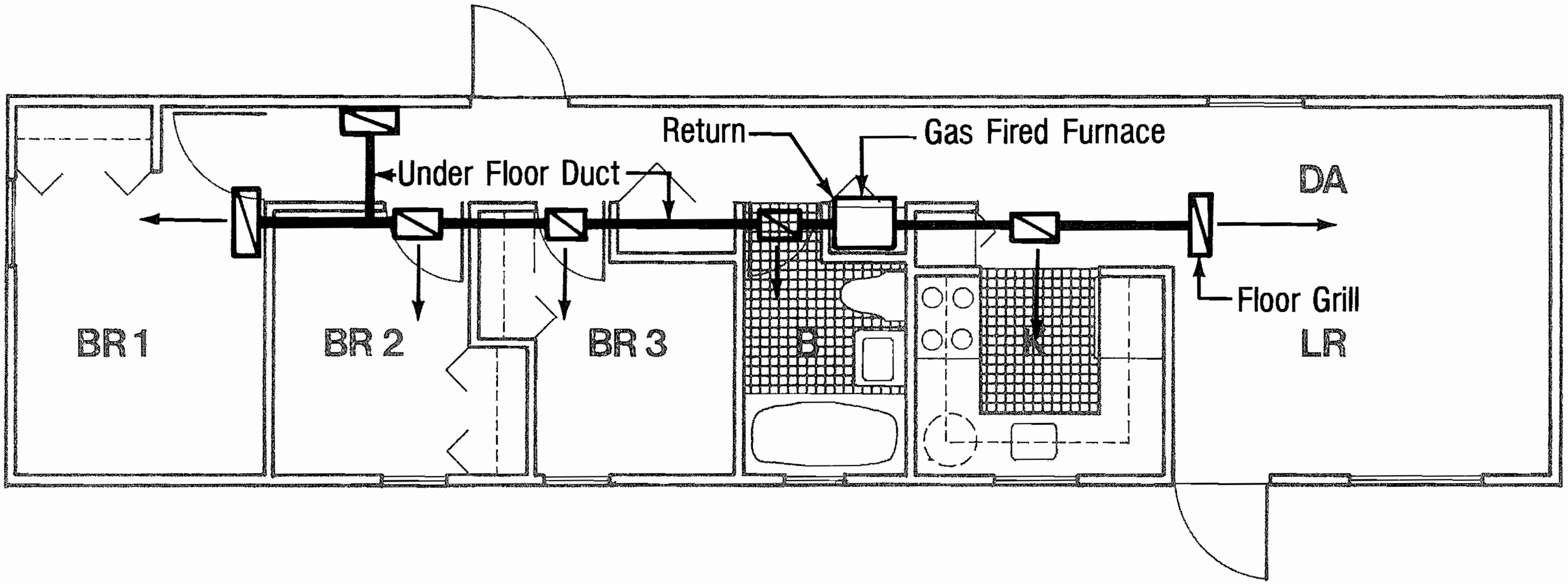
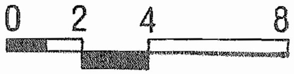


FIGURE 72
Mechanical Scheme 2.
(All Propane)

1. One Box On Wheels
(Special Design Mobile Home)
3BR 576 sq. ft.



Disadvantages

Deliveries of gas under certain conditions are questionable.

Price of gas is less controlled than that of electricity.

Fan driven furnace requires periodic maintenance.

Fan driven furnace requires replacement of parts or possibly entire unit.

Potential regulator, filter, blower, control wiring and supply connection problems.

Due to the number of parts, gas system is more susceptible to in transit damage.

- Scheme 3

Propane heating, electric cooking and hot water heating were not evaluated in detail because the operating cost of such a system is comparable to the other systems. The basic advantages and disadvantages are similar to Scheme 2. The installation cost of this system is somewhat higher due to increased electrical service requirements and a more costly cooking range than that required in Scheme 2.

3. RECOMMENDATION

Based on the investigation it is recommended that Scheme 1 (All Electric) be adopted for the temporary housing units. It is our opinion that the advantages of Scheme 1 significantly outweigh the disadvantages and are more desirable than the advantages of Scheme 2. In addition, housing units utilizing Scheme 1 are more readily adaptable to the diverse conditions demanded of disaster housing units.

V PORTABLE WATER AND WASTE TREATMENT SYSTEMS*

A. INTRODUCTION AND SUMMARY

1. WATER SUPPLY

The following are findings on water supply systems for disaster housing:

- The housing complex is best supplied from an existing potable water system. This will avoid the need for an independent treatment and supply system.
- The mobilization time available in an emergency usually precludes the use of groundwater as a supply source.
- For this study, it has been assumed that a surface water will be used, since this type of source can be developed faster and with more success than groundwater.
- It is also assumed that the surface water will require only coagulation, settling, filtration and disinfection. Saline or highly polluted waters are not considered as suitable supplies. Softening is not provided for.
- For the primary alternative, each housing unit is to be provided with normal plumbing fixtures, including a washing machine. Using an average water consumption of 70 gallons per capita per day, and figuring four persons per unit, water supply requirement is an average of 28,000 gallons per day (gpd). Peak hourly flow has been considered to be 7.5 times the average daily flow, or 150 gallons per minute (gpm).

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* Prepared by Quirk, Lawler & Matusky, Consulting Engineers.

- The major components of the primary alternative for water supply are listed in Table 39 . This system is fairly standard for small water supply systems. The major exception is that certain items like the supply pump are specified for portability and rapid installation. The study concludes that the water treatment plant and pressurizing system could be housed in a semi-trailer van. This van can also carry pumps and piping required for the designed housing situation and the wood stave tank materials. Major items of equipment should be pre-purchased and staged for deployment.

- Capital costs for the system cover pre-purchasing and installation of equipment. No storage or transportation costs are included. Table 40 summarizes capital costs for the primary alternative at 1974 material costs and installation at ENR index of 2100.

- Operating costs of this system cover power, chemicals and labor. Table 41 summarizes operating costs for the primary alternative.

- Capital and operating costs of the primary alternative can be expressed on a unit basis. Two assumptions have been made for the amortization of capital costs:

  -- All capital costs are amortized over one year at no interest;

  -- Only non-recoverable capital costs, such as pipe and installation costs, are amortized over one year at no interest, with no net cost assigned to recoverable items such as the treatment plant.

  Table 42 summarizes these computations.

  Costs per 1,000 gallons are high compared to those for public supplies, mainly because of rapid capital amortization and the poor economy of scale.

TABLE 39

MAJOR COMPONENTS
DISASTER HOUSING WATER SUPPLY SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

System Component	Design Flow	Size	Amount	Specification	Remarks
Intake Pipe	20 gpm	4" Ø	50'	Suction hose	Install to avoid freezing, tampering and bottom solids scour.
Raw Water Pump	20 gpm	1-2 H.P. 100' TDH	2 (incl. stand-by)	Outdoor, weatherproof operation; portable.	Can be housed to avoid tampering and freezing.
Raw Water Pipe	20 gpm	2" Ø	1,000'	PVC, Schedule 80	Bury to avoid freezing.
Treatment Plant	20 gpm	Length - 5' 10" Width - 4' 8" Height - 6' 10"	1	"Water Boy" Neptune Company	Mount in van, of original design. (See text.)
Storage Tank	-	10,000 gallons	1	Wood stave (on grade)	Required to meet peak demand flows.

TABLE 39

(Cont'd.)

System Component	Design Flow	Size	Amount	Specification	Remarks
Pressurizing Pump	150 gpm	30-60 psi	1	Hydro-pneumatic system, complete.	Can be installed in van, for protection against freezing.
Distribution Pipe	150 gpm	4" Ø	2000'	PVC, Schedule 80.	Bury to avoid freezing; can be carried in van.
House Connections	10 gpm	3/4" Ø	100 @ 40'	PVC, Schedule 80.	Bury to avoid freezing; can be carried in van.

TABLE 40

CAPITAL COSTS
DISASTER HOUSING WATER SUPPLY SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

	Material Cost	Installation Cost	Total Cost
Estimated	$58,950	$35,050	$ 94,000
Contingencies @ 15%	8,850	5,150	14,000
TOTAL COST:	$67,800	$40,200	$108,000
Cost Per Dwelling Unit:	$678	$402	$1,080

TABLE 41

OPERATING COSTS
DISASTER HOUSING WATER SUPPLY SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

Item	Cost Per Day
Power	$ 2.10
Chemicals	.75
Labor	36.00
TOTAL	$38.85
(Approximately):	$40.00

TABLE 42

TOTAL SYSTEM COST
DISASTER HOUSING WATER SUPPLY SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

Item	Cost All Capital Amortized	Cost Non-Recoverable Capital Only Amortized
Capital Cost per day	$300.00	$151.00
Operating Cost per day	$ 40.00	$ 40.00
Total System Cost per day	$340.00	$191.00
per unit	$ 3.40	$ 1.91
per 1,000 gal.	$ 12.10	$ 6.80

- As another option to the primary alternative, housing units could be supplied by tank truck, if an operating public water utility were available near the disaster housing site. Each housing unit could be provided with a storage tank and pressurizing system. Water could be hauled in FDA-approved tank trucks. The following are conclusions concerning costs of this method:

    -- Using a one-year amortization of all capital costs and normal water consumption total cost is $45/1,000 gallons, or 3.6 times that for the primary alternative;

    -- A 50% reduction in water usage, possible with water saving plumbing fixtures, will reduce the cost of this system by 45%, since costs reflect water consumption. Since the cost of the primary alternative is relatively insensitive to consumption, cost of hauling is reduced to 2.3 times that for the primary alternative with one-year amortization of total capital costs;

    -- If a two-month deployment is assumed and only non-recoverable capital costs are amortized, the trucked supply is only 15% more expensive than the primary alternative at normal water consumption. At 50% of normal consumption, the trucked supply costs only 60% of the primary alternative system;

    -- If fewer than 100 units are to be supplied, the trucked supply will gain in cost-effectiveness, since its unit cost does not reflect number of dwellings supplied.

In summary, if there is a need for advance equipment staging for brief installations particularly with fewer than 100 units, housing units with individual water systems and water-saving plumbing features should be investigated.

2. WASTE COLLECTION AND TREATMENT

The following are findings on the waste handling system for disaster housing:

- An existing waste collection and treatment system should be used to avoid logistical problems and costs associated with an independent system.

- The system should be designed to handle an average of 25,000 gpd -- slightly less than the water supply system.

- The basic treatment system should provide secondary treatment by means of the extended aeration process, to meet national requirements for secondary treatment of domestic wastes. To meet more stringent requirements, a filtration step should be added to the extended aeration plant. Sludge should be digested aerobically with digested sludge hauled to a local treatment plant for final disposal.

- Packaged treatment plants are available for each of these processes and must be pre-purchased to avoid long waits for delivery. These units are normally designed for outdoor installation, so no special provision is needed for housing the plant. However, the large size and weight of the extended aeration units create difficulty in transportation. Therefore, units might be staged near potential disaster areas.

- The collection system for the primary alternative has been designed as a conventional gravity sewer system with 8" diameter asbestos cement pipe. Under certain conditions, raw waste could be discharged into the treatment by gravity; however, pumping will probably be required to reach the treatment plant. Major system components are outlined in Table 43 .

TABLE 43

MAJOR COMPONENTS
DISASTER HOUSING WASTE WATER SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

System Component	Size	Amount	Specification	Remarks
House Connections	4" Ø	100 @ 40'		
Collection Pipe	8" Ø	3,000'	A.C.P.	
Manholes	4' Ø	14		
Package Pump Station	100 gpm	1, including standby pump capacity	Manhole, wet well.	Standby power desirable to prevent sewer back-up.
Extended Aeration Treatment Plant	25,000 gpd	Single Unit	-	Standby aeration capacity; installed on grade.
Aerobic Digestor	6,000 GAL	Single Unit	-	Aeration supplied in common with extended aeration plant; installed on grade.

- Capital costs for the system include material and installation costs. Table 66 summarizes capital costs for the primary alternative, at 1974 costs and installation costs at ENR index of 2100. This total cost is approximately twice that for the water supply system, due primarily to the greater cost of installing sewer pipe.

- Operating costs cover power, chemicals and labor. Table 67 summarizes operating costs for the primary alternative.

- Capital and operating costs are combined, on a unit basis, by providing for amortization of the capital costs. A one-year no-interest amortization is assumed. Either the entire capital cost or only the non-recoverable capital costs can be amortized. Table 68 presents the total cost for the primary alternative. These costs for sewage handling are more than double the water supply costs when all capital is amortized and more than triple the water supply costs where only non-recoverable capital is amortized.

- As an alternative to the central waste disposal system, septic tanks and tile fields could be used. These would require more site-specific design in laying out the tile fields, but costs are competitive with the central system:

Soil Condition	Total Capital Cost per Unit
Good	$ 930
Fair	$1,300
Poor	$2,000

None of this cost would be recoverable, but saving could still be realized, particularly with good soil. For two dwelling units connected to a common septic tank and tile field, land requirements for this system are:

Soil Condition	Land Area, Sq. Ft.
Good	1,100
Fair	2,100
Poor	4,100

TABLE 44

CAPITAL COSTS
DISASTER HOUSING WASTE WATER SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

	Material Cost	Installation Cost	Total Cost
Estimated	$80,200	$118,000	$198,200
Contingencies @ 15%	12,300	17,700	30,000
TOTAL COST:	$92,500	$135,700	$228,200
Cost per Dwelling Unit:	$925	$1,357	$2,280

TABLE 45

OPERATING COSTS
DISASTER HOUSING WASTE WATER SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

Items	Cost per day
Power	$ 3.10
Chemicals	.20
Labor	33.50
TOTAL:	$36.80
(Approximately):	$40.00

TABLE 46

TOTAL SYSTEM COST
DISASTER HOUSING WASTE WATER SYSTEM
PRIMARY ALTERNATIVE
100 DWELLING UNITS

	Cost	
Item	All Capital Amortized	Non-Recoverable Capital Only Amortized
Capital Cost, per day	$625	$480
Operating Cost, per day	$ 40	$ 40
Total System Cost, per day	$665	$520
Total System Cost, per day per unit	$ 6.65	$ 5.20
Total System Cost, per 1,000 gal.	$ 26.50	$ 20.70

With poor soil, this requirement could control the housing layout, but the septic tank system should be considered in disaster housing planning.

- A second alternative is waste water hauling, similar in concept to the trucked water supply. The following conclusions can be made about this system:

  -- With one-year amortization of non-recoverable capital costs and normal water consumption, total cost of this system is $8.70 per unit per day, or 70% more than the primary alternative;

  -- With normal water consumption, the trucked disposal system cost is equal to the primary alternative cost at a six-month deployment and amortization period;

  -- With a 50% reduction in water consumption and one-year amortization of non-recoverable costs, the trucked system is competitive with the central system -- $4.95 per unit per day versus $5 per unit per day.

  In summary, sewage disposal by hauling shows definite cost-effectiveness, particularly where deployment time is six months or less. Water conservation measures can dramatically reduce hauling disposal costs; water-saving devices should be considered in the dwelling unit.

- As an alternative to the gravity sewers used in the primary alternative, pressure sewers could be used. This type of collection system plus the central treatment plant would cost approximately the same as the primary alternative. However, a much larger portion of the cost is recoverable; the pressure sewer system can be less costly. Such systems are worth consideration in detailed phases of disaster relief planning.

- A modular sewer and water utility system, using pressure sewers, could be designed for the disaster housing situation. This system, consisting of water and sewer pipes housed in corrugated metal pipe, would have several advantages over the primary alternative systems. Pipe could be installed more cheaply, only one trench would be required for both water and sewer pipe and pipe could be recovered for future deployment. The major disadvantage is the possibility of water supply contamination, but proper design and testing should minimize this danger.

B. WATER SUPPLY

It is assumed that the water supply system for the 100-unit housing complex must be wholly self-contained. Practically, it might be cheaper and faster to connect the system to an existing water supply system, since one of the first efforts in disaster relief is re-establishment of potable water supplies. However, for this study it has been assumed that temporary housing will be located on a site which has a firm, developable source of surface water nearby and no opportunity for connection to an existing supply.

The water supply for emergency housing must be able to supply an adequate flow of potable water for cooking, washing and other domestic uses. This water must be of a high quality and delivered to the homes safely. There are six elements to be considered: quantity, quality, sources, treatment, storage and distribution, and pumping.

The following section discusses each element in the context of emergency housing, along with such factors as advance planning, purchase and stockpiling of equipment.

1. WATER QUANTITY

The emergency housing complex assumed for this study consists of 100 two- and three-bedroom units, such as mobile homes, capable of housing two to six people, with an average of four people per unit.

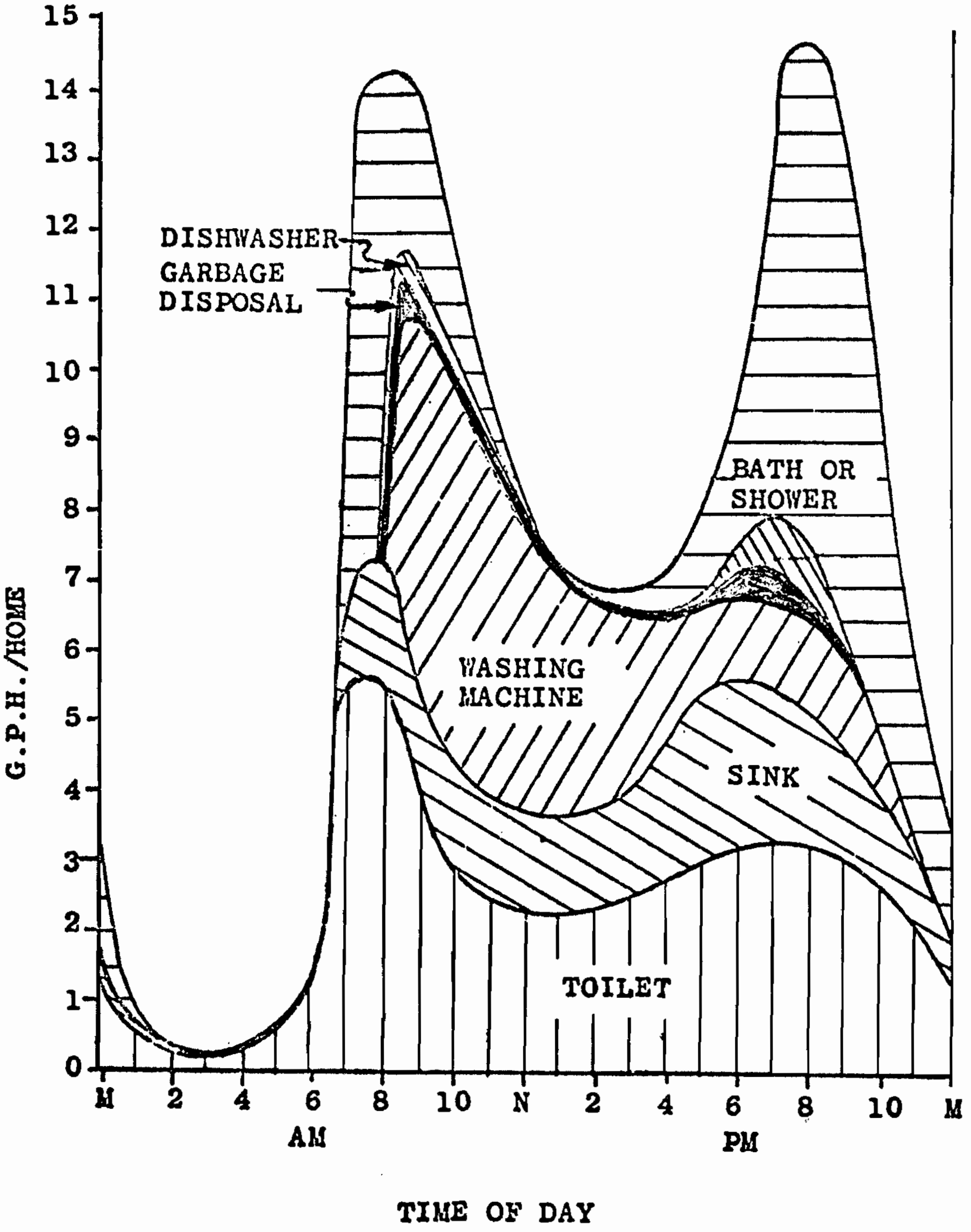
The water supply required by the 400 people in the complex is a function of per capita water consumption, daily pattern of use and type and number of water-consuming appliances. The per capita consumption used for designing water supply systems in the United States is traditionally 100 gallons per day. For a disaster housing complex, this number appears somewhat high, since a single bathroom will be provided in the mobile homes compared with the multiple bathrooms found in many homes. However, each unit will have a washing machine and no special water-saving plumbing features will be installed. Studies show that single-family dwellings with septic tank waste water disposal use 50 gallons of water per capita per day. For this study, it is assumed that 70 gallons per capita per day will be used. The water needs of the complex then average 28,000 gallons per day.

The rate of delivery of water from the supply source and storage requirements depend upon the daily use pattern. Figure 73 presents the daily water consumption pattern for a single-family household. Two distinct peaks occur -- one in the morning from 6:30 to noon representing rising for work, and a second peak from 5:30 to 10 representing the evening meal and preparations for retiring.

Figure 74 presents the duration of various intensities of use for individual homes. For one to four minutes a maximum flow of nine to 10 gpm can be expected; beyond a duration of four minutes the flow drops off sharply to 2.5 gpm for an 11-minute duration. Since the peak flows for 100 units occur over a period of several hours, the demand on the water system will not equal the sum of the short-period maximums of nine to 10 gpm per unit. Because of the small size of the system, however, the system peak will be larger than average over the duration maximum (Figure 73).

FIGURE 73

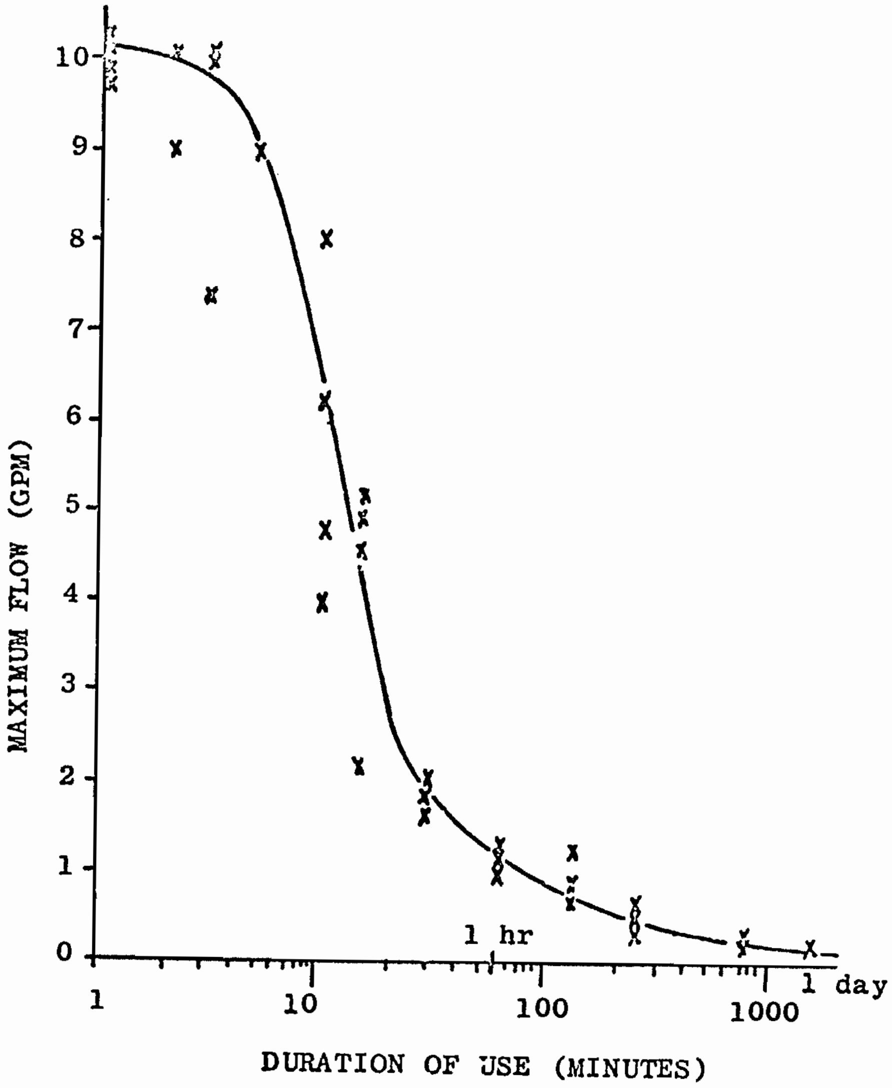
DAILY HOUSEHOLD WATER USE



Reference: Bennett, Edwin R. "Comparison of the Septic Tank and Aerobic Treatment Units: Impact of Wastewater Variations on these Systems" University of Colorado.

FIGURE 74

DURATION INTENSITY CURVE FOR INDIVIDUAL HOMES



Reference: Bennett, Edwin, R. "Comparison of the Septic Tank and Aerobic Treatment Units: Impact of Wastewater Variations on these Systems" University of Colorado.

The value for a one-hour duration for a single household is about 1.2 gpm. A value of 1.5 gpm per unit will be used as a design flow, giving a total peak for the housing complex of 150 gpm.

It is assumed that water supply for fire protection is not required. Multiple unit fires are unlikely in a mobile home complex, and a normal fire truck could handle a fire in a single unit.

2. WATER QUALITY

The raw water quality affects both degree of treatment required and the quality of the finished product. Certain metals are not easily removed from raw water. Table 47 shows all the chemical constituent standards for drinking water of the U.S. Public Health Service (USPHS). These standards represent the minimum finished water quality which must be supplied by licensed carriers engaged in interstate travel, and are thus a guide to domestic water supply.

Physical characteristics are limited to produce aesthetically pleasing drinking water. For this study, these standards will be considered as a definition of minimum water quality. Where no standard exists in the USPHS list, World Health Organization (WHO) standards are used.

TABLE 47

DRINKING WATER STANDARDS

Characteristic	Limit Not To Be Exceeded	Cause For Rejection
PHYSICAL		
Color	15 units	
Taste	unobjectionable	
Threshold Odor Number	3	
Turbidity	5 units	
CHEMICAL	mg/l	mg/l
Alkyl benzene sulfonate	0.5	
*Ammonia	0.5	
Arsenic	0.01	0.05
Barium		1.0
Cadmium		0.01
*Calcium	200.0	
Chloride	250.0	
Chromium (hexavalent)		0.05
Copper	1.0	
Carbon chloroform extract[1]	0.2	
Cyanide	0.01	0.02
Fluoride[2]	0.7 - 1.2	1.4 - 2.4
Iron	0.3	
Lead		0.05
Magnesium	150.0	
Magnesium + Sodium Sulfate	1000.0	
Manganese	0.05	
Nitrate	45.0	
Phenols	0.001	
Selenium		0.01
Silver		0.05
Sulfate	250.0	
Total dissolved solids	500.0	
Zinc	5.0	

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* World Health Organization standard

[1] Organic contaminants

[2] The concentration of fluoride should be between 0.6 and 1.7 mg/l, depending on the listed annual average maximum daily air temperatures.

Sources: U.S. Public Health Service; World Health Organization.

3. WATER SOURCES

Two sources to be considered for developing new water supplies are surface water and groundwater. In a disaster, water supply will depend upon several factors, including type of disaster, existing water supply, damage to existing water supply and presence of streams in the area. The type of disaster will affect the selection of water supply by determining how the existing water supply may have been contaminated. For example, a major flood may cause sewage contamination through broken water mains while an explosion could cause chemical contamination.

If possible, the water supply source for the disaster housing complex should be taken from the existing water distribution system. If the distribution system is not operational, water can be pumped from a nearby stream until the existing system can be repaired. The damaged water supply will be repaired quickly after a disaster since it represents a major source of disease if left alone.

In rural areas where individual wells are used as a water supply, site selection for the housing project must be made with the water supply uppermost in mind. A location near a clear stream or lake is usually preferred, since individual household wells will probably not be able to supply 100 mobile homes.

In summary, use of existing water supplies is recommended. If no existing public supply is available, a surface source should be developed.

4. WATER TREATMENT

a. General

With the use of an existing water supply, raw water quality will probably be adequate. However, since disaster housing must be able to meet any contingency, a treatment and storage system must be provided. The treatment unit must be capable of taking raw water from streams, lakes or contaminated distribution systems and producing a stable water meeting USPHS standards. The basic processes of water treatment are aimed at removing particular objectionable characteristics of the raw water supply. These processes are coagulation, settling, filtration, carbon adsorption and disinfection.

Certain chemical constituents in a raw water supply can make treatment almost impossible. The chemicals listed in Table 47 are among these untreatable constituents.

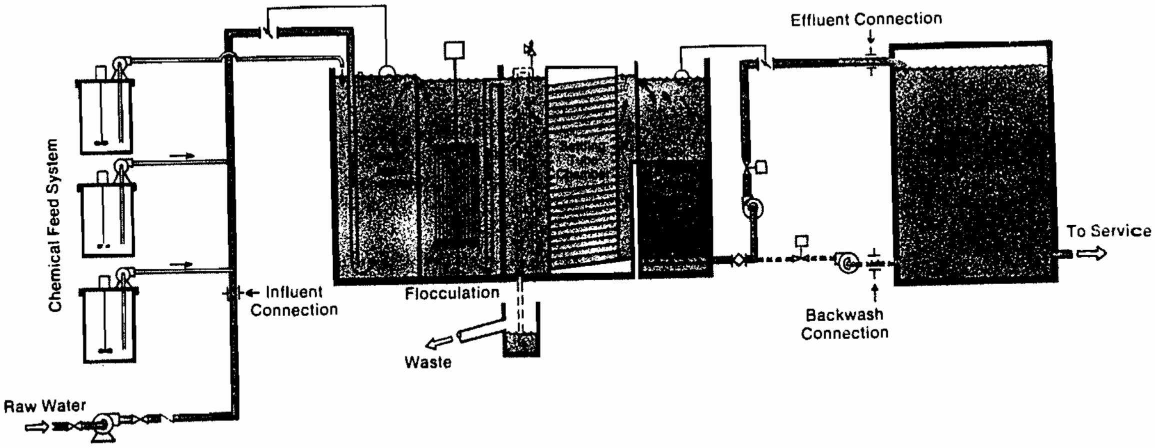
Since the source and quality of raw water supply cannot be known, water treatment for the disaster housing will be assumed to require coagulation, sedimentation, filtration and disinfection, with activated carbon as an optional addition. The treatment plant must be mobile to make it easier to erect. Treatment processes selected for the plant are all readily available, commercially produced operations and should be pre-packaged. The plant should operate on a continuous basis and treat the average flow, with variation in flow taken up by a storage tank. The average design flow of 28,000 gpd is equal to a flow rate of about 20 gpm.

b. Design, Water Treatment

The Neptune Company manufactures self-contained water treatment plants called "Water Boy" in capacities of 10, 20, 60 and 100 gpm. In this system, raw water is pumped from the supply to a mixing chamber as shown in Figure 75. Chemicals are added to the discharge of the supply pump and are rapid-mixed in the first chamber. This chamber overflows into a slow mix flocculation chamber and out into a settling compartment. The settling

FIGURE 75

"WATER BOY" PACKAGED WATER TREATMENT PLANT



Source: Neptune Company.

compartment is fitted with a device called a tube settler which increases the efficiency of clarification and reduces the size of this compartment. The clarified water overflows the settling chamber into a gravity, mixed media filter for further solids removal. The solids removed from the settling compartment are allowed to thicken and are drawn off to be wasted. The filtered water is pumped to a storage tank which acts as a reservoir for backwashing the filter.

The treatment unit consists of the basic mixing chambers, settling tank and filter. The storage facility is a separate tank, as are the chemical feed systems. This allows flexibility in setting storage requirements and types and number of chemicals to be added. Disinfection is accomplished by adding sodium hypochlorite at the beginning of the unit along with the coagulation chemicals. The only connection required is from the raw water supply to the distribution system and from an electric supply to the system.

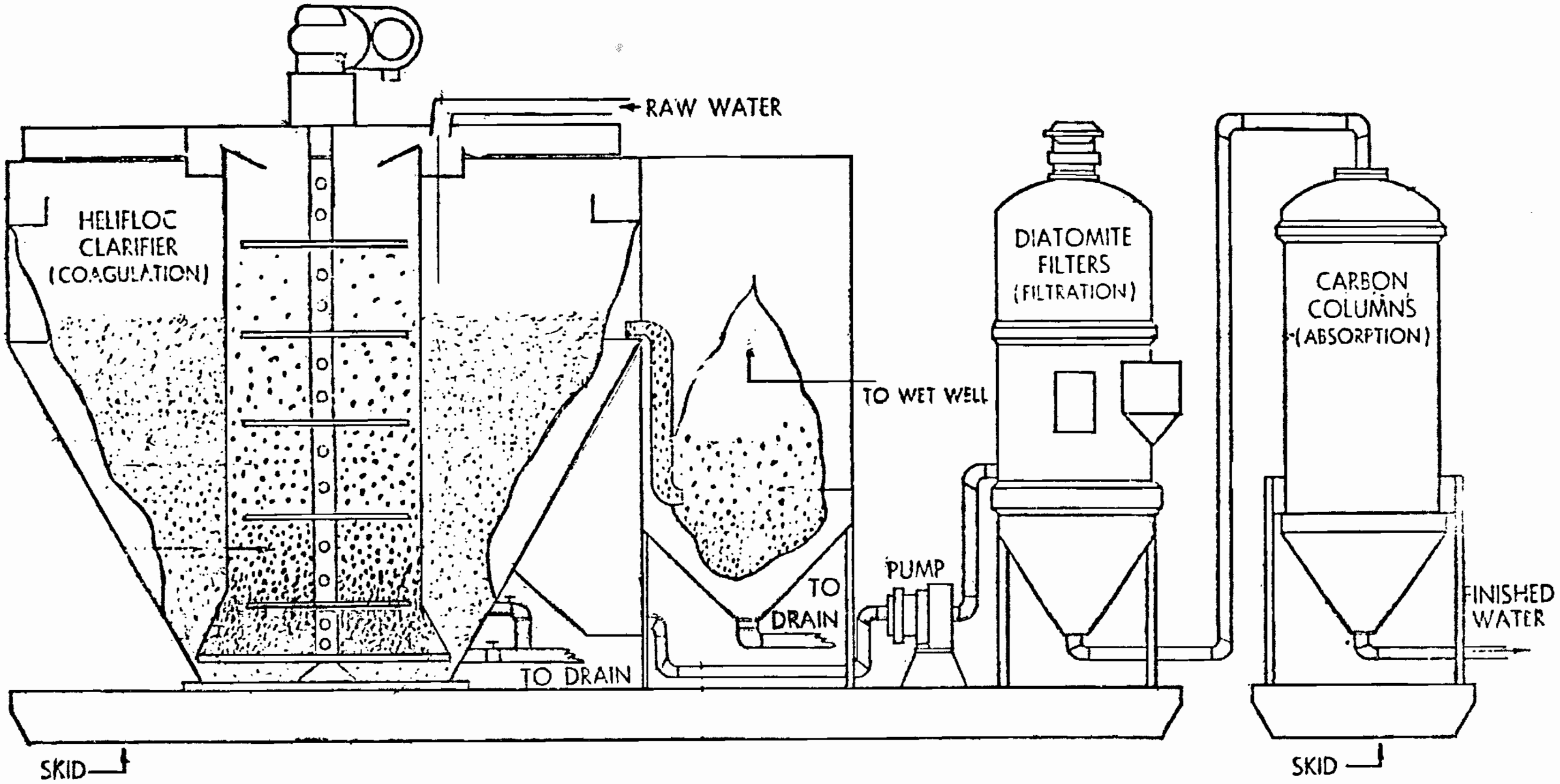
The 20 gpm package for a 100-unit mobile home requires a 30 amp, 120/240V, single-phase electric service. This is readily available throughout the country and is small enough to operate from a portable generator. The unit weighs 3,500 pounds in shipment with an overall operating weight with water of 11,000 pounds. The basic unit is 5'10" long, 4'8" wide and 6'10" high. The chemical feed tanks are each 2'6" in diameter and handle enough chemicals for a single day's treatment. Controls are all automatic, requiring only a single daily visit by one man to mix the next day's chemicals. Since the chemical feeds are separate from the main package, larger storage tanks can be adapted. This would provide operations of longer than one day and relieve the need for daily attendance. A seven-day supply of chemicals requires 200-gallon tanks which are 3' in diameter by 4' high, or 2.5' diameter and 5.5' high.

The Neptune unit has no activated carbon filtration. However, since the effluent is pumped to storage, carbon columns from another manufacturer can easily be added to the plant.

A second package water plant is manufactured by Met Pro Systems. Called "Helifloc," this unit consists of a flocculator-clarifier unit followed by diatomite filters and optional carbon absorption columns. A schematic drawing of the unit is shown in Figure 76. Chemicals are added with the raw water at the center of the clarifier.

FIGURE 76

"HELIFLOC" PACKAGED WATER TREATMENT PLANT



Source: Met Pro Systems.

The raw water is aerated before entering the center by cascading over plates at the top of the unit. As floc particles form in the center, they flow to the bottom of the clarification section of the unit. This section is an upflow solids contact clarifier where a blanket of chemical floc is maintained at the bottom of the clarifier so that the raw water must pass through the solids, thereby being filtered along with plain settling. The clarified water is drawn to a small storage well where it is pumped into pressure filters. The sludge from the clarifiers is drawn into a thickening section to concentrate prior to disposal.

The diatomite filters work by coating a screen with a slurry of diatomaceous earth which acts as a very fine filter. The water is then applied at high pressure to the media until the backwash cycle, which discharges the diatomaceous earth, discharges the spent material to the clarifier and applies a new pre-coat. The backwash cycle utilizes only five gallons of water and takes 10 minutes. The optional carbon filters are connected to the end of the diatomite filters using the pressure at the outlet. Treated water is then pumped to storage or distribution.

The Helifloc unit supplied to the U.S. Army comes in 10, 25 and 50 gpm capacities and is skid mounted for complete mobility. The chemical feed systems are on the skid, but the Army unit provides only one-hour chemical storage. This would require modification to be suitable for disaster housing.

Both packaged plants described can be operated with minimal attendance if chemical feed storage is increased. Both will produce high quality drinking water from suitable raw water. The unit processes are those traditionally used in modern water treatment plants but are more advanced in some respects because of their small size.

These two plants are not the only ones manufactured nor necessarily the best. But they illustrate the availability of commercially produced and marketed package water treatment plants which provide the unit processes needed to produce safe, high quality potable water from raw water supplies.

To be practical for rapid mobilization and installation in a disaster, staging, transportation and set-up time and cost must be planned for and optimized. The water treatment plants are small and light enough for easy transportation by highway or rail. But several other factors should be considered in establishing design and usage criteria:

(1) Pre-Purchasing

These units are not "shelf" items and the normal lag time between contract and delivery is at least 12 to 14 weeks. Although this period might be shortened somewhat, delivery time will still be unsuitable for rapid deployment. Therefore, water treatment units must be pre-purchased and staged for deployment.

(2) Housing

The electrical equipment must be housed to afford protection from weather during storage and operation. Chemical storage tanks must be protected during operation, but not in storage. When operating in northern parts of the country, the entire treatment plant must be housed and heated when operating to protect against freezing.

The most cost-effective way to meet these requirements is to build the units with a protective heated van enclosure, as Met Pro does for the Army. These units are then ready for transportation and set-up, with little work needed at the site. A van-mounted unit in operation will weigh about 18,000 pounds, so that soil pressures resulting from jacking on plates can easily be reduced to 600 to 1,200 lbs./sq. ft., suitable for all but the poorest soil.

A space heater and insulation should be specified to provide inside temperatures of at least 50^{o}F at an outdoor temperature of -10^{o}F. Inside walls and floor of the van should be resistant to deterioration in a damp environment.

The van should be designed so that the entire unit can be removed by sliding and should have a man-door as well. A removable stairway can also be provided.

Design specifications should include a lifting mechanism for raising re-supply chemicals from the ground to the level of the van floor. The type of mechanism found on moving vans would be suitable but provisions should be made for it to operate on an AC power supply. A capacity of one ton should be sufficient.

5. STORAGE AND DISTRIBUTION

Treated water is produced at a constant rate 24 hours a day at average flow. As Figure 73 shows, water use fluctuates throughout the day, so some means is needed to store water during periods of low consumption for use during peak hours. The size of a storage facility depends on relative magnitude of the peak flow, use of storage water and duration of greater than average flows. A flow of 150 gpm was selected as the peak hourly flow which will occur in the morning with a lesser but longer peak in the evening. Between midnight and 6 a.m., the flow from the storage tank is about zero.

The storage tank must fill during the night at a rate of 20 gpm. It must be full by the morning and almost full for the evening. The storage tank must also be able to provide backwash water for the treatment unit.

The minimum storage required is that which can be filled in the six hours of zero night flow. For an average inflow of 20 gpm, this is 7,000 gallons or one-fourth the daily use. For the emergency system, a 10,000-gallon storage tank is recommended. A circular tank of this capacity is 12' in diameter and 14' high. Since rapid assembly and mobility are essential, a wood stave tank in a water resistant wood like redwood would be best. These tanks can sit on grade with no linears and are easily bolted together in the field with 15 steel hoops. When wet, the wood expands to form a watertight tank. The advantages of wood tanks over steel or concrete are low initial cost, ease of storage and transportation, rapid assembly and short useful life. The structure can be discarded after several brief uses or dismantled and stored for re-use. The 10,000-gallon tank costs $2,000 plus assembly.

The distribution system will consist of 3/4" diameter connections to the housing units from a loop running through the site. The size of the water main depends on the layout of the homes. If the units are arranged in a circular or rectangular pattern, the main will be 2,000 feet long. With a peak flow of 150 gpm, a 4" main should be used. The pipe should be made of plastic, due to its low purchase cost, light weight and ease of installation. PVC pipe, Schedule 80, will meet most local codes for water supply and has a rating of over 300 psi working pressure. This pipe is supplied in 20' lengths and is coupled with solvent welded joints. A 3' to 4' cover will usually protect against freezing.

This pipe could be pre-purchased and stored in the van containing the water treatment plant. One hundred lengths (2,000' of pipe) will occupy a space of 2'6"x7'.

6. PUMPING

Water must be pumped at two points in the system. The raw water must be pumped to the treatment area, and treated water must be pumped after storage, to pressurize the distribution system.

a. Raw Water Pump

The pump must be able to deliver 20 gpm under varying conditions and must be self-priming. An electrical supply will be available but a gasoline motor or a portable generator might be provided.

It has been assumed that the pump will be located at an elevation where total suction lift (static plus friction losses) is less than 15' to 20'. Discharge static lift (elevation difference between pump and plant) would be no more than 100'.

The pump should be specified for outdoor, weatherproof operation and could be mounted on a two-wheeled buggy. For security reasons, lockable housing should be installed over the pump. The pump is 12" high and 18"x8" in length and width. It weighs 150 pounds.

Pump discharge piping should be 2" diameter. Schedule 80 PVC pipe is satisfactory. Pipe should be laid deep enough to avoid freezing.

Suction hose can be used for withdrawing raw water. Placement of this hose will depend on site characteristics, but it should be positioned so sediment is not sucked off the bottom of the water body. Freezing and tampering -- two potential hazards -- could be avoided by installing the suction line near or on the water body bottom and burying the onshore portion.

The raw water pump should be provided with a duplicate unit, so that supply will not be lost in the event of service pump failure.

b. Pressurizing Pump System

The pressurizing system must be able to provide a widely fluctuating demand rate of flow -- from zero to 150 gpm -- at a relatively constant pressure at the housing unit connection, from a minimum of 30 psi to a maximum of 60 psi. Two pumping systems can provide the service: a hydro-pneumatic system and an in-line pump with variable speed coupling.

(1) Hydro-Pneumatic System

The hydro-pneumatic system uses a sealed tank partially filled with water and overlain by air to provide pressure. As water is withdrawn from the tank, the air under pressure expands, resulting in a loss of pressure. When the lowest desired pressure is reached, a water pump turns on, supplying the tank until the air is compressed to the maximum desired pressure. At this point the pump shuts off.

For the 100-unit housing site, a 2,000-gallon tank is needed. Such large tanks are usually cylindrical, with the long dimension laid horizontally. However, this tank must be protected from freezing and it should therefore be installed in the van with the water treatment plant. A squat cylindrical shape (7' diameter, 7' high) or a rectangular solid shape (7'x5'x7' high) could be used. This tank would weigh 8,000 pounds in operation but most soils could accommodate this weight.

This system also requires a pressurizing pump and an air compressor to make up for the pressure tank air dissolved in the water. Both items are standard, and should be installed in the van and the tank. Piping connecting the storage tank to the treatment plant and the pressurizing system must be protected from freezing. A duplicate pump should be provided in case of equipment failure.

Although space consuming, the hydro-pneumatic tank uses fairly standard equipment with a rather simple control system.

(2) In-Line Pump, Vari-Speed Coupling

This pressurizing system was developed primarily for large urban buildings to eliminate large roof storage tanks. It consists of a normal centrifugal pump with a fluid drive coupled to a constant speed motor. A pressure sensing device on the pump discharge pipe, with pre-set limits, controls the fluid drive. This way the pump rotational speed can be varied without varying motor speed. This system is compact, since no tank is required for pressurizing. But the control system is more sophisticated than the tank system. A duplicate pump should be provided in the van or near the storage tank.

7. COST ESTIMATE, PRIMARY ALTERNATIVE

A preliminary cost estimate has been made for the water supply system described above. Approximate costs are shown for providing a water supply system to the 100-unit housing complex.

a. Capital Cost

The following assumptions have been made:

- Equipment costs -- Current prices.
- Installation costs -- ENR Index: 2100.
- Contingencies -- 15%.
- Engineering -- None.
- Water supply source -- Conventiently developable.
- Water treatment -- Not requiring activated carbon.
- Water supply pressurizing -- Hydro-pneumatic system.
- Water main requirements -- 2,000' of 4" diameter PVC.
- Staging and transportation costs -- Not included.

Based on these assumptions, Table 48 gives a breakdown of the estimated capital cost. Costs per unit are high compared with developed areas of the United States. This reflects primarily a lack of economy of scale, since the population served is low.

b. Operating Cost

Operating costs associated with the system include power, chemicals and operating and maintenance labor. The following assumptions have been made to arrive at an estimated operating cost:

- Total installed horsepower -- 10.
- Electricity cost -- $75/HP/yr.

TABLE 48

CAPITAL COST OF WATER TREATMENT AND SUPPLY SYSTEM FOR 100-UNIT EMERGENCY HOUSING COMPLEX

	Material Cost	Installation Cost	Total Cost
Intake	$ 500	$ 500	$ 1,000
Supply Pump	400	500	900
Supply Pipe	1,250	4,750	6,000
Treatment Plant	37,000	1,000	38,000
Pipe to Storage	100	200	300
Tank	2,500	1,500	4,000
Piping from Storage	100	200	300
Pressure Pump	5,700	1,000	6,700
Dist. Valves	400	400	800
Dist. Piping	8,000	16,000	24,000
Connections	3,000	7,000	10,000
Electrical Connections		2,000	2,000
SUBTOTAL	$58,950	$35,050	$ 94,000
Contingencies @ 15%			14,000
TOTAL COST			$108,000
Cost per Unit			$ 1,080

- Chemical dosage -- chlorine: 1 ppm.
  alum: 30 ppm.
- Chemical cost -- chlorine: $.20/lb.
  alum: $.10/lb.
- Operating labor time -- at site: 2 hr./day.
  travel: 1 hr./day.
- Maintenance labor time -- 8 hr./2 wk.
- Labor cost -- $10/hr.
- Administration costs -- Not included.

Total operating costs are shown on Table 48 .

TABLE 48

OPERATING COST OF
WATER TREATMENT AND SUPPLY SYSTEM
FOR 100-UNIT EMERGENCY HOUSING COMPLEX

Item		Cost Per Day
Power		$ 2.10
Chemicals		.75
Labor		
Operating		30.00
Maintenance		6.00
	TOTAL	$38.85
	or approximately	$40.00

c. Total Cost of Water

To compare this system with an alternative method, capital and operating costs must be combined and expressed on a unit basis. To accomplish this, it has been assumed that the entire capital cost of the system will be written off in one year, with no interest charges. Table 50 presents the total water system cost.

TABLE 50

TOTAL SYSTEM COST OF WATER TREATMENT AND SUPPLY SYSTEM FOR 100-UNIT EMERGENCY HOUSING COMPLEX

Item	Cost Per Day
Capital	$300
Operating	40
TOTAL	$340
Total Per Unit	$ 3.40
Total Per 1,000 gallons	$ 12.10

The cost per 1,000 gallons is high compared with that for most public supplies in the United States, which is rarely greater than $1/1,000 gallons. Rapid write-off of capital expense and poor economy of scale account for this.

8. ALTERNATIVE WATER SUPPLY SYSTEM

The main alternative to the system described above is to supply water by hauling from an outside source. Such a supply could be used with several variations:

- Each housing unit could have its own storage tank and pressurizing system. Water would be delivered to each individual unit.

- The storage and pressurizing system could be identical to that in the primary alternative, with water hauled to the central storage tank. The trucked supply would be a substitute only for the raw water intake and treatment plant.

- The trucked supply could be used only for a very short time -- maybe less than a month -- until an existing system was repaired.

- The disaster might be very small, requiring less than 100 homes.

- The trucked supply could be used in conjunction with housing units specifically designed for water conservation. These units might include low-water-use toilets and showers with water-saving fixtures. Water consumption could thus be reduced dramatically, with significant savings resulting. The trucked supply is very high in operating cost and, unlike the primary alternative, the cost per housing unit is very sensitive to water consumption.

a. System Design

To compare this system with the primary alternative, a 100-unit housing complex and an average daily water consumption of 28,000 gallons will be assumed.

(1) Storage and Pressurizing System

Each housing unit could be provided with a storage tank and pressurizing (hydro-pneumatic) system consisting of a pump and pressurizing tank. The storage tank could be almost any size, but a 500-gallon tank would be best. It would have to be re-supplied every one to two days, and it would be 66 cubic feet -- 4' in diameter and 6' high.

To protect it against freezing the system could be designed as an integral part of the housing unit. Or it could be designed as a separate module and stockpiled separately to increase its flexibility.

This module should be located near the water truck and should be protected against contamination. It should not be placed too close to a tank used for sewage storage and it should be relatively vandal-proof. Fittings on the tank should make it easy to supply it, since labor time involved in delivering the water from the truck to the home must be minimal.

(2) Water Supply

It is assumed that a safe supply of potable water will be available near the housing site. This should be an operating public water supply, either undamaged by the disaster or quickly restored to service. Otherwise, this system would be as costly as the primary alternative.

(3) Hauling Vehicle

To protect public health, FDA-approved trucks must be used to haul potable water. These trucks are stainless steel and should hold 5,000 gallons.

The cost estimate for this supply method is based on figures supplied by a commercial tank truck leaser.

b. <u>Operation</u>

The following operation schedule is proposed for the delivery of 5,000 gallons of water:

- Pick up water at treatment plant, pumped at 200 gpm, plus connecting hoses, etc.	30 minutes
- Drive 10 miles, at average speed of 20 miles an hour	30 minutes
- Deliver water to houses, at average delivery volume of 350 gallons: 15 homes at 10 to 15 minutes per home	180 minutes

- Drive back to treatment plant, as per (2)	30 minutes
TOTAL TIME	270 minutes
or	4.5 hours
or approximately	4 hours

Thus, in an eight-hour day a driver could make two deliveries of 5,000 gallons each. Three driver shifts per day, including weekends, would be required to supply the 100-unit housing complex.

c. Cost Estimates

The individual unit tank and pressurizing system could be installed for $500 to $600, excluding the cost of housing equipment. For the 100-unit complex, the cost is almost identical to that of the primary alternative.

The following prices were quoted for a commercially supplied tank, truck and driver:

5,000-gallon tank on trailer	$50/24-hr. day
Driver plus tractor	$16/hr.
Haul surcharge, minimum charge for up to 25 miles, one way	$112

The cost of purchasing the water at the treatment plant has been assumed to be $.25/1,000 gallons, but this cost is negligible compared with the other costs.

Assuming that the drivers work only the day shift, the cost to deliver 10,000 gallons is thus:

Truck rental	$ 50
Driver and tractor ($16/hr. x 8 hr.)	128
Haul surcharge ($2 x 112)	224
	$402
Cost per 1,000 gallons	$ 40
Cost per day per unit	$ 11

Using a one-year write-off of the capital cost of the individual storage and pressurizing systems -- $500 per year or $1.40 per day per unit -- the total cost is:

Capital write-off: $ 1.40/day/unit = $ 5/1,000 gallons

Operating cost: $11.00/day/unit = $40/1,000 gallons

TOTAL COST $12.40/day/unit = $45/1,000 gallons

The cost of this system for a full year's operation at 70 gallons per capita per day and 100 units is thus 3.6 times that for the primary alternative. (See Table 72.) If some conditions are changed, however, the cost of this method might be more competitive with that of the centralized system. For example:

- If water consumption is reduced by one-half, the cost per unit would be reduced to $6.90/day/unit -- a 45% reduction of the cost at normal water usage. The cost of the central system is relatively insensitive to flow. It is estimated that a one-half reduction in flow will result in only a 10% to 15% reduction in total cost, to $3/day/unit. The trucked supply is then 2.3 times as expensive.

- Using the same terms for capital write-off weights the results in favor of the centralized system. However, large portions of the centralized capital cost are unrecoveragle, whereas individual units are fully recoverable at minimal cost. Thus, in a temporary installation of a few months, using that period for write-off of the centralized system will make the trucked supply more economical. Assuming a two-month use of each system, and writing off all non-recoverable items in the centralized system in that two months, the comparison becomes:

	Central System gallons/capita/day		Truck Supply gallons/capita/day	
	70	35	70	35
Capital	$550.00	$550.00	$ 0.00	$ 0.00
Capital write-off per day	$ 9.00	$ 9.00	$ 0.00	$ 0.00
Operating per day	$ .40	.38	$11.00	$ 5.50
Total per day	$ 9.40	$9.38	$11.00	$ 5.50

Thus, the cost-effective response to a disaster will depend on how long the emergency water supply is used.

- With fewer than 100 units, the trucked supply will gain in cost-effectiveness, since its cost is not sensitive to number of units supplied. The central system, however, becomes significantly greater in unit cost as the population served decreases.

In summary, if a disaster will be brief and involve fewer than 100 units, housing units with individual water systems and water-saving plumbing features might be advisable.

C. WASTE TREATMENT SYSTEMS

1. PRIMARY ALTERNATIVE - CENTRAL SYSTEM

a. General

The waste treatment system for an emergency housing complex must provide satisfactory treatment of waste waters directed to the system. The capacity of the system should be equal to 90% of the water usage, due to losses normally occurring between water consumption and sewering.

The degree of treatment provided to the waste water depends upon the assimilation capacity of the receiving stream. The treatment system must be adaptable for discharge to major rivers or to intermittent stream beds which would be dry for long periods.

Any disaster requiring emergency housing for 100 or more families will place a severe burden upon community resources, particularly trained personnel. Therefore, simplicity of design, construction and operation are essential.

The following elements of design and operation must be considered for an emergency waste treatment system:

- Required degree of treatment.

- Pumping facilities.

- Reliability of treatment.

- Capacity requirements.

- Processes.
- Solids (sludge) disposal.
- Power supply.
- Material supply.
- Operational requirements.
- Sewers and collection system.
- Staging, transportation and installation.

These elements are discussed in the following sections.

(1) Required Degree of Treatment

The degree of treatment required for a specific location would be established by the state or federal agency having jurisdiction or by the Environmental Protection Agency (EPA) under provision of the 1972 amendments to the Water Pollution Control Act. Any treatment system should provide secondary treatment as defined by the EPA, since any lesser treatment would violate the provisions of the 1972 amendments.

An emergency housing complex should be located so as to permit gravity discharge of waste waters to an existing sewer system. If this is not feasible, it may be possible to pump to an existing system. In such a case, the emergency treatment facility would consist of only a pumping station. with necessary appurtenances. But it may be difficult to establish necessary pump characteristics, since the static lift and the length of force main will control pump design.

If no existing sewer system is available, a complete waste treatment system must be provided -- either a permanent installation or a temporary one lasting one year. A permanent system would have permanent, portable tankage designed for a long service life, along with equally durable equipment. This unit could be reclaimed, refurbished as necessary and returned to storage if the housing complex were abandoned. It would thus be a permanent investment in disaster relief equipment. The temporary unit would be designed partially for a relatively short service life, but some equipment would be relatively durable. Salvagable units may then be stored for reuse.

The emergency housing complex can generally be located near water for which secondary treatment would be sufficient. Thus, the best basic treatment system would be a secondary treatment plant with a daily capacity of 25,000 gallons.

But such a location may not be possible. It may be necessary to consider discharge to an intermittent stream which would be dry for long periods. Therefore some tertiary treatment units should be available. One-third or one-fourth of the secondary units should have a tertiary unit available and some secondary units should be equipped with tertiary treatment devices. Such a secondary-tertiary unit could be used for either secondary or tertiary treatment by provision of a dual connection to the effluent line.

In summary, degree of required treatment will vary -- the minimum would be secondary treatment, the maximum tertiary treatment. Most locations will require secondary treatment; only a few will need tertiary treatment. But combination secondary-tertiary units may be used to provide either type of treatment. If a secondary treatment unit is installed in a location where tertiary treatment is required, a tertiary treatment unit can be ordered and installed quickly.

(2) Pumping Facilities

Pumping facilities for emergency treatment systems are of relatively small capacity and can normally be obtained quickly and easily. In general, the static lift and the dynamic losses in the force main cannot be established without knowledge of specific site conditions. The best type of pumping installation for small amounts of waste water consists of two submersible pumps of equal capacity installed in a standard precast manhole. Guide rails would be installed in the manhole, with the pumps mounted to permit lowering or raising them. The pumps would be connected to the force main by a special fitting. The pump is controlled by means of "balloon" floats incorporating mercury switches with the floats supported by the electric cable. The normal float control installation includes a start float for each pump, a float to indicate high-water level in the event of pump failure and a double-switch float to stop both pumps.

Electrical controls are located adjacent to the manhole serving as the wet well. The electrical panel is frequently located directly on the power pole serving the installation. These submersible pump installations are economical, practical and normally available from the stock of any large sewer system.

It will also be necessary to provide pumping facilities, since emergency installation can be most effective and practical if the treatment unit is placed above grade. It will invariably be necessary to pump to the emergency treatment unit; pumping equipment should be included as an integral part of the treatment system. A typical system might have a sewer system which discharges 6' to 8' below grade to the wet well, a wet well 16' in depth with pumping lift ranging from 22' to 28' static lift and an additional 5' to 10' of head for hydraulic losses.

Pump controls for the pumping installation serving the treatment plant can be incorporated in the electrical control panel for the plant itself. This will minimize complications with the main power supply connection. Pumping station control panels incorporating all the control devices and interconnecting wiring could be stored, leaving only major power wiring to be installed on short notice. This would sharply reduce the lead time required to install a pumping station of specific and unusual capacity.

In case of power failure, the wet well of the station could fill in minutes. Failure to restore pump operation would result in flooding of the sewer system. A standby power supply should be provided for permanent installations. A standby power supply for an isolated pumping station would consist of a separate engine-generator set, arranged to provide local power whenever required. However, standby power supplies should not be included in the emergency equipment stock, since it could easily be installed if it were determined that a treatment facility was to be permanent.

(3) Reliability of Treatment

The capacity of the system proposed to serve 100 mobile homes is 25,000 gallons per day. With more homes, additional treatment units would be provided. Each unit is designed to operate independently and no redundancy or duplication of tankage is needed. However, all operative equipment like blowers and pumps should have full capacity standby equipment. Thus, when two plants are located on the same site and the air supply piping, for example, interconnected, the dual-unit plant would have additional redundant equipment.

A treatment system with an average daily capacity of 25,000 gallons seems appropriate. There must be allowance for the fact that a system serving so few people is subject to extremely high peak flows. However, the actual peak rate of delivery to the process will be the discharge rate of the pumping station. Thus the extreme peak flow rates of the water supply system would not appear at the treatment plant. The design of the proposed water supply system provides for a peak flow capacity of 7.5 times average flow. A somewhat lesser peak flow capacity should be provided in the waste water treatment system, due to the attenuation of extreme peak flow rates in the sewers and pumping station. However, the ratio of peak to average flows affects selection of the treatment process, since it would be best to select a process which incorporates some storage in the process to further attenuate peak flows. Thus while a treatment system can be designed with minimum tankage volume, it should be designed to take peak flow into consideration. As the storage volumes in the system increase, major elements may be designed for flow rates more closely approximating average flows.

Furthermore, as the capacity of the treatment system is increased, a relatively long peak flow is needed to upset the process. Thus, selection of a treatment process incorporating large tankage volumes reduces the danger due to peak flows.

(4) Treatment Processes

The proposed treatment systems would make use of prefabricated "package" plants and standard equipment. A "package" plant was considered to be pre-engineered, factory-built and of modular size.

The provision of inexpensive tankage for the temporary plants has also been considered, since the tankage could be abandoned once the plant was removed. However, the basic processes for both permanent and temporary plants would be about the same. Secondary processes are based on biological treatment and tertiary processes are based on physical-chemical treatment.

(a) Biological Treatment

Several biological treatment processes can be applied to package waste water treatment for the capacity under consideration. These include extended aeration activated sludge and other biological processes such as conventional activated sludge, complete mix actuated sludge, contact stabilization and fixed film biological reactors.

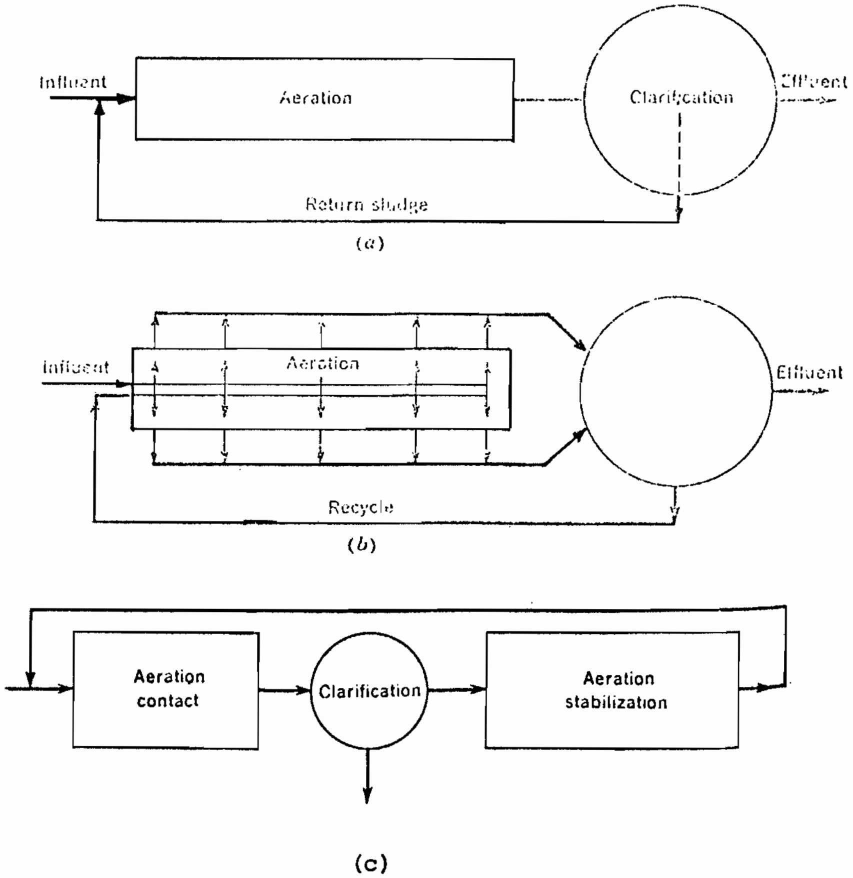
i. Extended Aeration

The extended aeration process flow diagram is shown on Figure 80. The general design elements are:

Raw sewage characteristics	BOD	- 300-400 mg/l
	S.S.	- 300-400 mg/l
Food to micro-organism ration (F/M) lb BOD/lb MLVSS/day		0.05 - 0.15
Volumetric Loading lb BOD/1,000 cu. ft./day		10-25
Mixed liquor suspended solids mg/l		3,000 - 6,000
Hydraulic detention time-hr.		18 - 36
Sludge recycle ratio		0.5 - 1.5

FIGURE 80

SCHEMATIC WASTE WATER TREATMENT METHODS



(a) Conventional Plug Flow Activated Sludge and Extended Aeration.

(b) Complete Mix Activated Sludge.

(c) Contact Stabilization.

The waste undergoes a significant period of aeration resulting in a relatively low loading rate. This long detention time in the extended aeration system results in a stable process with respect to waste variability. The long detention time also causes solids to undergo some degree of endogenous respiration. This results in lower amounts of sludge for disposal than in other activated sludge processes.

Under optimal conditions, extended aeration can produce an effluent carrying 15 mg/l of BOD and 20 mg/l of suspended solids. Under normal operation, the plant will produce an effluent of less than 20 mg/l of BOD and less than 40 mg/l of suspended solids. Thus, a filtration step is necessary to meet intermittent stream criteria, but not to meet the EPA standard for secondary treatment.

Extended aeration has the advantage of effecting ammonia nitrogen removal. Under optimum conditions, less than 2 mg/l of ammonia have been observed with the effluent normally less than 10 mg/l.

Nitrification is effected by bacteria according to the following reaction:

$$NH_3 + 2O_2 \text{ bacteria } NO_3^- + H_2O + H^-$$

These bacteria are slower growing than bacteria which metabolize carbon and are subject to washout if the process is upset hydraulically. Nitrifying bacteria are also extremely sensitive to temperature. Optimum temperatures for nitrification are between 28^o and 32^oC.

Nitrification ceases below 5°C. One method of overcoming the effects of low temperature is to increase the mixed liquor concentrations. A 40% increase in the MLVSS from 2,500 to 3,500 should increase the rate of nitrification by 25% to 30%.

Skimming facilities are required but should not be operated continuously. Continuous operation can cause vertical velocity gradients which can result in solids carryover. Scum problems can be aggravated by too much air; 2,600 cubic feet of air per pound of BOD is appropriate.

The shape and design of the aeration tank should maintain effective mixing, minimize dead spots, prevent deposition of solids and prevent short circuiting. Standby blower units should be installed. The drop-off pipes in the aeration tank should be easily removable and equipped with individual shut-off valves.

The design of the final settling tanks is critical and should meet applicable standards. For the 25,000 gpd modular unit, the surface overflow rate should be no greater than 300 gallons per day per square foot.

The maximum surface overflow rate at peak flow should not exceed 1,000 gal/day/sq. ft. Baffles should be provided at the inlet and outlet of the clarifier. The outlet should consist of an overflow trough equipped with an adjustable weir. The weir overflow rate should not exceed 2,500 gpd/linear foot average flow, or 7,500 gpd/linear foot on a maximum flow basis.

Sludge recycle capacity should be based on a return rate of at least 100% of the average daily flow with a variable adjustment and control of the return rate. Airlift sludge return is preferred.

Scum skimming equipment should be provided, along with froth and foam control equipment. For permanent plants, flow should be indicated, recorded and totaled. Temporary plants could be operated without flow metering equipment. On-site sludge handling facilities should be provided, consisting of an aerobic digestion system with a tank capacity of 10% of the daily flow rate. The design elements for an aerobic digestion system are:

Sludge residence time - days	12-30
Solids loading Lb vol. solids loaded/ft^3/day	0.1-0.2
Oxygen required lb. 0 /lb. vol. solids destr.	1.6-2.2
Energy requirements Mechanical aeration hp/1,000 cu. ft.	0.5-1.5
Air mixing Scfm/1,000 cu. ft.	20-40
Dissolved oxygen level, mg/l	1-3
Volatile solids reduction	36-50%

The plant piping system should be able to divert some or all of the return sludge to the aerobic digestion system or to the aeration tank. Sludge should be sent to the digestion system when the mixed liquor solids reach a high level, usually between 4,000 to 6,000 mg/l. The frequency of removal can range from once every two weeks to once every four months.

Sludge should be collected from the aerobic digestion system when the digestion tank is full. The sludge can be spread on sludge drying beds, disposed on land in liquid form or processed at a large municipal sewage treatment plant.

ii. Other Biological Processes

Other available processes include conventional activated sludge, complete mix activated sludge, and processes in which biological treatment cultures are supported on fixed media.

The activated sludge process is not appropriate here, since it normally requires primary settling tanks and much more sophisticated operation. The increased costs and complexity make this process inappropriate.

A complete-mix activated sludge process could also be used. However, many states limit such a plant to those requiring treatment of more than 2,000 pounds per day of BOD; the proposed plant would treat 80 pounds per day. Thus, the complete-mix activated sludge violates some state standards.

The contact-stabilization process requires careful attention to sludge loading and wasting rates and is not resistant to shock loads. In addition, physical/chemical treatment would be required as a tertiary step and such treatment is not considered suitable for the disaster situation. Therefore the contact-stabilization system is not considered further.

Biological processes which use fixed media for support of the biological culture provide no significant advantage and would present various problems if used with a small plant. They were therefore considered unsuitable for disaster use.

(b) Physical/Chemical Treatment

The following tertiary treatment processes were reviewed:

UNIT PROCESS	APPLICATION
Filtration	S.S. Reduction
Activated carbon	Soluble Organic Reduction
Coagulation and settling	BOD, S.S. and PO_4 Reduction
Breakpoint chlorination	Ammonia Nitrogen Reduction

Three processes require chemicals to perform properly. Generally, it is not desirable to use unusual chemicals in an emergency treatment facility. Processes using chemicals should be applied only as a last resort when the desired performance can be achieved no other way.

The filtration process is relatively simple. The secondary process effluent is directed to a filter bed composed of sand and/or other granular media. Passing the effluent through the bed removes any fine solid particles which have escaped the sedimentation process.

A major portion of the BOD remaining in the extended aeration process effluent is in the form of fine solids. Thus tertiary treatment by filtration is particularly effective in reducing the BOD and suspended solids of an extended aeration process effluent. Therefore the combination of extended aeration secondary process and filtration tertiary process would provide economy, simple operation and efficient treatment where the effluent must be discharged to an intermittent stream bed.

The tertiary treatment process should be limited to filtration equipment. Such equipment may be arranged for automatic operation and would not require unusual operating techniques or unusual chemicals.

Rapid sand filters and multi-media filters are available in package units. Filter rates of between two and 15 gpm/ft^2 can be used. With stable effluents, a rate of between 10 to 15 gpm/ft^2 can be used. For the plants considered here, a rate of four to five gpm/ft^2 should be used.

(c) Summary, Treatment Processes

The best process for the proposed emergency treatment system is an extended aeration process followed by a filtration process when tertiary treatment is required.

The use of a single treatment process would result in operating simplicity, since relief personnel can be trained to operate the process. Training personnel to operate the process should be part of pre-disaster planning. The recommended processes are also resilient and can accept variations in waste water flow.

(5) Solids Disposal

Disposal of solids generated in the treatment facility is essential. The activated plant sludge process generates solids, consisting of organic cultures which feed upon the waste material in the waste water. Suspended solids in the waste water are also collected in the treatment system. To avoid continuous build-up of solids, sludge must be periodically removed, stored and treated.

Normally, waste sludge in an extended aeration facility is treated and disposed of by an aerobic digestor from which sludge is removed periodically by a scavenger. Aerobic digestion is preferred to anaerobic, since power requirements are small, odor is minimal and no significant operating problems are anticipated.

The sludge storage/digestor unit in aerobic plants is normally equipped with diffused air supply. The stored sludge does not have access to the food supply of the raw waste water. In the aerobic sludge digestor process, organic materials are reduced in volume in the digestor. The clear supernatant liquor from the digestor may routinely be returned to the aeration tankage. Normally, the plant operator turns off the air supply to the digestor, allowing solid material to settle. The supernatant liquor may then be transferred by airlift or by pump to the aeration zone or by gravity to the raw waste pump station. Then the liquor volume may be replaced by additional waste sludge. Periodically, a scavenger truck may remove digested solids.

Several methods are available for final disposal of digested solids: discharge to a larger treatment facility solids processing operation, liquid disposal on land and diversion to a drying bed, among others. Specific techniques will depend upon local disaster conditions. Any method through which solids are digested and rendered stable and inoffensive is acceptable, if state and federal approval is obtained. Solids should not be disposed of on the housing site because residents would probably object.

(6) Power Supply

A power supply to the treatment system should be part of the power supply to the emergency housing complex. Electrical equipment should be designed to use the same type of power supply as the emergency housing.

Three-phase power should be provided for the treatment system, since the electric motor sizes required normally exceed those available for single-phase operation.

Normally, power requirements for mobile homes units would not exceed 120 volts single-phase, 60 Hertz alternating current. Three-phase 208/120 power supply should be adopted for the housing complex, including the water supply and waste water treatment facilities. This way, 120 volts single-phase would be available for housing units and three-phase 208 will be available for the waste treatment and water supply facilities.

Previous disaster experience has shown a shortage of transformer equipment and personnel for emergency installations. Accordingly, the emergency equipment provided should include transformer equipment suitable for pole installation for connection to standard distribution network voltages.

Three-phase power is not always available in rural areas. Selection of housing sites should take into account the problems associated with providing three-phase power supply.

While the treatment facility does not require standby power, enough available generator sets should be provided to serve water supply facilities, treatment facilities and the housing complex. For portable units, separate smaller equipment could be used initially.

(7) Material Supply

The proposed treatment system does not require large amounts of material during operation. The primary requirement is chlorine supplies for disinfection. A moderate quantity of disinfecting chemicals should be stored with the treatment facility to meet initial requirements. Once the housing and the treatment facility are in operation, disinfecting chemicals, lubricant supplies and similar items may be obtained from local suppliers.

(8) Operational Requirements

The extended aeration treatment process requires minimal time on the part of the plant operator. Housekeeping and maintenance should take only one or two hours a day.

Arrangements for an operator should be made right after the plant has been placed in service. Preferably, a treatment plant operator serving a nearby municipal plant would operate the facility. Initially, however, municipal employees will probably be engaged in other relief operations and would not be available. Therefore and operator should be provided for the first month or two. If a local operator is not available, the emergency operator could train a resident of the emergency housing complex to do the job.

(9) Sewers and Collection System

Collection sewers serving the emergency housing complex should be designed to meet normal state and federal sewer standards. Generally, these sewers will be as small as possible. A minimum diameter of eight inches meets normal requirements.

A supply of sewer pipe meeting these standards could be stockpiled with the emergency treatment facility. Plastic pipe might be preferable due to its light weight. But the quantities of pipe required to serve the 100-unit complex are not large, and it might be best to obtain such materials from manufacturers' normal stocks.

(10) Staging, Transportation and Installation

The packaged waste treatment plant recommended is not a "shelf" item, and delivery would take at least 14 weeks. Therefore plants should be pre-purchased and staged for deployment. However, these plants differ from the water treatment plants in certain ways. These differences must be considered in disaster planning.

A major difference is that the waste treatment plants are designed for outdoor installation, with no housing required. Thus storage is simplified. Purchase specifying is also simplified, since no custom fabrication is involved. Stored units might be covered with a waterproof membrane, but no other special provision is needed. Any freezing problems would be minimal.

A second major difference is in the size of the units. The extended aeration plant is much larger than the water treatment plant. The 25,000 gpd unit is 38' long, 12' wide, and 11.5' high (before installation of mechanical equipment). It weighs 23,000 pounds empty, and 275,000 pounds in operation. The aerobic digestor is 8' long, 10' wide and 10' high. Thus the waste treatment system is harder to transport and install.

The plant can be transported by highway, but permits would be needed and overhead clearance might not be sufficient. Two trailers might be required. These units might be staged close to the disaster area.

These units are best installed on grade. Installation on the transporting truck bed is not feasible due to the weight of water. Soil-bearing pressure of the operating unit will be about 800 pounds/sq. ft., so that spread footings should not be required. In permanent installations, these plants are normally installed on concrete pads, but a 6" gravel layer on well-compacted soil should suffice. A crane would be preferable for placing the unit, but the unit can be removed from the trailer by a combination of rolling and dropping. The aerobic digester can be transported separately and bolted to the main treatment unit after unloading.

2. COST ESTIMATES FOR WASTE COLLECTION AND TREATMENT SYSTEM

Preliminary cost estimates have been made for the proposed sewage system. Approximate costs are indicated for the 100-unit housing complex.

a. Capital Cost

The following assumptions have been made:

- Equipment costs - Current prices.
- Installation costs - ENR Index: 2100.
- Contingencies - 15%.
- Engineering - None.
- Sewer requirements - 3,000 feet, 8"Ø A.C.P., 14 manholes.
- House connections - 50' each, 4"Ø.
- Package lift station - Required.
- Degree of sewage treatment - Secondary.
- Discharge to water-course - Convenient.
- Staging and transportation costs - Not included.

Table 51 gives a breakdown of the capital cost estimate. Costs per unit are quite high compared to the water supply system, primarily due to the high cost of installing pipe. Some of these costs might be reduced by such methods as placing units closer together.

TABLE 51

CAPITAL COST ESTIMATE
WASTE COLLECTION AND TREATMENT SYSTEM
FOR 100-UNIT EMERGENCY HOUSING COMPLEX

Item	Material Cost	Installation Cost	Total Cost
Treatment Plant	$37,000	$ 4,000	$ 41,000
Package Lift Station	15,000	5,000	20,000
Pipe - 3,000', 8"Ø	9,000	60,000	69,000
Manholes (14)	4,200	7,000	11,200
Connections - 4"Ø	15,000	40,000	55,000
Electrical		2,000	2,000
Sub-Total:	$80,200	$118,000	$198,200
+ Contingencies @ 15%:			30,000
Total Cost:			$228,200
Cost per Unit:			$ 2,300

b. Operating Cost

Operating costs include power, chemicals and operating and maintenance labor. The operating cost estimate is based on the following assumptions:

- Total installed horsepower : 15
- Electricity cost : $75/HP/year
- Chlorine dosage : 5 ppm
- Chlorine cost : $.20/lb.
- Operating labor - at site : 1.5 hrs/day
  - travel : 1 hr/day
- Maintenance labor time : 12 hrs/ 2 weeks
- Labor cost : $10/hr
- Administration costs : not included

Total operating costs are shown in Table 52 .

TABLE 52

OPERATING COST
WASTE COLLECTION AND TREATMENT SYSTEM FOR 100-UNIT EMERGENCY HOUSING COMPLEX

Item		Cost Per Day
Power		$ 3.10
Chlorine		.20
Labor:	Operating	25.00
	Maintenance	8.50
	Total	$36.80
	(Approximately)	$40.00

c. Total Cost of Sewage System

The total cost of the sewage system has been computed using a one-year, no-interest capital write-off. The result is shown in Table 75.

TABLE 53

TOTAL SYSTEM COST
WASTE COLLECTION AND TREATMENT SYSTEM
FOR 100-UNIT EMERGENCY HOUSING COMPLEX

Item		Cost
Capital Cost, per day		$625
Operating Cost, per day		40
Total System Cost, per day		$665
	day/unit	$ 6.65
	day/gallon	$26.50

The cost per 1,000 gallons is more than double the cost of the water supply, reflecting the one-year capital write-off and the small scale of the system.

3. ALTERNATIVE SEWAGE HANDLING SYSTEM

The exorbitant cost of the proposed sewage system emphasizes the need to investigate alternative water disposal methods. The following possibilities exist:

- Individual treatment units
    - Septic tanks and tile fields
    - Other individual treatment systems
- Waste water hauling, similar to water supply alternative
- Alternative (pressure) collection system

Water-saving plumbing fixtures can be used with any of these alternatives.

a. Individual Treatment Units

(1) Septic Tanks

Costs associated with septic tank systems include piping from the housing unit to the tank, the tank itself and a tile field for effluent disposal. If two housing units are connected to a single 1,000-gallon septic tank, the capital cost of connection and tank is:

Connection for two units	$ 550
Septic tank, installed	475
TOTAL	$1,025

Tile field cost will vary considerably with the local soil characteristics, described here as good, fair and poor. Costs for tile field for two housing units for each soil condition are:

Soil Condition	Perc. Rate (min./inch)	Cost
good	10	$ 600
fair	30	$1,250
poor	60	$2,500

Thus, total capital costs for each soil condition are:

	Soil Condition		
	Good	Fair	Poor
Connection and tank	$1,025	$1,025	$1,025
Tile field	600	1,250	2,500
SUBTOTAL	$1,625	$2,275	$3,525
15% contingencies	240	340	530
TOTAL CAPITAL COST	$1,865	$2,615	$4,055
Capital cost per unit	$ 930	$1,300	$2,000

The operating cost of a septic tank is negligible. Septic tanks are cheaper than the central collection and treatment system, even with poor soil conditions. The entire septic tank system is buried and therefore unrecoverable.

The following are approximate dimensions of the tile field required for two housing units:

Soil Condition	Land Area Required for the Tile Field for Two Units
Good	40'x27' = 1,100 sq. ft.
Fair	50'x41' = 2,100 sq. ft.
Poor	100'x41' = 4,100 sq. ft.

The amount of site specific planning and design would be greater for the septic tank systems than for the centralized system. Percolation tests will have to be performed and each tile field will require survey, design and field layout. This will be more time-consuming and costly than the design and layout of the central system, but the cost should still be competitive with the centralized system.

If the percolation rate is greater than 60 minutes per inch, most local and state codes prohibit septic tanks and an alternative system is needed.

(2) Other Individual Treatment Systems

Some systems are available which treat only toilet wastes. One such system is than manufactured by Cycle Let of Florida, which employs a vacuum toilet which continuously recycles water.

Since this unit is still at the experimental stage it is difficult to evaluate its effectiveness or cost. The capital cost of the unit is almost as high as the entire centralized sewage system; however, it could be installed in the housing unit and, unlike the central system, would be fully recoverable. If wastes other than toilet waste were disposed of via septic tank or central pipe system, this would not be a cost-effective choice.

One advantage, however, is that this unit completely eliminates the discharge of toilet wastes, which account for half the water use in a housing unit. If this system were used in conjunction with water-saving plumbing fixtures and if there were no washing machine, waste flow could be reduced to as little as 20 gpcd. At this rate, waste collection by truck could be very cost-effective.

b. Waste Water Hauling

This system would be similar to the water-hauling system described earlier. It is subject to the same cost-effectiveness considerations as the water-hauling method: it will become more competitive with decreases in length of use, per capita water consumption, distance to disposal point and number of housing units served. The capital cost would involve a holding tank installed at each housing unit. Local building codes might produce problems, due to the possibility of disease transmission and odors, but the tank could be buried. This could be done close to the housing unit, requiring little connection cost. If buried, a 500-gallon tank would cost $400 per housing unit. The cost-effectiveness analysis will assume this as a non-recoverable cost, although careful design could reduce this cost and make it recoverable.

Sewage hauling costs have been analyzed, using quoted commercial rates and consultant's estimate of time required for various tasks. With 350 gallons picked up at each house, per visit, and a 2,500-gallon vacuum truck, the cost is $30 per 1,000 gallons. For normal water usage, one-year capital write-off and 100 units, the total daily cost per unit is:

Capital	$1.20
Operating	7.50
TOTAL	$8.70

With only 23% of the central system cost recoverable, the daily cost per unit of the central system becomes:

Capital	$4.80
Operating	.40
TOTAL	$5.20

Thus, the trucked system is about 70% more expensive than the central system. With 10C units at normal water usage, the trucked system cost becomes equal to the central system cost for six-months useful life -- that is, all non-recoverable capital costs are written off in six months.

The effect of water conservation is analyzed by assuming that waste water flow can be reduced to 35 gpcd by eliminating washing machines and using water-saving devices. With this situation, using 100 units and a one-year write-off and assuming a reduction in treatment plant size, costs become:

	Central System	Trucked System
Capital cost (per unit per day)	$4.60	$1.20
Operating cost (per unit per day)	.40	3.75
TOTAL COST (per unit per day)	$5.00	$4.95

Thus, the trucked system is competitive with the central system if water is conserved. As deployment time becomes shorter, the trucked system becomes more attractive.

Therefore, a trucked sewage hauling system shows definite possibilities for the emergency housing situation. The overall cost-effectiveness analysis and modular housing design should consider the installation of water-saving devices, since the savings have dramatic effect. The psychological impact of water-saving devices should also be considered.

c. Pressure Collection System

In recent years, two alternatives to the conventional gravity collection of sewage have been developed: pressure sewer systems and vacuum sewer systems. Since the collection system of the vacuum system requires careful site-specific design and installation control, it is not discussed further. The pressure system is discussed with respect to design features and cost-effectiveness.

(1) System Description

A pressure sewage collection system is one in which the contribution from each home is pumped under positive pressure into a collection main which is also under pressure. Possibilities for cost savings arise mainly in the collection mains, since they can be of smaller diameter, require no manholes, can be laid at a constant shallow depth, require no attention to grade and require no capacity for infiltration. Increased costs will come from the costs of buying and operating a pump.

The major element in the system is the pump and auxiliary equipment. It would be impossible to pump raw waste into small-diameter pipes without solids clogging the pipe system. This problem can be overcome by grinding the waste before pumping or installing the pump on a septic tank effluent. The latter seems more reliable and will reduce the contaminant load to the treatment plant. But this concept negates an advantage of community collection systems -- elimination of the bother and cost of septic tank cleaning.

A report* on a demonstration project of a pressure sewer system using the grinder pump in 12 homes in Albany, New York has been reviewed. This study reported successful operation of modified grinder pump units. Pumps used were positive displacement

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* Environmental Protection Agency, A Pressure Sewer System Demonstration, EPA-R2-72-091, November, 1972.

"Monyo" units, with a specially designed grinder on the suction side, mounted on a fiberglass reinforced polyester tank which provided surge storage. Pumps were designed to deliver 12 to 16 gpm at heads of 35 psi to zero (1HP). The authors say a positive displacement pump is essential in a pressure sewer system. This unit could be installed in pre-built emergency housing units, if gravity flow to the tank could be maintained.

Design of the pipe system is critical. If too small a design flow is used, pipes will be undersized. Excessive pumping heads could shorten pump and motor life. If the design flow rate is too large, pipes will be oversized, increasing capital costs.

(2) Operation and Maintenance

The only information on operating and maintenance costs found was in the noted EPA study. The operating cost given was for motor power consumption which, at 300 gallons per household per day, 20 psi discharge pressure and $0.015/KWH, was $2.12 per unit per year. This reference did not estimate maintenance costs but did report in detail on equipment malfunction. For the modified units, which showed superior reliability, a "service ratio" was computed as:

$$\text{Service Ratio} = \frac{\text{Unit - Days requiring service}}{\text{Unit - Days of actual operation}}$$

For nine units operating nine months each, this ratio was 0.003. This indicates that a unit will require one service visit per year. The visit would last two to three hours and cost $20 to $30. Annual maintenance charge will probably increase as the unit ages, but no data are available to estimate this charge.

(3) Cost-Effectiveness

With normal permanent sewer systems, for which capital expenditures are amortized over long periods, pressure systems become cost-effective only when homes are set far apart or where topography or soil conditions are unfavorable for gravity sewer installation. Savings result because of the small-diameter pipe used and the fact that the pipes need not be laid to grade. These savings must overcome the high initial cost of the grinder pump unit, which costs about $1,000.

However, in the emergency housing situation, the grinder pump unit is recoverable whereas the conventional pipe system is not. Therefore, even though emergency housing units are close together, the cost-effectiveness of the system is worth considering. Also, no central lift station would be required, since individual pumps would discharge directly to the treatment plant.

Table 54 shows the estimated capital cost of the pressure sewer system for the 100-unit complex.

Operating costs include cost of treatment plant operation, plus pump maintenance cost. Cost of power consumption for the grinder units is negligible. At $30 to $40 per unit per year for pump maintenance, or $0.10 per day per unit, total operation cost is $0.50 per day per unit. Using a one-year write-off of all capital costs yields the following total cost of the pressure system, including treatment:

Capital (per day)	$615
Operating (per day)	50
TOTAL COST (per day)	$665
Total cost per day per unit	$ 6.65
Total cost per 1,000 gallons	$ 26.50

These costs are identical to those for the primary alternative using a one-year write-off of all capital costs.

TABLE 54

CAPITAL COST
PRESSURE COLLECTION AND SEWAGE TREATMENT
FOR 100-UNIT EMERGENCY HOUSING COMPLEX

Item	Material Cost	Installation Cost	Total Cost
Treatment plant	$ 37,000	$ 4,000	$ 41,000
Pump units, pre-installed	100,000	0	100,000
Connections, 50' each	5,000	15,000	20,000
Pressure main	9,000	21,000	30,000
Electrical	0	1,000	1,000
SUBTOTAL	$151,000	$41,000	$192,000
Contingencies (15%)			29,000
TOTAL			$221,000
Cost per unit			$ 2,210

By eliminating the cost of recoverable items, the cost comparison between the conventional and pressure system becomes:

Item	Conventional System	Pressure System
Capital cost	$175,000	$63,000
Capital cost, per day per unit	$4.80	$1.75
Operating cost, per day per unit	.40	.50
	$5.20	$2.26

This analysis is obviously weighted in favor of the pressure system, since no cost is charged to the pump units which represent an initial investment of $1,150 each. To provide a true comparison this cost should be included. The analysis does point out, however, that if recoverable capital items are considered less costly than non-recoverable items, the pressure system can be less expensive for emergency housing than the conventional system. Therefore, it is recommended that these systems be considered in planning for emergency housing.

There is little economy of scale with this system but a greater benefit in brief deployment, due to the high percentage of recoverable capital expenditures. Compared with the sewage hauling alternative, the break-even deployment time will be less than the six months needed for the conventional system.

d. Summary, Alternative Sewage Handling Systems

Several viable systems exist as alternatives to the primary alternative of conventional gravity collection and package sewage treatments:

- Where soil conditions permit the use of septic tanks and leaching field, these systems are less expensive than the centralized systems.

- Where deployment times are short, sewage hauling should be considered.

- If water-saving plumbing fixtures are installed in the housing units, sewage hauling is economical over longer deployment times.

- Pressure sewage collection can be competitive with gravity collection. Depending on the policy of amortization of recoverable versus non-recoverable capital expenditures, the pressure system can be less expensive than the gravity collection system.

D. MODULAR PIPING SYSTEM

The use of "Utilidor" systems, in which the utility pipes are installed in insulated housing, is recommended in areas of permafrost in Alaska and Canada. Water and sewer pipes along with electrical cables and telephone lines are often installed in the "Utilidor" housing. The systems are expensive since the entire unit must be laid to sewer grade and present circulation problems if laid above grade.

There are certain aspects of such a system that offer cost savings possibilities in the emergency housing situation. The primary attractions are reduction in time and cost of installation and the recovery of pipe after use. The cost of pipe, particularly installation costs, is quite high, and none of this cost is recoverable. If the material can be salvaged and the installation cost reduced significantly, the conventional systems would be much more competitive with the alternative systems discussed, particularly with regard to sewage collection and disposal.

In the permafrost areas, previous "Utilidor" installations have used gravity sewers, which complicates the entire site planning process, and adds to the installation cost. However, the "Utilidor" system might be used with pressure sewers, so that topographical considerations would be less important. The danger of water supply contamination could be eliminated by proper safeguards.

The following are preliminary recommendations for water supply and sewage collection piping.

- Corrugated metal pipe, which is inexpensive and lightweight, could be used as the housing material.

- Plastic pipe, such as PVC Schedule 80, could be used for the water supply and pressure sewer systems. Diameters of 4" and 2.5" would serve the 100-unit complex. A CMP size of 10" - 12" would thus be required.

- If the module were packed with insulation, only minimum burying would be required -- perhaps 1' to CMP crown, for structured protection. For very short deployment, the system could be left above grade, anchored to offset pressure thrust.

- Means of physical separation of the two pipes could be installed to reduce the possibility of water supply contamination.

- Modular lengths of the system could be packaged for advance staging. For connecting purposes, the water and sewer pipes would be longer than the CMP pipe, with standard CMP couplings installed in the field to complete the protective system.

- Screwed or solvent welded joints could be used for the PVC pipe. Solvent welding is faster, but some pipe length would be lost when the pipes are cut apart after deployment. Increasing coupling length could make up for this loss, however, which would be about 4" per deployment.

- If the system were buried, the entire pipe system could be joined above grade and dropped into the excavated trench.

- Drains could be provided at low points in the pipe to allow release of any sewage leakage.

- Recovery could be simplified by providing lifting dogs on the CMP, perhaps extending above grade. Although some cover soil would have to be excavated, the entire pipe might not have to be laid bare before removing it from the trench.

- Sewer pipe would require cleaning prior to re-storage, but this can be accomplished fairly rapidly and economically.

This system should be given serious consideration in a detailed evaluation of emergency utility cost-effectiveness. A small demonstration project could be designed to answer questions regarding cost, public health protection, serviceability and recovery.

APPENDICES

APPENDIX I

GLOSSARY

Sources: 1. National Association of Building Manufacturers

2. Hodes, _et al_.

3. Seabold

4. _Directory/Census of Manufactured Housing_

5. Consultant's Definition

ANSI CONTAINER: An ISO container which meets the standards of the American National Standards Institute (ANSI).[3]

BOX: A not necessarily code complying three-dimensional section of a shelter, designed to be shipped to site and joined with one or more other boxes or components to form a shelter.[5]

CARGO: Goods carried by a vehicle.[3]

CLOSED-PANEL CONSTRUCTION: Factory-assembled roofs, wall or floor panels closed in on two sides, and which may enclose factory-installed wiring, plumbing, insulation. The panels are not open for visual inspection of equipment or structure at the site. Panel size may range from room width to full house length.[1]

CLOSED SYSTEM: A system in which the components are peculiar to that system and cannot be combined with those of another system.[2]

COMPONENT: An individual element which may be partially fabricated by the builder or purchased from a number of specialized manufacturers and shipped to the site for assembly. Generally, components are thought of as trusses, rafters, wall and partition panels, preglazed windows, floor panels and gable ends in unfinished condition.[1]

CONTAINER: An enclosed, or partly enclosed, volume for holding and protecting cargo.[3]

CONTAINERIZED CARGO: Cargo which is unitized by means of containerization, specifically connoted as cargo carried in intermodal containers.[3]

CONTAINERIZED SHELTER: (1) A container-shelter, (2) a shelter which can be packed into an ISO container, (3) a shelter which conforms to enough ISO recommendations to be shipped as compatible cargo along with ISO containers, or (4) a shelter which can be knocked-down and shipped with others as compatible cargo along with ISO containers.[3]

CONTAINER-SHELTER: An item which is both a container and a shelter, specifically connoted as a shelter which conforms to all of the ISO container recommendations as well as the shelter requirements.[3]

CONVENTIONAL CONSTRUCTION: On-site construction of a building or shelter by tradesmen using hand and power tools and basic raw materials.[2]

CORE AND PANEL: Combination of panels and mechanical cores. Few manufacturers producing combination now, but interest increases because: (1) small size of three-dimensional mechanical unit permits over-road movement without special permits, and (2) mechanical core unit and closed panels (in which electrical is installed at factory) keep large percentage of total work done in factory.[4]

DISPOSABLE SHELTER: A shelter intended to be discarded at the end of a single deployment to a single location, usually inexpensive and with short service life.[3]

DOUBLE-WIDE MOBILE HOME: A double-wide mobile home is, in effect, two mobile homes joined together to form a housing unit, usually 28 feet wide. The double-wide is similar in appearance to sectional/modular housing, but may have furniture and decorative appointments usually associated with mobile products. Half sections are shipped separately to the site for joining and positioning on a semi-permanent foundation. The wheeled chassis on which the units are trailed to the site may be left intact or may be removed. Double-wides are usually financed as chattel property, taxed as vehicles or personal property, and are not necessarily in compliance with local building codes.[1]

EXPANDABLE BOX: An expandable box with all walls of exclusively panel construction, usually enlarged by the hinged-panel method or the telescoping method.[3]

HOUSING MISSION: A HUD administered mission to provide temporary housing to the area of a major disaster.[5]

INDUSTRIALIZED HOUSING: All forms and concepts of residential, commercial and institutional housing manufactured by duplicative precision techniques applied to a wide range of materials in assembly line operations.

Industrialization encompasses all categories of concepts, systems, sub-systems and processes, including portable manufacturing facilities which may be established temporarily on the job for a single project only.[1]

INTERMODAL CONTAINER: A shipping container used in more than one mode of transportation (sea, land, and air) and standardized to interface with especially configured vehicles.[3]

ISO CONTAINER: An intermodal container which conforms to the recommendations of the International Organization for Standards (ISO).[3]

MECHANICAL CORE: A factory-assembled, three-dimensional section of a building which includes installed mechanical elements containing all mechanical, electrical, plumbing, heating and cooling elements and related systems. Mechanical cores may contain the kitchen, with its range, cabinets, counters and sinks, and the bath and associated fixtures. Ranging in size from 8 by 10 feet to 12 by 20 feet, cores are shipped to the site and erected on a previously prepared foundation, or stacked for multistory structures. The remainder of the structure surrounding them may be of component, panel or conventional type. Use of mechanical cores substantially reduces the need for the scarce, expensive skilled trades on the erection site. (Also called Utility Core.)[1]

MECHANICAL SUBSYSTEM: A combination of components used to supply, transport, and dispose of air, water, or energy.[3]

METAL STRUCTURES: Structures pre-designed for commercial, institutional, industrial or agricultural use. Of two types: (1) structural frame, to which roll-formed panels are attached, and (2) panelization, in which the skin serves as the structure as well as the surface. Customer specifications are ususally fed into computer, permitting infinite variety of options as to size and loading.[4]

MOBILE HOMES (STANDARD MOBILE HOMES): Factory built home constructed on its own chassis so it can be towed to the site, and typically used as a house without a permanent foundation. Mobile homes are commonly sold on conditional sales contracts through dealers and are treated as personal property for taxing and legal purposes. Double-Wide Mobile Homes are two mobile homes placed together to form a house, usually measuring 24x 44-60 feet. They differ from modulars in that they usually do not meet local building codes, though several manufacturers are building units on a chassis which meets or exceeds FHA standards. FHA and VA are insuring mobile home loans though units do not necessarily meet standards of FHA Structural Engineering Bulletins.[4]

Since the typical use of mobile homes does not involve repeated movement from one site to another, they do not necessarily qualify as mobile shelter.[5]

MODULAR (SECTIONAL) BOX: A modular house minus a factory-installed roof system. Roof types may include trussed rafters, precut rafters and joists shipped from the factory as part of the total package, or purchased separately. The elimination of the factory-installed roof reduces the over-all shipping height thus allowing increased ceiling height. Steeper pitched roof systems applied on site to the increased ceiling height of the modular box produce houses which look like conventional construction.[1]

MODULAR HOUSING: Factory-produced modules which are fabricated and assembled in the plant for shipment to the erection site. On site, the module may be connected to other modules or to other systems for a structurally complete building. Certain forms of modular housing are complete on delivery as to exterior and interior finish, plumbing and wiring and mechanical systems.[1]

Modular units generally meet all local and FHA building codes and are eligible for long-term real estate financing and are taxed as real property. The heating system, plumbing and wiring are factory installed. Sectional is a term which is often used interchangeably with modular, though sectional is presently a term in transition. It is also being used by mobile home manufacturers to describe some of their double-wide units which may, or may not, be code conforming.[4]

MODULAR (SECTIONAL) STACK-ON: The stack-on sectional concept refers to modules, one of which is mounted on the foundation and the second of which rests atop the first and is equipped with a roof assembly. Stacking is usually limited to two stories except when steel framed or concrete modules are involved, but the variety of configurations makes this type of housing most aesthetically acceptable and most suitable for multi-family dwellings.[1]

MODULE: A factory-assembled three-dimensional section of a building to be shipped to site and joined with one or more sections to form a building or house to meet the same construction, health and life safety requirements as for conventional on-site building. (Not to be confused with the more general architectural definition of a module--a uniform dimensional increment used in design.)[1]

NON-PERMANENT CONSTRUCTION: Buildings produced for temporary use and placed upon temporary foundations where they will not need to meet local building codes.[1]

OPEN-PANEL CONSTRUCTION: An industrialized building technique in which roof, roof trusses, wall and floor panels are shipped to the site without final exterior or interior finishing. Wiring, plumbing and related mechanical work is usually omitted and is done at the site. Where wiring and plumbing are included, the work is clearly visible for on-site inspection. The items of open-panel construction are usually shipped flat and loaded in the proper order for quick assembly on the foundation.[1]

OPEN SYSTEM: One in which components are interchangeable between systems.[2]

PACKAGED HOUSING (PRE-CUT, PRE-FABRICATED, PANELIZED): Factory produced buy not finally constructed into a three-dimensional unit. The factory assembles all the basic structural materials of the structure, such as walls, roof trusses, interior partitions, windows, doors, cabinets, shingles, flooring, insulation, etc., and loads them on a truck so they can be used as the truck is unloaded. Unless a manufacturer includes a mechanical core with his unit, the packaged home does not include mechanical components such as heating, plumbing and electrical work. Prefabricated and panelized are synonyms for packaged housing. Pre-cut housing, in which materials are pre-cut and labeled, but little or no assembly work is done in the factory, are also packaged homes.[4]

PANEL: A section of a wall or partition usually ceiling high but in various lengths. (See "closed panel" and "open panel")[2]

PANELIZED CONSTRUCTION: Panelized construction describes either closed-panel or open-panel techniques in industrialized housing. Generally, it refers to either fully finished or partly finished wall and floor panels, roof panels and trusses shipped flat to the site.[1]

PERMANENT CONSTRUCTION: A building produced in accordance with prevailing building codes and to be placed on a permanent foundation. It is taxed as real property and qualifies for financing under a mortgage loan.[1]

PRECUT: Off-site fabrication of materials to standardized lengths; usually refers to lumber.[2]

RELOCATABLE SHELTER: A shelter which can be moved from one location to another; requiring a minimum amount of time and effort for disassembly, packing, moving, unpacking, and reassembly to be relocated.[3]

RIGID BOX: A short term used specifically to refer to rigid-wall non-expandable boxes that can be directly connected to form a shelter.[3]

SHELTER: An enclosed, or partly enclosed, volume for protecting personnel and/or material by controlling the environment, specifically connoted to include the structure and any necessary wiring, plumbing, etc.
In the context of temporary housing it can be
1. a temporary housing unit
2. a temporary community facility
3. a temporary storage space.[3,5]

SHIPPING CONTAINER: A container used for unitizing cargo, usually an element in a transportation system.[3]

SUBSYSTEM: Preassembly of all the elements pertaining to a certain functional area in a house such as wall system, roof system or mechanical system.[2]

SYSTEMS BUILDING: Systems building integrates building components, subsystems and assembly procedures and is characterized by a high degree of standardization. Systems building can be implemented by manufacturing processes either away from or within the project site. The open system permits interchange of components with other systems while the closed system involves components that are unique to that system. Systems building is usually associated with mid-rise apartment units since it was evolved in Europe following World War II to fill the immediate demand for housing units in war ravaged areas. Thus, one commonly identifies names such as Balency, Firnkas, Bison and Tracoba with this building technique. U. S. structural and pre-stressed concrete producers are evolving panel systems that do not require market aggregation that has limited introduction of European systems.[4]

TWO-PIECE MODULAR/SECTIONAL HOUSING: This type of modular housing refers to units fabricated in half-house sections. Widths may vary from 10 to 14 feet, and length from 38 to 56 feet, and even greater length where permitted by highway regulations. Roof pitch is usually 3 inches in 12 to stay within shipping height limits, since most units are shipped on special flatbed trailers or transporters.

The most common shape is rectangular with 3-to-1 or 5-to-1 proportions, and units are usually shipped completely finished.[1]

UNITIZED CARGO: A type of cargo which is assembled into standardized shipping modules and ordinarily carried in vehicles which are especially configured to receive and restrain these modules.[3]

VEHICLE: A means of transportation, e.g. ship, train, truck, plane, and helicopter.[3]

WOOD FRAME CONSTRUCTION: Construction using wood as the framing material such as studs, rafters, headers, and joists.[2]

APPENDIX II

GENERAL SURVEY OF INDUSTRIALIZED HOUSING MANUFACTURERS LIST OF COMPANIES WITH AN ANNUAL LIGHT-WEIGHT SYSTEMS PRODUCTION IN 1972 OF AT LEAST 1,000 MOBILE HOMES, 25 MODULAR HOMES, 500 PACKAGED HOMES, AND/OR ANY RELOCATABLE HOUSING

Source: *Directory/Census of Manufactured Housing*, Section 2-6, 1973

APPENDIX II-A

Company Name and Address		Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
1.	Active Homes Corp. 8048 South Van Dyke Marlette, MI 48453	Jack C. Ramsay			X	X	
2.	Adrian Housing Corp. Hwy. 80, Box #246 Adrian, GA 31002	Carl Gillis, Jr.			X		
3.	A.F.C. Modular Const. Inc. P.O. Box #6057 Phoenix, AZ 85005	Earl Hazelett			X		
4.	Allen Homes Inc. Box 5147, Drew Street Clearwater, FL 33518	B.J. Lechner	X				
5.	Allied Mfg. Corp. P.O. Box #390 Dowagiac, MI 49047	Dale Lyons	X				
6.	Altair Industries, Inc. 255 Channel Street San Francisco, CA 94107	J.C. Walker		X			X
7.	Altura Inc. P.O. Box Drawer 10130 Albuquerque, NM 87114	K.W. Mount			X		
8.	American Classic Homes 3802 Raeford Rd. Fayetteville, NC 28305	Johnny Hughes				X	
9.	American Coach Co. 1501 Virginia Street St. Louis, MI 48880	N. Christo-pherso	X				
10.	American Heritage Homes P.O. Box #636 Joplin, MO 84801	L.W. Browne, Jr.			X		
TOTAL MANUFACTURERS			3	1	5	2	1
RESPONSES			0	1	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
11. American Home Ind., Inc. P.O. Box #2445 Bakersfield, CA 93302	D.G. Cross	X		X		
12. American Modulars Corp. 2424 Far Hills Dayton, OH 45419	R.E. McDaniel				X	
13. American Standard Homes 700 Commerce Ct. Martinsville, VA 24112	M.B. Eanes				X	
14. American Timber Homes Box 357 Escanaba, MI 49829	John Wallbridge				X	
15. Amotek, Inc. 819 East Street Fairport Harbour,OH 44077	William J. Snider			X		
16. Andrews-Gladdy Ind., Inc. Hickory Grove SC 29717	M.J. Andrews			X		
17. Apeco 2100 Dempster Evanston, IL 60204	Clayton Rautbord	X				
18. Architectural Specialties 5911 Loomis Road Victor, NY 14564	J.S. Cusick			X		
19. Artcraft Homes P.O. Box #309 Marshfield, WI 54449	John F. Wick	X				
20. Art Homes, Inc. P.O. Box 289 Fairborn, OH 45324	Ken Durnbaugh				X	
TOTAL MANUFACTURERS		3	0	4	4	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
21. Astro Manufacturing Co. Box #189 Ghippenville, PA 16254	James R. Hyde	X				
22. Atco Industries, Ltd. 1243 McKnight Blvd. Calgary, Alberta, CN	R.D. Southern	X	X	X		X
23. Atkinson Industries, Inc. Saratoga & Franklin Shawnee, OK 74810	B.B. Wood			X		
24. Atlantic International P.O. Box 412 Cockeysville, MD 21030	W.H. Gowl		X		X	X
25. Atlas Homes Corp. 249 Old River Road Wilkes-Barre, PA 18702	Stanley Urbanski	X		X	X	
26. Atlas Portable Bldg. Co. 4034 Canyon Drive Amarillo, TX 79109	G.R. Campbell		X	X		X
27. Aurora Mobile Homes 16831 Krameria Riverside, CA 92504	R.J. Kothlow	X		X		
28. Automated Bldg. Comp. P.O. Box #116 Long Lake, MN 55370	J. Reichenberger				X	
29. Avco Modular Homes P.O. Box #226 Suncook, NH 03275	Albert J. Maki			X		
30. Avco Precision Products Sheridan Street Richmond, IN 47374	Fred J. Higgins			X		
TOTAL MANUFACTURERS		4	3	7	3	3
RESPONSES		1	3	2	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
31. Barcraft Homes, Inc. P.O. Box 289 Laurens, SC 29360	Jas. A. Barnes	X				
32. Barden & Robeson Corp. Kelly Avenue Middleport, NY 14105	Robert Gelder				X	
33. Chase Barlow Lumber Co. 4600 Robards Lane Louisville, KY 40218	C.T. Barlow				X	
34. Barns Lumber & Mfg. Co. 2813 Lombardy Lane Dallas, TX 75220	Ralph Humphrey				X	
35. Barrington Homes of Fla. 1603 Grove Street Haines City, FL 33880	L.C. Tozzer	X				
36. Bendix Home Systems 61 Perimeter Park Atlanta, GA 30341	J.C. Clayton	X				
37. Bernard Lumber Company Box 13726, 4333 New Orleans, LA 70125					X	
38. W.G. Best Homes Corp. 2301 S. Banker Effingham, IL 62401	M. O'Donnell				X	
39. Better Living, Inc. 310 Avon Charlottesville, VA 22901	R.L. Nunley			X		
40. Bohemia Homes P.O. Box #1338 Eugene, OR 97401	J. McKean			X		
TOTAL MANUFACTURERS RESPONSES		3 0	0 0	2 0	5 0	0

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
41. Boise Cascade Mftd. Hsg. One Jefferson Square Boise, ID 83701	L.C. Geyer			X	X	X
42. Boise Cascade Mftd. Homes P.O. Box 608 Healdsburg, CA 95448	E. Jeffreys				X	
43. Bon Aire Ind., Inc. 17 Bon Aire Circle Suffern, NY 10901	S. Goldstein			X		
44. Bradley Homes Div. Bradley Ind. Park, 140 Columbus, GA 31902	E.D. Griffin			X		
45. Brigadier Ind. 234 Main Street Thomson, GA 30824	J.A. Hutchinson	X				
46. Briggs Mfg. Company 3755 S. 60th St. Tacoma, WA 98409					X	
47. Brown-Graves Company 191 E. Miller Avenue Akron, OH 44301	Harold Graves				X	
48. Builders Components Sup. 210 W. Haven Salt Lake City, UT 84107	John Gunther				X	
49. Building Block Invest. 44250 Warm Springs Fremont, CA 94114	D. Hanson			X		
50. Building Syst., Inc. 3113 Prospect Avenue Cleveland, OH 44115	S. Rothenfeld				X	
TOTAL MANUFACTURERS		1	0	4	6	1
RESPONSES		0	0	1	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
51. Building Syst., Inc. P.O. Box #2010 Galveston, TX 77550	D.R. Feinman			X	X	
52. Burkin Homes Corp. U.S. 131, South White Pigeon, MI 49099	K.O. Burton			X		
53. Butler Homes, Inc. P.O. Box #667 Butler, GA 31006	Phil Carroll, Jr.			X		
54. C & G Corporation 3366 W. Franklin St. Elkhart, IN 46514	D.L. Greenawalt	X				
55. C & M Homes 2331 King Avenue Billings, MT 59102	H.E. Carpenter			X		
56. Cabin Craft 9306 E. 11th Street Tulsa, OK 74112	W.C. Hulsey, Sr.			X		
57. California-Hawaii Corp. 91-291 Hanka Street Ewa Beach, Oahu, HA 96706	R.C. Raab			X		
58. Camelot Homes, Inc. P.O. Box #347 Burleson, TX 76028	Jerry Franks	X		X		
59. Capital Ind., Inc. P.O. Box #326 Avis, PA 17721	Jack W. Croes			X		
60. Cardinal Homes, Inc. Highway 15 Wylliesburg, VA 23976	D.J. Cappaert	X		X		
TOTAL MANUFACTURERS		3	0	9	1	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
61. Cardinal Ind. 2040 S. Hamilton Road Columbus, OH 43227	A.V. Guirlinger			X		X
62. Carpentry Eng., Inc. 3400 East Grand River Howell, MI 48843	John D. Parcels			X	X	
63. Cary-Way Portable Bldg. P.O. Box #26937-77032 Houston, TX 77032	Ray Hamon			X		
64. Castle Industries P.O. Box #5187 Lubbock, TX 79417	Leonard Wilson	X				
65. Castle Industries P.O. Box #288 New Castle, KY 40050	E.W. Brewer			X		
66. Celebrity Homes Corp. P.O. Box #1622 Athens, GA 30601	P.S. Nestor, Jr.	X				
67. Celtic Corporation 1411 N. Westshore Tampa, FL 33610	C.B. Merrill	X				
68. Central Homes 237 22nd Street Greely, CO 80631	C.A. Rymes	X		X		
69. Century Modular Homes P.O. Box #737 Ft. Morgan, CO 80701	D.H. Hawkins	X		X		
70. Champion Home Builders 5573 North Street Dryden, MI 48428	Henry E. George	X				X
TOTAL MANUFACTURERS		6	0	6	1	2
RESPONSES		1	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
71. Chateau Homes, Inc. P.O. Box #1283 Orangeburg, SC 29115	M.L. Stephens			X		
72. Chickasha Mobile Homes P.O. Box #405 Chickasha, OK 73018	Stan Raczynski	X				
73. Chief Ind., Inc. Box #349 Aurora, NE 68818	Mel Auch	X				
74. Clark Bilt Homes 610 E. 76th Street, N. Atherton, MO 64118	Robert Hayes			X		
75. Clary Corporation P.O. Box #5627 Arlington, TX 76011	H.G. Cooley				X	
76. Clearspan Components P.O. Box #4195 Meridan, MS 39301	J.L. McRae				X	
77. Coastal Mob. & Mod. Corp. Allender Road White Marsh, MD 21162	L.S. Stanley			X		
78. Cole Manufacturing Cole Road, Box #67 Horn Lake, MS 38637	Lynn Pitts				X	
79. Coleman Homes Indust. Drive, Box #482 Morgantown, KY 42261	D.D. Coleman			X		
80. Commodore Corporation 8712 W. Dodge Road Omaha, NE 68144	Dan Katzman	X				
TOTAL MANUFACTURERS		3	0	4	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
81. Community Homes, Inc. P.O. Box #45 Bethesda, OH 43719	Nick Dobrich			X		
82. Comm. Hum. & Ind. Dev. 17th & Chillicothe Portsmouth, OH 45662	C.A. Pitzer			X		
83. Community Technology 1 Spc. Pk. Bldg. E 1 Redondo Beach, CA 90278	A.V. Sommer			X	X	
84. Components, Inc. 5800 Pecos Denver, CO 80221	S. Dixon				X	
85. Components, Inc. 4400 Homerlee Avenue E. Chicago, IN 46312	R.J. Dye				X	
86. Component Systems, Inc. P.O. Box 188 Rogers, MN 55374	W.F. Feyersen				X	
87. Conchemco, Inc. 10000 Marshall Drive Lenexa, KS 66215	D.W. Techentien	X				
88. Concord Mobile Homes P.O. Box 887 Lake City, FL 32055	Wm. Payne	X				X
89. Conner Homes Corp. P.O. Box #520 Newport, NC 28570	Wallace Conner	X		X		
90. Conotech, Inc. P.O. Box 537 Santee, SC	B.W. Renninger				X	X
TOTAL MANUFACTURERS		3	0	4	5	2
RESPONSES		1	0	0	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
91. Construction Components Box #555, 245 Bypass Greenville, AL 36037	H.B. Shirley				X	
92. Construction Modules, Inc. Box #2570 San Antonio, TX 78299	R.E. Hood			X		
93. Continental Homes P.O. Box 1800 Roanoke, VA 24008	Marshall Pugh			X		X
94. Coordinated Bldg. Syst. 8500 Glendale Milford Rd. Camp Dennison, OH 45111	G.L. Crump			X		
95. Craftmade Homes P.O. Box 1185 Henderson, TX 75652	John W. Lowe	X				
96. Craftmark Homes, Inc. Box #175, 4595 Morgan Pl. Liverpool, NY 13088	J.S. Caldwell, III			X		
97. Creative Bldgs., Inc. 1101 E. University Urbana, IL 61801	Roy D. Murphy			X		
98. Crown, Inc. P.O. Box #45 Terryville, CT 06786	Karl J. Schwarts			X		
99. Cubex, Inc. P.O. Box #42 Donora, PA 15033	H.E. Phillips			X		
100. Custom Bldg. Components 399 S. Meridian Avenue Youngstown, OH 44509	Pat Colantone				X	
TOTAL MANUFACTURERS		1	0	7	2	1
RESPONSES		0	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
111. DeRose Ind., Inc. of Ind. 4002 Meadows Drive Indianapolis, IN 46205	R.A. DeRose	X				
112. Development Int'l. Corp. 2801 Ponce deLeon Coral Gables, FL 33100	Fred Epstein			X		
113. Dickinson Homes, Inc. 1500 W. Breitung Ave. Kingsford, MI 49801	A.E. Santoni			X		
114. Dixie Royal Homes Box #805 Cookeville, TN 38501	Hugh Bussell				X	
115. Domino Homes, Inc. 20300 Civic Centre Dr. Southfield, MI 48075	C.T. Hessee			X		
116. Donn Building Systems 1000 Crocker Road Cleveland, OH 44145	D.L. Foss			X		
117. Dukor Modular Syst. 2525 El Camino Real Redwood City, CA 94061	G.K. Bissell			X		
118. Dyna-Flex Modular Box 613, 1 Mod. Sq. Naples, FL 33940	Garson Dinaburg			X	X	
119. Dynamic Homes, Inc. 525 Roosevelt, Box 875 Detroit Lakes, MN 56501	W. Baumgart			X		
120. East Coast Homes, Inc. Box 535A Beaver Dam Cockeysville, MD 21030	George Mueller				X	
TOTAL MANUFACTURERS		1	0	7	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
121. Elcona Homes Corp. P.O. Box #520 Elkhart, IN 46514	W.A. Price			X		
122. Elder International P.O. Box 2061 Houston, TX 77001			X			X
123. Elite Modules Syst. 14 Alleyne Street Quincy, MA 02169	E.H. Wood			X		
124. E-Lete Homes Inc. Highway 80, South Pittsville, WI 54466	Edgar C. Wright			X		
125. Endure Products Inc. Box #666 Miami, FL 33166	Irvine Kimmel		X		X	X
126. Ende Co., Inc. 3270 W. 2196 S Salt Lake City, UT 84119	G.C. Jenkins			X	X	
127. Engineered Components 924 E. State Street Clarinda, IA 51632	R.A. Michal				X	
128. Envirohousing P.O. Box #67 Birdsboro, PA 19508	Harlan Cohen			X		
129. Enviro. Communities P.O. Box #1700 Corona, CA 91720	J.T. Moon	X		X		X
130. Marshall Erdman & Assoc. 5117 University Madison, WI 53705	M. Erdman			X		
TOTAL MANUFACTURERS		1	2	7	3	3
RESPONSES		1	2	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
131. Erie Module Corporation 2600 Hamburg Turnpike Lackawanna, NY 14218	Robert Hannon			X		
132. Evans Products Company 1121 S.W. Salmon Portland, OR 97205	E.M. Preim				X	
133. Everglades Div. P.O. Box #1364 Leesburg, FL 32748	J.P. Duane, Jr.			X		
134. Fleetwood Enterprises P.O. Box #7638 Riverside, CA 92503	W. Weide	X				
135. Fontaine Mod. Struct. Rt. 10, Easthampton Rd. Northampton, MA 01060	T.T. Growley			X		
136. Foremost Manufacturing Co. 1700 Shady Oaks Drive Denton, TX 76201	A.J. Belling	X				
137. Four Seasons Structures Box #7 Phelps, WI 54554	N.E. Isaacson			X		
138. Fuqua Ind., Inc. 3800 1st National Bank Atlanta, GA 30303	N. Swisher	X				
139. Gain, Inc. Box #3574 Shreveport, LA 71103	A.C. Epes			X		
140. Galaxy Homes, Inc. 301 Fifth Street, N.W. Dyersville, IA 52040	M.S. Goodson	X				
TOTAL MANUFACTURERS		4	0	5	1	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
141. General Electric Re-Entry & Eng. Syst. 3198 Chesnut Street Philadelphia, PA 19101	R. Farrelly			X		
142. General Homes Corp. 1193 Chesapeake Avenue Columbus, OH 43212	Chas. Shanklin			X		
143. Gerring Ind., Inc. Route 1, Box 1-B Shipshewana, IN 46565	Hal Gerring	X				
144. Gibraltar Ind., Inc. 725 North Point Road Baltimore, MD 21237	Fred Painter			X		
145. Glen Manor Homes R.D. 2, Box 89 Danville, PA 17821	Robert E. Paterson			X		X
146. Golden West Mob. Homes 1929 E. St. Andrews Santa Ana, CA 92711	H. E. Karsten,Jr.	X				
147. Goodyear Aerospace Litchfield Park, AZ 85340			X			X
148. Great Southwest Corp. Box 5555 E. Arlington, TX 76011	William C. Baker	X				
149. Greenwood Homes, Inc. 624 E. Division Street Greenwood, WI 54437	Robert J. Keyes	X		X		
150. Greg. Enter., Inc. P.O. Box 1110 Lancaster, SC 29720	C.A. Bundy				X	
TOTAL MANUFACTURERS		4	1	5	1	2
RESPONSES		0	1	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
151. L. Grossman Sons, Inc. 200 Union Street Braintree, MA 02814	Mike Grossman				X	
152. Grumman Mod. Bldgs. 600 Old Country Road Garden City, NY 11530	R.J. Farren			X		X
153. Guerdon Ind., Inc. P.O. Box 1259 Louisville, KY 40201	Jack Dahl	X		X		X
154. Hallamore Homes 18060 Euclid Fountain Valley, CA 92708	L.G. Hallamore			X		
155. Hallmark Homes Box 5237, D. Bowles Augusta, GA 30901	A.T. Mulherin, Jr.				X	
156. Hamill Homes P.O. Box 190 Grand Ledge, MI 48837	R.B. Hamill			X		
157. Hampton Homes, Inc. Drawer D Edwardsburg, MI 49112	Russ Covey	X		X		
158. Heartland Homes Corp. Industrial Park Bremen, IN 46506	Donald L. Cort			X		
159. Heckaman Ind. Box 229, R.R. 1 Nappanee, IN 46550	Ivo Heckaman			X		
160. Hellwood Corporation Box 257 Afton, MN 55001	Loren Derrill			X		
TOTAL MANUFACTURERS		2	0	8	2	2
RESPONSES		1	0	2	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
161. Heritage Homes Box 669, 1135 Robeson Fayetteville, NC 28302	William Faircloth				X	
162. Hessee Ind., Inc. 20300 Civic Centre Dr. Southfield, MI 48076	Claude T. Hessee			X		
163. Hodgson Houses, Inc. 540 Madison Avenue New York, NY 10022	R.D. Silver			X		
164. Home Bldg. Corporation P.O. Box 1213 Sedalia, MO 65301	Neil Reyburn			X		
165. Home Marketing, Inc. P.O. Box 254 Gainesville, TX 76240	C.W. Case			X		
166. Homecraft Corporation P.O. Box 35 South Hill, VA 23970	H.R. Legg				X	
167. Homes by Fisher, Inc. P.O. Box 248 Richfield, NC 28137	J.E. Fisher, Jr.	X				
168. The House of Merrill P.O. Box 403 Merrill, WI 54452	J.P. Semling			X		
169. Housing by Tiffany Industrial Park Moultrie, GA 31768	B.T. Holloway	X				
170. IBC Homes East Route 316 Mattoon, IL 61938	D.W. Hutton				X	
TOTAL MANUFACTURERS		2	0	5	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
171. Imperial Components, Inc. 300 N. Randall Road St. Charles, IL 60174	David Chambers				X	
172. Imperial Homes, Inc. P.O. Box 35 Griffin, GA 30223	M.O. Gustafson				X	
173. Industrial Laminates Corp. 1806 E. Fourth Austin, TX 78762	R.E. Kelly			X	X	
174. Industrialised Bldg. Ind. 1265 Florence Blvd. Florence, AL 35630	Howard Craig			X		
175. Ind. Uniment, Inc. 55740 Currant, Box 17 Mishawaka, IN 46544	John Morris			X		
176. Inland-Scholz Housing Syst. 800 Country Street Milan, MI 48160	W.E. Ekblaw			X	X	X
177. Inland Systems, Inc. 1950 Covington Ave. Piqua, OH 45356	John McVeigh			X	X	
178. Insta-Housing, Inc. 130 A North Street N. Vernon, IL 47265	Lester L. Lee			X		
179. Intermodex Corporation 2 Corporate Park Drive White Plains, NY 10604	David Hanania			X		
180. Intermodular Struct. Inc. 381 Blair Road Avenel, NJ 07001	H. Kullman			X		
TOTAL MANUFACTURERS		0	0	8	5	1
RESPONSES		0	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
181. International Mobile Homes Ontario, CA 91761	R.E. West	X				
182. International Mod. Syst. 111 E. 14th Place Lombard, IL 60148	T.E. Gilbert			X		
183. Interstate Structures Box 5546 Orlando, FL 32805	John Curry			X		
184. Iseman Mobile Homes 4733 N. Cliff Avenue Sioux Falls, SD 57104	Lloyd L. Reaves	X				
185. Jal-Donn Mod. Bldg. P.O. Box 45100 Westlake, OH 44145	F.E. Borgemiller			X		
186. Jones Homes Inc. P.O. Box 1 Hendersonville, TN 37075	Ralph L. Jones				X	
187. Jordan Homes 4656 Hungerford Rd. Memphis, TN 38118	R.B. Haynes				X	
188. Kaufman & Broad Home Systems, Inc. P.O. Box 67753 Los Angeles, CA 90644	Ron Kershaw	X				
189. Kentucky Construction Co. 342 Waller Avenue Lexington, KY 40505				X	X	
190. Key Company P.O. Box 20207 Greensboro, NC 27420		X				
TOTAL MANUFACTURERS		4	0	4	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
191. Keyway Modular Homes 3584 Bath Road Perry, MI 48872	Richard Torrey			X		
192. Kingsberry Homes 61 Perimeter Park Atlanta, GA 30341	Rudy A. Brown			X		
193. Kit Manufacturing Co. 1401 W. 17th Street Long Beach, CA 90801	D. Pocapalia	X		X		
194. LSI Hawaiian Homes 91250 Kalaelae Ewa, Oahu, HI 96707	K.A. Ruck			X		
195. Lakeshore Homes, Inc. Box 5, Ind. Park Road Eufaula, AL 36027	R.A. Hornsby,Jr.			X		
196. Lakewood, Inc. Route 2 Washington Ct. Hts., OH 43160	Ray French			X		
197. Lancer Mobile Homes 1660 Magnolia Avenue Corona, CA 91720	Ken Moore	X				
198. Lanchart Industries Hamilton Bldg. Wichita Falls, TX 76301	Ben Woody	X				X
199. La Valley Bldg. Supply P.O. Box 267 Newport, NH 03773	H.A. LaValley				X	
200. Lear Siegler, Inc. 3171 S. Bundy Drive Santa Monica, CA 90405	D.E. Cuckler			X	X	
TOTAL MANUFACTURERS		3	0	7	2	1
RESPONSES		1	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
201. Leisure Homes, Inc. Route 302 Bridgeton, ME 04009	Raymond Fagan			X		
202. Lenoir Ind., Inc. Box 190 Town Cr. Road Lenoir City, TN 37771	William Hall			X		
203. Lester Homes P.O. Box 2188, Barrows Mill Road Martinsville, VA 24172	L.I. Lester,Jr.			X		X
204. Liberty Homes, Inc. P.O. Box 35, Ind. Park Goshen, IN 46526		X				
205. Lindal Cedar Homes P.O. Box 24426 Seattle, WA 98178	S.W. Lindal				X	
206. Lord Ashley Mod. Homes P.O. Box 355 Mt. Pleasant, SC 29464	W.B. Causey	X		X		
207. LTV Aerospace Corp. P.O. Box 871 Chatham, VA 24531	W.E. Armstrong			X		
208. Ludlow Corporation 145 Rosemary Street Needham Heights, MA 02194	Chas. Chandler	X		X		
209. Lumber Components 4223 Troy Highway Montgomery, AL 36111	H.A. Jones,Jr.					X
210. Majestic Ind., Inc. 714 Falvey Avenue Texarkana, TX 75501	H. P. Eckstein	X				X
TOTAL MANUFACTURERS		4	0	6	2	2
RESPONSES		1	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
211. Mann Ind., Inc. 2408 S. Nappanee St. Elkhart, IN 46514	D.D. Weidner	X				
212. Manufactured Homes, Inc. 40 Lexington Park Drive Elkhart, IN 46514	Robert Willard	X		X		
213. Mark IV Homes, Inc. Hampton Industrial Park Taylor, PA 18504	P. Delaney	X			X	
214. Marlette Homes, Inc. 3305 Wilson Street Marlette, MI 48453	Wayne L. Swett	X				
215. Marshfield Homes P.O. Box 530 Marshfield, WI 54449	H. Federwitz	X				
216. Maryland Housing Corp. 5820 Southwestern Baltimore, MD 21227	M.J. Macks				X	
217. Material Systems Corp. 751 Citracado Parkway Escondido, CA 92025	I. Kriegsfeld			X		
218. Mayhill Homes, Inc. 221 Washington Gainsville, GA 30501	John Odegaard				X	X
219. Melby Module Mfg. Ellsworth, WI 54011	Dale Melby			X		
220. Melody Homes Mfg. Co. Box 1227 Ft. Worth, TX 76101	Maury Owen	X				
TOTAL MANUFACTURERS		6	0	3	3	1
RESPONSES		0	0	0	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
221. Mid-America Homes P.O. Box 765 Madisonville, KY 42431	Frank Chambers			X		
222. Mid-America Homes, Inc. 2821 E. Lincoln Highway Crown Point, IN 46307	D. Kirkendorfer				X	
223. The Midland Company 111 E. 4th Street Cincinnati, OH 45202	C.M. Fellows	X		X		
224. Mid-Low Corporation East Wabash Carrollton, MO 64663	C. Tatlow			X		
225. Midwest Structures, Inc. P.O. Box C Carlisle, IN 47838	H.C. McKinley			X		
226. Midwestern Homes P.O. Box 2064 Rapid City, SD 57701	G. Buckingham				X	
227. Miles Homes 4500 Lyndale, No. Minneapolis, MN 55412	Miles Fiterman				X	
228. Mill-Craft Housing Corp. Box 27A, Tower Road Waupaca, WI 54981	F.W. Schlatterer			X		
229. Millard Lumber Inc. 5005 S. 135th Street Omaha, NE 68137	G.F. Russell				X	
230. Miller Homes Box 1356 Richmond, VA 23211	C.A. Pritchard				X	
TOTAL MANUFACTURERS		1	0	5	5	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
231. Miller & Smith Struct. P.O. Box 141 Gainesville, VA 22065	O.D. Coston, Jr.			X		
232. Minne-Mods, Inc. 113 S. Main Street Hutchinson, MN 55350	Merlin Nygaard			X		
233. Mobile Bldg. Mfg., Inc. 601-B Manning Avenue Sumter, SC 29150	W.J. Lawrence			X		
234. Mobile Home Ind., Inc. P.O. Box 2253 Tallahassee, FL 32304	E.C. Allen	X				
235. Mobile Products Yadkin Road Southern Pines, NC 28387	Norman Black	X				
236. Modcomp Homes, Inc. 12th Street, N.E. Independence, IA 50644	J.J. Fuller			X	X	
237. Mod-U-Kraf Homes, Inc. P.O. Box 573 Rocky Mount, VA 24151	R.K. Fitts			X		X
238. Modulage/Albee Homes 931 Summit Avenue Niles, OH 44446	W. Gross			X		
239. Modular Component Syst. P.O. Box 1837 N. Hollywood, CA 91604	I. Green			X		
240. Modular Corp. of America P.O. Box 2756 Charlotte, NC 28210	H.S. Wenal			X		
TOTAL MANUFACTURERS		2	0	8	1	1
RESPONSES		0	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
241. Modular Manufacturing Inc. 1500 Old Silver Road Belzoni, MS 39038	Joel E. Barnett			X	X	
242. Modular Syst. Dynamics P.O. Box T Rehobeth Beach, DE 19971	T.H. Fooks			X		
243. Modular Syst., Inc. 925 Buckeye Avenue Newark, OH 43055	R.K. Weakley			X		
244. Moduline International P.O. Box 209 Chehalis, WA 98532	L.C. Merta	X				
245. Monarch Ind., Inc. P.O. Box 1 Goshen, IN 46526	R.C. Mynsherge	X				
246. Moore Builders, Inc. P.O. Box 458 Banks, OR 97106	Ben Moore			X		
247. Mullins Homes, Inc. 901 Sears Road Perry, GA 31609	W.G. Mullins			X		
248. Multiport, Inc. Pueblo Memorial Arpt. Pueblo, CO 81004	G.H. Joubin			X		
249. National Building Centers P.O. Drawer 1069 Waco, TX 76703	Ross Kimmel, Jr.			X		X
250. National Homes Corporation Earl Avenue & Wallace Lafayette, IN 47902	George E. Price	X		(X)	X	X
TOTAL MANUFACTURERS		3	0	7	2	2
RESPONSES		0	0	1	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
251. National Housing System P.O. Box 669 Vernon, AL 35592	Larry Tidwell	X				
252. National Modular, Inc. Box 268, Ind. Park N. Columbus, MS 39701	Paul Quinn			X		
253. Nat'l. Mod. Syst. Corp. Black Meadow Road, 578 Chester, NY 10918	Sheldon Goldstein			X		
254. National Structures Inc. P.O. Box 1772 Jasper, AL 35501	G.N. Sparks			X		
255. Nationwide Homes, Inc. 1100 Rives Road Martinsville, VA 24112	J.W. Severt			X		
256. New England Comp., Inc. 799 State Road N. Dartmouth, MA 02747	William Schuler				X	
257. New England Homes, Inc. P.O. Box 464 Portsmouth, NH 03801	Dan J. Donahue			X	X	
258. New Style Homes Hwy. 71, S. Box 607 Pineville, MO 64856	R.C. Durst	X				X
259. New World Housing P.O. Drawer C Hamilton, AL 35570	L.L. Moore			X		
260. Newport Homes Route 443 Pine Grove, PA 17963	Paul E. Moros	X				
TOTAL MANUFACTURERS		3	0	6	2	1
RESPONSES		1	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
261. Nobility Homes, Inc. 1768 SW College Road Ocala, FL 32670	Terry Trexler	X				
262. N. American Housing Corp. Rock Hall Road Point of Rocks, MD 21777	J.R. Triesler			X		
263. Northern Homes, Inc. 10 LaCrosse Street Hudson Falls, NY 12839	M. Carusone	X				
264. Northland Homes 601 Hyde Street Kalkaska, MI 49646	F. Sonderegger			X		
265. Oakwood Mobile Homes Corp. P.O. Box 371 Wilkesboro, NC 28697	James Lavasque	X				
266. Otis International, Inc. Box 3900, Route B New Iberia, LA 70560	H.C. Otis,Jr.			X		
267. Ozark Homes Manufacturing P.O. Box 580 Neosho, MO 64850	D. Caudell	X		X		
268. The O'Connor Corporation 507 Southampton Road Westfield, MA 01085	C.R. O'Connor				X	
269. Pacific Buildings Covington Road Marks, MS 38646	W. King Self				X	
270. Pacific Home Ind. 931 W. Fifth Street Azusa, CA 91702	T.H. Core	X		X		
TOTAL MANUFACTURERS		5	0	5	2	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
271. Palevsky Ind., Inc. 5111 Richmond Road Cleveland, OH 44146					X	
272. D & J Palmer, Inc. Route 6 Matamoras, PA 18336	J.T. Palmer			X		
273. Panama Modular, Inc. 4104 W. 23rd Street Panama City, FL 32401	Wayne Tennyson			X		
274. Panelfab 1600 NW LeJeune Rd. Miami, FL 33126	Milton Fisher		X		X	X
275. J.K. Parker, Inc. 129 Parker Lane Virginia Beach, VA 23454	G.J. Parker				X	
276. Parkline 62 & Winfield Lock Road Winfield, WV	D. Hofstetter			X	X	
277. Parkwood Homes, Inc. P.O. Box 237 Bristol, IN 46507	Ray Bassett	X		X		
278. Frank Paxton Lumber Co. 6311 St. John Avenue Kansas City, MO 64123	D.C. Moreland				X	
279. Pease Company 900 Forest Avenue Hamilton, OH 45012	J.L. Pease, Jr.				X	
280. Pembroke Homes, Inc. 13700 Hooksett Road Hooksett, NH 03105	A.F. Trabucco			X		
TOTAL MANUFACTURERS		1	1	5	6	1
RESPONSES		0	1	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
281. Pemtom, Inc. 8200 Humboldt Avenue S. Bloomington, MN 55431	Bruce Thompson	X		X		
282. Perdue Housing Industry Box 1324 Chickasha, OK 73018	C.V. Perdue			X	X	
283. Perry Bldg. Systems 100 E. 17th Street Rivera Beach, FL 33404	Raymond Barnhart			X		
284. Pioneer Lumber Company Box 38 Dallas City, IL 62330	R.A. Wood			X		
285. Poloron Products 165 Huguenot St. New Rochelle, NY 10801		X		X		
286. Porta House 717 Kevin Court Oakland, CA 94621	Jim Dodge			X	X	
287. Porta-Kamp P.O. Box 7064 Houston, TX 77008	F.E. Bigelow		X			X
288. Post Coach, Inc. 730 Casey Avenue Wilkes-Barre, PA 18702	James B. Post			X		X
289. Prairie Schooner, Inc. 1510 W. Bristol Street Elkhart, IN 46514	Lee Roth	X		X		
290. Pre-Built Structures 2719 Front Avenue Spokane, WA 99202	E.D. Zanck			X		
TOTAL MANUFACTURERS		3	1	9	2	2
RESPONSES		0	1	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
291. Pre-Fabrication Inc. 9226 E. Adm. Place Tulsa, OK 74115	Frank Mance				X	
292. Precision Structures P.O. Box 351 Addison, TX 75001	P.G. Oetking			X		
293. Price-Meyers Corporation 1135 Kent, Box 36 Elkhart, IN 46514	George E. Price	X				
294. Princess Homes, Inc. 2030 State Street San Diego, CA 92101	L. Feller			X		
295. Production Homes, Inc. P.O. Box 96 N. Ridgeville, OH 44029	M.F. Shave			X	X	
296. Quadrant Corporation P.O. Box 130 Bellevue, WA 98009	Dick Willard			X		
297. R & M Corporation 15507 Airline Highway Baton Rouge, LA 70815	Ralph A. Riles			X		
298. Ready Built Homes Box 1983, 408 Comal Austin, TX 78219		X				
299. Reasor Corporation 500 West Lincoln Charleston, IL 61920	Walter Reasor, Jr.			X	X	
300. Redman Mobile Homes, Inc. Redman Plaza Dallas, TX 75229	Lee Posey	X				
TOTAL MANUFACTURERS		3	0	6	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
301. Regal Manufacturing Comp. P.O. Box 389 Twin Falls, ID 83301	L.F. Frazier			X		
302. Republic-Henslee, Inc. 1100 Mercantile Bank Bldg. Dallas, TX 75201	George Guthrie	X				X
303. Reynolds Metals 918 16th Street, N.W. DC 20006					X	
304. Richardson Homes Corp. 2421 S. Nappanee St. Elkhart, IN 46514	S.F. Stitgen	X				
305. Richmond Homes, Inc. P.O. Box 336 Richmond, IN 47374	Arnie Dietz				X	
306. Ridge Homes 1100 Ridge Pike Conshohocken, PA 19428	H. Madway				X	
307. Rite-A-Way Ind., Inc. Box 13, E. Highway 30 Kamball, NE 69145	Joel H. Wiens			X		
308. Rockwood Mod. Inc. 440 S. Front, Box 237 Rockwood, TN 37854	Robert Hill			X		
309. Roycraft Ind., Inc. 117 First Street Chesaning, MI 48616	K.H. Crone			X		
310. Rushmore Homes Box 1944 Rapid City, SD 57701	Del Herr	X		X		
TOTAL MANUFACTURERS		3	0	5	3	1
RESPONSES		1	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
311. Rycenga Homes, Inc. 1053 Jackson St. Grand Haven, MI 49417	Chas. Rycenga				X	
312. St. Regis Paper Company 733 E. 11th Street Tacoma, WA 98421	W.R. Hasleton			X	X	
313. Salem House 9th & Oak Street Berwick, PA 18603	T.R. Judge			X		
314. Sandler Bilt Homes Old Highway 30 Boone, IA 50036	Mike Koufer			X	X	
315. Sanford Co., Inc. P.O. Box 3990 Vernon, AL 35592	E.C. Sanford, Jr.				X	
316. Savina Home Inc. 5700 S. Hoover Road Wichita, KS 67215	M.J. Savina			X		
317. Scholz Homes, Inc. 2001 N. Westwood Ave. Toledo, OH 43607	O.A. Thomas			X	X	X
318. Schult Mobile Home Corp. P.O. Box 151 Middlebury, IN 46540	Walter E. Wells	X				X
319. Scott Rich Homes 710 W. 9th Street Claremore, OK 74017	R. Connely, Jr.			X		
320. Scotty's Home Bldrs. Supply P.O. Box 939 Winter Haven, FL 33880				X		
TOTAL MANUFACTURERS		1	0	7	5	2
RESPONSES		1	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
321. Serendipity Homes, Inc. P.O. Box 2549 San Francisco, CA 94126	R.A. Moe				X	
322. Service Technology Corp. 2345 W. Mockingbird Dallas, TX 75235	W.F. Cramer			X		
323. Seth Lumber Company 128 Motz Avenue Lincolnton, NC 28092	G.L. Hodson				X	
324. Shelter Homes Corporation 1550 E. 78th Street Minneapolis, MN 55423	L.A. Laukka			X		
325. Shelter Mod. Corporation R.D. 2, Box 89 Danville, PA 17821	Alvin Einbender			X		
326. Shelter Resources Corp. Leader Bldg. Cleveland, OH 44114	Carl Glickman	X				
327. Shelterex Corporation 3210 E. Amity Road Boise, ID 83705	Jim White	X				
328. Shurmont Homes Corp. Box 9, Ind. Highway Wrightsville, GA 31096	James Crabb				X	
329. Sigma Ind., Inc. P.O. Box 37 Seale, AL 36875	William Wickham			X		
330. Skyline Corporation 2520 ByPass Road Elkhart, IN 46514	V.D. Swikert	X				
TOTAL MANUFACTURERS		3	0	4	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
331. C.O. Smith Ind., Inc. P.O. Box 490 Moultrie, GA 31768	Cecil Alvis	X		X		
332. Solar Homes, Inc. 700 E. Adams Street Marengo, IA 52301	Larry O. Warner			X		
333. Southern Builders, Inc. E. Green Street, Box 137 Turbeville, SC 29162	J.R. Black			X		
334. Spacemakers, Inc. 146 Will Drive Canton, MA 02021	Stan Miller				X	
335. Spears Mfg. & Eng. Corp. 1904 Byrd Avenue Richmond, VA 23230	P.G. Spears			X		
336. Squire Homes, Inc. P.O. Box 98 Constantine, MI 49042	K.S. Case	X		X		
337. Standard Homes Company Box 1900, 169 & 1-35 Olathe, KS 66061	E.D. Smith				X	
338. Starcraft Homes, Inc. Gowen Field, Box 4393 Boise, ID 83705	R. Williamson			X		
339. Starrett Modular Constr. 880 3rd Avenue New York, NY 10022	Henry Benach			X		X
340. Stearnswood, Inc. P.O. Box 72 Hutchinson, MN 55350	R.H. Stearns			X		
TOTAL MANUFACTURERS		2	0	8	2	1
RESPONSES		0	0	1	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
341. Sterling Custom Homes 225 W. McWilliams St. Fond Du Lac, WI 54935	Earl T. Hunt				X	
342. Stiles-Hatton, Inc. 3050 Breton Road Grand Rapids, MI 49508	F.C. Stiles			X		
343. Style Master Homes, Inc. 7704 Bluffton Road Ft. Wayne, IN 46809	Joseph J. Lebrato			X		
344. Stylex Homes, Inc. 1200 Airport Road Aliquippa, PA 15001	Chas. Pelkey			X		
345. Stylhomes, Inc. 800 S. Broadway Riverton, WY 82501	A.E. Winter			X		
346. Suburban Homes Corp. P.O. Box 428 Valparaiso, IN 46383	L. Paul Saylor			X		
347. Summit Building, Inc. 140 Amelia Street Gretna, LA 70053	C. Ray Grein				X	
348. Summey Building Supply Phil. Church Road Dallas, NC 28034	D.W. Hoyle			X	X	
349. Superior Modular Homes Highway 5, South Tipton, MO 65081	W. H. Ketterlin			X		
350. Sure-Lock Homes, Inc. P.O. Box 1321 Longview, WA 98632	Andrew Thayer			X		
TOTAL MANUFACTURERS		0	0	8	3	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
351. Swift Ind., Inc. 241 Curry Hollow Road Pittsburgh, PA 15061	Ira H. Gordon	X		X	X	
352. Sylvan Homes P.O. Box 68 Syracuse, IN 46571	R.J. Baldwin	X				
353. TRW Inc. 23555 Euclid Avenue Cleveland, OH 44117				X		
354. Taconic Ind., Inc. Box 67 Hollowville, NY 12530	Chas J. Ross			X	X	
355. Taylor Homes 110 Leslie Street Troy, NC 27371	Fred Taylor	X				
356. Tek Homes Corporation R.R. 3, Box 13A Elkhart, IN 46514	Alex Seskin			X		
357. Thrift-Built Housing Syst. 624 Sargent Road Manchester, NH 03103	D. Greenbaum				X	
358. Tidwell Industries P.O. Box 679 Haleyville, AL 35565	Gus Garrard	X				
359. Timber Structures, Inc. P.O. Box 3782 Portland, OR 97208	J.L. Heinz			X	X	
360. Timbercraft Homes R.R. L, Box 60 W. Burlington, IA 52655	R.L. Schwenker			X	X	
TOTAL MANUFACTURERS		4	0	6	5	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
361. Timely Corporation P.O. Box 18165 San Antonio, TX 78218	D.L. Sutton			X		
362. Town & Country M.H. P.O. Box 5003 Wichita Falls, TX 76307	Barry Donnell	X				
363. Travelo Homes Corp. P.O. Box 1427 Saginaw, MI 48605	John Raponos			X		
364. Twin Lakes Mfg. Company P.O. Box 4519 Clearwater, FL 33515	H.L. Marion	X				
365. Twin State Components, Inc. 1600 12th Avenue Orion, IL 61273	R.T. Jones				X	
366. UGI Corporation 1401 Arch Street Philadelphia, PA 19105	William Holmes			X		
367. Unex Building Systems Box 3044 Louisville, KY 40201	Katherine Peden			X		
368. Unibilt Ind., Inc. 4671 Poplar Creek Road Vandalia, OH 45377	Douglas Scholtz			X		
369. Unibuilt Structures Box 460 Charleston, IL 61273	R.T. Jones			X		
370. Union Manufact. & Supply P.O. Box 541 Ft. Collins, CO 80521	Bill Lewis			X	X	
TOTAL MANUFACTURERS		2	0	7	2	0
RESPONSES		0	0	0	0	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
371. United Housing of N.M. Box 2424 Hobbs, NM 88240	J. Johncox	X				X
372. United Modular of Delaware 100 Hay-Edgemoor Wilmington, DE	W.R. Monday			X		
373. United States Financial 1250 Sixth Avenue San Diego, CA 92101	R.H. Walter	X		X		
374. United States Industries 250 Park Avenue New York, NY 10017		X		X		
375. United States Modules,Inc. 2732 W. Missouri Phoenix, AZ 85018	Reed Juett			X		
376. United States Steel Homes 2549 Charlestown Road New Albany, IN 47150	R.E. McDaniel				X	X
377. Unitized Systems Company P.O. Box 127 South Hill, VA 23970	I.L. Hauenstein	X		X		
378. Universal Mod., Inc. 146 Maryville Pike Knoxville, TN 37920	H. Pat Wood			X		
379. Utah Components & Mfg. 1840 S. Sixth, W. Salt Lake City, UT 84104	L.C. Diehl			X		
380. Valley Forge Corporation 750 E. Swedesford Valley Forge, PA 19471	Jas A. Parker			X	X	
TOTAL MANUFACTURERS		4	0	8	2	2
RESPONSES		1	0	0	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
381. Vindale Corp. 4999 Northcutt Place Dayton, OH 45414	Paul S. Riedel	X		X		
382. Vintage Homes, Inc. 3825 NE Expressway Atlanta, GA 30340	T.S. Cheek	X				
383. Virginia Building System P.O. Box 3979 Charlottesville, VA 22903	F. O'Neill			X		
384. W.M.W. Corporation F.M.R. #2444 Corpus Christi, TX 78415	G.E. Zdansky			X		
385. Wakefield Homes, Inc. Barbee Street Spring Hope, NC 27882	R.A. McGilvary			X		
386. Wausau Homes, Inc. 901 N. Cherry Street Wausau, WI 54401	Earle Schuette				X	X
387. Wayne Ind. Bldgs. Inc. 632 Fairport Road C Painesville, OH 44077	C.W. Rhodes			X	X	
388. Wayside Homes, Inc. P.O. Box 1157 Ft. Worth, TX 76101	Bill Norris	X				
389. Del E. Webb Corporation 3800 N. Central Avenue Phoenix, AZ 85011	Del E. Webb				X	
390. Weill - McLain Company 10400 N. Central Exp. Dallas, TX 75231	J. Sommer-halder			X		X
TOTAL MANUFACTURERS		3	0	6	3	2
RESPONSES		0	0	1	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
391. Welbuilt Homes, Inc. 5010 Flint Hill Road Austell, GA 30001	James Dobson			X		
392. West Coast Mills 666 State Chehalis, WA 98532	Ben L. Jones				X	
393. Westland Modulars, Inc. Box 869, 1810 W. 2nd Hastings, NE 68901	W.G. Pauley, Jr.			X		
394. Weston Homes P.O. Box 126 Rothschild, WI 54474	Earl Schuette				X	X
395. Westville Homes Corp. P.O. Box 1 Westville, NH 03892	Adam R. Rizzo			X		
396. Whitman Ind., Inc. 331 Industrial Parkway Ithaca, MI 48847	J.R. Whitman			X		
397. Wick Building System P.O. Box 398 Mazomanie, WI 53560	John F. Wick	X			X	
398. Wickes Corp. 110 W. A Street San Diego, CA 92101	D.C. Walker	X				
399. Winston Delaware 315 Main Street Noel, MO 64854	C.A. Fiford	X				
400. Wonder Mod. Syst., Inc. 3651 Maryland Pkwy. Las Vegas, NV 89109	J.W. Harrison			X		
TOTAL MANUFACTURERS		3	0	5	3	1
RESPONSES		0	0	0	1	

Company Name and Address	Chief Executive	Mobile	Relocatable	Modular	Packaged	Response
401. Wood Components Co. 2125 Cross St. Eugene, OR 97402	G.S. Moshofsky				X	
402. Wood Fabricator 1550 Marietta Way Sparks, NV 89431	W.E. Dennis			X	X	
403. Wood Tech. Corporation 130 Byasee Drive Hazelwood, MO 63047	J.T. Hover				X	
404. Zimmer Homes 777 SW 12th Avenue Pompano Beach, FL 33060	Paul Zimmer	X		X		
TOTAL MANUFACTURERS		1	0	2	3	0
RESPONSES		0	0	0	0	
GRAND TOTALS:						
MANUFACTURERS		110	9	239	121	
RESPONSES		11	9	17	7	38
PERCENT		10	100	7	6	9

APPENDIX II-B

REQUEST FOR INFORMATION FROM SELECTED PRODUCERS OF MANUFACTURED PERMANENT HOUSING

COMPANY HEADQUARTERS:
TELEPHONE:
PERSON CONTACTED:

I. <u>GENERAL INFORMATION</u>

A. What is the type of industrialized building currently produced by your company? (Check)

1. Single-family code complying:
    - a. Single-family detached ☐
    - b. Single-family semi-detached ☐
    - c. Single-family townhouse ☐

2. Other type of manufactured units:
    - a. Garden apartments ☐
    - b. High-rise apartments ☐
    - c. Commercial/Industrial units ☐
    - d. Schools ☐
    - e. Single-wide Mobile Homes ☐
    - f. Double-wide Mobile Homes ☐
    - g. Other (Specify)________________________ ☐

B. How many years has your company been in this business? ________

C. What type of primary structural system do you use for your single-family units?

1. Wood ☐
2. Steel ☐
3. Aluminum ☐
4. Other (specify) ________________________________

D. What is the basic configuration of your industrialized building system?

1. Modular/Sectional ☐
2. Open panel ☐
3. Closed panel ☐
4. Mechanical cores and panels ☐
5. Other (describe)______________________________

____

II. <u>THE SINGLE-FAMILY HOUSING SYSTEM TO BE EVALUATED FOR PERMANENT DISASTER RELIEF</u>

A. Selection of standard models meeting FHA Minimum Property Standards

Table 1 (page 3) lists six types of single-family housing. Please select from your currently marketed houses one specific model for each of these models in the space provided. If you do not produce a model fitting a particular housing type, please leave the space blank.

Since we are interested in the least expensive <u>economy</u> models, please list only those of your standard models that meet <u>applicable current FHA Minimum Property Standards</u> but do not exceed these standards significantly.

Please attach for each of the models selected on Table 1 the following materials:

a. Scaled Foundation Plans
b. Scaled Floor Plans, Sections and Elevations
c. Specifications
d. Any other materials

TABLE 1

SELECTION OF STANDARD MODELS OF MANUFACTURED HOUSING MEETING FHA MINIMUM PROPERTY STANDARDS

HOUSING		1. Name of Model Selected or other Identif.	2. Number of Floors	3. Outside Dimensions	4. Size of Individual Module or Packaged Unit	5. Comments	Total Estimated Current Cost of Complete Unit F.O.B. Plant	
							20 Units	50 Units
2 Bedroom Models	a. Det. ☐ Semi-D. ☐							
	b. Townhouse							
3 Bedroom Models	c. Det. ☐ Semi-D. ☐							
	d. Townhouse							
4 Bedroom Models	e. Det. ☐ Semi-D. ☐							
	f. Townhouse							

6. Assuming a normal production schedule, what is the average total number of complete single-family housing units you can produce during one single shift in each of your plants?

PLANT NAME	LOCATION	PRODUCTION CAPACITY PER SINGLE SHIFT

7. What states are you normally shipping into?

____

B. Transportability

1. Please describe the type of transportation equipment normally used to ship the unit from the plant to the site.

____
____
____
____
____

2. Do you ship by company owned, leased or commercial carrier? ______________________________

3. What is the average distance you ship your units from plant to site? ______________________

4. What is the farthest distance you would consider shipping your unit? ______________________

5. What is the cost/mile for an average shipment?

____

C. Storability

1. Are your units as priced F.O.B. Plant on Table 1 (page 3), packaged for extended storage (e.g. 6 months)?

Exterior (please check) Yes☐ No☐ ____________

Interior (please check) Yes☐ No☐ ____________

Please estimate the cost of such packaging per housing unit.

Exterior $____________

Interior $____________

D. Site Erection

1. Please describe in Table 2 below the extent to which site development, foundation work, site erection, utility hook-up and finishing is typically provided.

TABLE 2

	Site Development	Foundation Work	Site Erection	Utility Hook-Up	Exterior Finishing	Interior Finishing
Your Company						
Dealer						
Subcontractor						
Other (describe)						

2. What special equipment (i.e. cranes, etc.) is typically required to erect your unit on prepared foundations?

____
____
____
____
____
____
____
____
____
____

3. Please estimate the number of days and man-hours required to erect and close in your complete housing unit? (models selected above)

Days ____________________

Man-hours _______________

4. Please estimate the number of days and man-hours required to completely finish out the unit.

Days ____________________

Man-hours _______________

E. Maintenance

1. Please describe the warranty you give your customers on the selected models (enclose copies of such warranties.

____
____
____

F. Lead-Time

1. Please estimate the typical time required from the date a purchase order is placed to the date the above selected models can be completed (Turnkey) on the site, provided that site preparation and foundations do not cause delays. (If there are seasonal differences, please describe.)

G. Miscellaneous

1. Considering the subject of the study, could you suggest other solutions to provide fast delivery permanent housing units consistent with your existing production techniques?

APPENDIX III

THE LEADING INDUSTRIALIZED HOUSING MANUFACTURERS THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

Source: *Directory/Census of Manufactured Housing*,
Section 2-6, 1973
Joint Venture's Survey

APPENDIX III-A

THE LEADING MOBILE HOME MANUFACTURERS, THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

THE GEOGRAPHIC LOCATIONS OF HEADQUARTERS AND PLANTS OF THE MANUFACTURERS LISTED ON THIS TABLE ARE SHOWN ON MAP 2,5

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro-jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com-panies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
1.	APECO[1)]	2100 Dempster Evanston, IL 60204 (312) 869-9000	Clayton Rautbord	H. O.	12,DW	3	3,700	4,100	37-34					--	--	--
a.	CRAFTMADE HOMES	P.O. Box 1185 Henderson, TX 75652 (214) 657-6571	John W. Lowe	H.&P.												
b.	NEWPORT HOMES	Route 443 Pine Grove, PA 17963 (717) 345-8001	Paul E. Moros	H.&P.												
c.	TOWNHOUSE CORP.	Townhouse Dr. Selmer, TN 38375 (901) 645-3491	C.J. Young-erman	H.&P.												
2.	BEATRICE FOODS CO.[1)]	120 S. LaSalle Chicago, IL 60603 (312) 782-3820	B.W. Gannon	H. O.	12,14	6	5,100	5,900	24-26		2	B	A	--	--	--
a.	FAIRWAY HOMES			P. O.												
b.	HOLIDAY HOMES			P. O.												
c.	JACOBSEN MOBILE HOMES, INC.			P. O.												
d.	NEW YORKER HOMES CORP. (MHMA)	701 Collins Rd. Elkhart, IN 46514 (219) 294-1611	D.E.Castello	H.&P.												
e.	PYRAMID MOBILE HOMES, LTD.	4100 Sandwich Windsor,Ont.Can. (519) 969-2700	H. Zekelman	H.&P.												
3.	BENDIX HOME SYSTEMS, INC.[1)]	61 Perimeter Pk. Atlanta, GA 30341 (404) 458-3241	John C. Clayton	H. O.	12,14,DW	23	15,000	17,000	7-7	Bendix Corp.	8	W	A	--		
4.	BRIGADIER INDUSTRIES[1)2)]	234 Main St. Thomson, GA 30824 (404) 595-1507	J.A. Hutchinson	H.&P.	12,DW	4	4,600	6,000	28-25		8	-	C	25,056,	195	46
a.	BEAVER ENTERPRISES			P. O.												
5.	C & G CORP.[2)] (MHMA)	3366 W.Franklin Elkhart, IN 46514 (219) 294-3691	D.L. Greenawalt	H.&P.	-	2	1,624	-	51--		1	W	A	10,374	406	72

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
a.	RAINBOW CORP.			P. O.												
6.	CASTLE INDUSTRIES, INC.2)	P.O. Box 5187 Lubbock, TX 79417 (806) 765-8186	Leonard Wilson	H.&P.	-	1	2,000		49		1	B	C	15,000,	317	61
7.	CELEBRITY HOMES CORP.1)2)	P.O. Box 1622 Athens, GA 30601 (404) 549-9004	P.S. Nestor, Jr.	H. O.	12,14	2	1,350	2,800	53-48		1	B	A		--	--
8.	CELTIC CORP.1)2)	1411 N.Westshore Tampa, FL 33610 (813) 879-3661	C.B. Merrill	H. O.	12,14,DW	5	2,000	4,000	50-38		1	B	A	10,600,	402	71
a.	BRANDON HOMES			P. O.												
9.	CHAMPION HOME BUILDERS1)2)3) (MHMA)	5573 North St. Dryden, MI 48428 (313) 796-2206	Henry E. George	H. O.	12,14,DW	31	35,340	44,000	3-3		8	B	A	29,037,	4	3
10.	CHICKASHA MOBILE HOMES1)2)	P.O. Box 405 Chickasha, OK 73018 (405) 224-2456	Stan Raczynski	H.&P.	12,14	3	3,730	3,670	36-40		1	W	A	21,700,	228	53
11.	COMMODORE CORP.1)2) (MHMA)	8712 W.Dodge Rd. Omaha, NE 68144 (402) 339-1310	Dan Katzman	H. O.	12,14,DW	17	15,680	15,000	6-9		8	W	A	110,718,	27	10
12.	CONCHEMCO, INC.1)2) (MHMA)	10000 Marshall Lenexa, KS 66215 (913) 888-6710	D.W. Techentien	H. O.	12,14,DW	9	5,440	8,400	22-20		8	W	A	32,000,	151	36
a.	NASHUA			P. O.												
b.	WESTCHESTER HOMES CORP.			P. O.												
13.	CONNER HOMES CORP.1)2) (Modular also)	P.O. Box 520 Newport, NC 28570 (919) 223-5121	Wallace Conner	H.&P.	12,14,DW	4	2,300	3,000	48-46		1	W	C	17,247,	288	56

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro- jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com- panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
a.	CONNER INDUSTRIES OF AMERICA			P. O.												
b.	CONNER INDUSTRIES OF ARKANSAS			P. O.												
c.	CONNER INDUSTRIES OF LUBBOCK			P. O.												
14.	DMH COMPANY 1) 2) (MHMA)	1517 Virginia St. Louis, MI 48880 (517) 681-2111	John F. Trask	H. O.	12,14,DW	10	14,000	15,000	8-8	National Gypsum	8	W	A	66,000,	54	17
a.	CLARION HOMES	Box 350 Clarion, PA 16214 (814) 764-3291	C.L. Macan	H.&P.												
15.	DeROSE INDUSTRIES, INC. 1) 2) (MHMA)	4002 Meadows Dr. Indianapolis, IN 46205 (616) 445-2471	R.A. DeRose	H. O.	12,14,16,DW	8	6,460	8,500	19-19		8	W	A	28,091,	171	39
16.	ELCONA HOMES CORP. 1) 2) (MHMA)	P.O. Box 520 Elkhart, IN 46514 (219) 294-1521	W.A. Price	H.&P.	12,14,DW	2	4,000	4,070	31-35		1	W	A	22,104,	223	52
a.	MEMORY HOMES	P.O. Box 1042 Elkhart, IN 46514 (219) 293-0637	Ron M. Linten	H.&P.												
17.	FLEETWOOD ENTERPRISES 1) 2) 3) (MHMA)	P.O. Box 7638 Riverside, CA 92503 (715) 785-3500	Wm. Weide	H.&P.	12,14,DW	37	27,500	31,500	5-4		1	W	A	346,200,	1	1
a.	BARRINGTON/ BROADMORE HOMES			P. O.												
b.	BARRINGTON HOMES OF FLAS.			P. O.												
c.	BROADMORE MOBILE HOMES			P. O.												
d.	FESTIVAL HOMES			P. O.												
e.	FESTIVAL HOMES OF TEXAS			P. O.												
f.	FLEETWOOD HOMES			P. O.												
g.	SUNCREST HOMES			P. O.												

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry: All Companies	Rank Among Giants of The Industry: Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
18.	FUQUA INDUSTRIES, INC. 1)2)	3800 1st Natl.Bk. Atlanta, GA 30303 (404) 658-9000	N. Swisher	H. O.	12,14,DW	10	6,000	7,000	20-23		8	B	A	53,370,	76	20
a.	SECTIONAL HOUSING SYSTEMS			P. O.												
19.	GOLDEN WEST MOBILE HOMES 1)2)	1929 E. St. Andrews Santa Ana, CA 92711 (714) 835-0909	H.E. Karsten,Jr.	H.&P.	12,14,DW	7	3,820	4,500	33-32		8	W	8	40,500,	104	27
a.	KEY WEST HOMES, INC.	821D Mira Loma Sp. Cen. Mira Loma, CA 91752 (714) 685-5243	Lou Bradvica	H.&P.												
20.	GUERDON INDUSTRIES, INC. 1)2)3) (MHMA) (Modular also)	P.O. Box 1259 Louisville, KY 40201 (502) 583-3931	Jack Dahl	H. O.	12,14,DW	42	28,000	30,150	4-5	City Investing Co. New York	8	W	C	172,447,	14	6
a.	AIRE-LINE MOBILE HOMES CORP.			P. O.												
b.	ARMOR MOBILE HOMES MG. CORP.			P. O.												
c.	ARMOR MOBILE HOMES MFG. OF GA.			P. O.												
d.	CAROLINA MOBILE HOMES			P. O.												
e.	EMBASSY HOMES			P. O.												
f.	G & L HOMES			P. O.												
g.	G. M. HOMES			P. O.												
h.	GRAND WESTERN HOMES	P.O. Box 2974 Lubbock, TX 79408 (806) 763-7005	Ernie Reichley	H.&P.												
i.	INTRA AMERICA HOMES			P. O.												
j.	LONERGAN CORP.			P. O.												
k.	MAGNOLIA HOMES MFG. CORP.			P. O.												
l.	MODERNAGE HOMES SALES			P. O.												
m.	RICHLAND HOMES			P. O.												
n.	STATLER HOMES MFG., INC.			P. O.												

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
21.	INTERNATIONAL MOBILE HOMES, INC.2)	1610 S. Cucamonga Ontario, CA 91761 (714) 983-1877	R.E. West	H.&P.	-	1	800		58--	Western Orbis	8	B	A	12,000,	370	68
22.	KAUFMAN & BROAD HOME SYSTEMS, INC.1) 2)	P.O. Box 67753 Los Angeles, CA 90644 (213) 272-7853	Ron Kershaw	H. O.	12,14,DW	7	11,100	11,100	11-13	Kaufman & Broad	8	W	A	284,659,	6	4
a.	BILTMORE HOMES			P. O.												
b.	WAYSIDE HOMES, INC.			P. O.												
23.	KEY COMPANY1) 2) (MHMA)	P.O. Box 20207 Greensboro, NC 27420 (919) 273-2521	-	H. O.	12,DW	2	1,500	2,700	52-50		1	W	A	24,283,	200	48
a.	STERLING HOMES CORP.	P.O. Box 486 Aberdeen, NC 28315 (919) 944-7101	W.T. Weigand	H.&P.												
b.	TWIN LAKES MFG. CO.	P.O. Box 4519 Clearwater, FL 33515 (813) 446-1023	H.L. Marion	H.&P.												
24.	KIT MANUFACTURING COMPANY1) 2) (Modular also)	1401 W. 17 St. Long Beach, CA 90801 (213) 437-7494	Dan Pocapalia	H. O.	10,12,14,DW	9	3,512	5,000	25-30		8	W	F	46,996,	87	25
25.	LANCHART INDUSTRIES1) 2) 3)	C/O R.G. Dickinson & Co. 208 So. LaSalle Chicago, IL 60604	James M. Kelley, V.P.	H. O.	14	4	2,240	3,000	42-44	Shelter Resources (?)	1	B	A	15,087,	311	60
a.	BERKELEY HOMES, INC.			P. O.												
b.	GRAHAM HOMES			P. O.												

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro- jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry	
															All Com- panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
26.	LIBERTY HOMES, INC.$^{1)2)}$ (MHMA)	P.O. Box 35 Goshen, IN 46526 (219) 457-3121	Edward Hussey	H.&P.	10,12,14	8	10,500	11,040	13-14		1	W	A	47,380,	86	24
a.	SYLVAN HOMES	P.O. Box 68 Syracuse, IN 46571 (219) 593-2406	R.J. Baldwin	H.&P.												
27.	LUDLOW CORPORATION$^{1)2)}$ (Modular also)	145 Rosemary St. Needham Hts.,MA 02194 (617) 444-4900	Chas. Chandler	H. O.	12,14,DW	4	2,275	3,100	47-43		8	W	C	26,573,	183	41
a.	ALLIED MFG. CORP.	P.O. Box 390 Dowagiac, MI 49047 (616) 782-8604	Dale Lyons	H.&P.												
b.	VIKING - EDGEWOOD CORP.			P. O.												
28.	MAJESTIC INDUSTRIES, INC.$^{3)}$	P.O. Box 5577 714 Falvey Ave. Texarkana, TX 75501 (214) 838-7585	Henry P. Eckstein	H.&P.	-	1	1,200	-	55--		4	B	C			
29.	MARK IV HOMES, INC.$^{1)2)}$ (Packaged also)	Hampton Ind. Pk. Taylor, PA 18504 (717) 961-5311	P. Delaney	H.&P.	12,EX	5	2,760	3,760	43-39		8	B	-	23,341,	209	50
a.	CROWN HOMES, INC.	Hampton Ind. Pk. Taylor, PA 18504 (717) 562-0180	Frank Bevlock	H.&P.												
b.	HOMES BY DUNHILL			P. O.												
c.	ROYCRAFT IND. INC.	117 First St. Chesaning, MI 48616 (517) 845-3011	K.H. Crone	H.&P.												
30.	MARLETTE HOMES, INC.$^{1)2)}$ (MHMA)	3305 Wilson St. Marlette, MI 48453 (517) 635-7521	Wayne L. Swett	H.&P.	12,14,DW	6	3,874	4,000	32-37		8	W	C	80,000,	43	16
31.	MELODY HOME MANUFAC- TURING COMPANY$^{1)2)}$	Box 1227 Ft. Worth, TX 76101 (817) 232-0350	Maury Owen	H.&P.	12,14	1	2,600	3,000	44-45		1	W	A	13,715,	340	63

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro-jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com-panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
a.	PANLSEL LUMBER			P. O.												
32.	THE MIDLAND CO.1)2) (MHMA) (Modular also)	111 E. 4 St. Cincinnati, OH 45202 (513) 721-3777	C.M. Fellows	H. O.	12,EX,DW	4	6,940	7,500	18-21		8	W	F	48,602,	82	22
a.	ALTAIR HOMES, INC.			P. O.												
b.	CULLIP IND., INC.	P.O. Box 386 Ellaville, GA 31806 (912) 937-2421		H.&P.												
c.	GEM HOMES, INC.			P. O.												
d.	HORIZON MOBILE HOMES			P. O.												
33.	MOBILE HOME INDUSTRIES, INC.1)2)	P.O. Box 2253 Tallahassee, FL 32304 (904) 224-5111	E.C. Allen	H. O.	12,DW	3	2,030	2,800	48-47		1	B	A	13,113,	350	65
a.	HOUSING BY TIFFANY			P. O.												
b.	HOUSING BY VOGUE			P. O.												
34.	MODULINE INTERNATIONAL1)2) (MHMA)	Box 209 969 Pacific Chehalis, WA 98532 (206) 748-6626	L.C. Merta	H. O.	12,14,DW	5	3,600	5,000	39-29		8	B	S	23,132,	212	51
35.	MONARCH INDUSTRIES, INC.1)2) (MHMA)	P.O. Box 1 Goshen, IN 46526 (219) 533-9581	R.C. Mynsherge	H. O.	12,14,DW	6	5,660	6,500	21-24		8	W	A	34,000,	132	33
a.	FAWN HOMES			P. O.												
b.	REGENT HOMES			P. O.												
c.	AUTOMATED BLDG. CO.	P.O. Box 1 Goshen, IN 46526 (219) 533-9581	Chas. Teall	H.&P.												
d.	CAMBRIDGE HOMES			P. O.												
36.	NATIONAL MOBILE HOMES1)2) (Modular & Packaged also)	Earl Ave. & Wallace Lafayette, IN 47902 (317) 447-3131	George E. Price	H.&P.	12,14,DW	9	12,272	13,500	10-10	National Homes Corp.	5	W	F	242,655,	7	5

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro-jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry: All Com-panies	Rank Among Giants of The Industry: Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
a.	OLD ORCHARD HOMES, INC.			P. O.												
37.	NEW STYLE HOMES, INC.3)	P.O. Box 607 Pineville, MO 64856 (417) 223-4356	Robert D. Durst	H.&P.	-	-	1,200	-	56--		1	B	A	--	--	--
38.	NOBILITY HOMES, INC.1)2)	1768 SW College Ocala, FL 32670 (904) 622-5157	Terry Trexler	H.&P.	12,14,DW	9	4,960	7,000	26-22		8	B	A	23,964,	202	49
a.	JAMISON HOMES, INC.			P. O.												
b.	NOBILITY HOMES OF GA.			P. O.												
c.	NOBILITY HOMES OF IND.			P. O.												
d.	NOBILITY HOMES OF N.C.			P. O.												
e.	NOBILITY HOMES OF TEXAS			P. O.												
f.	BRADFORD HOMES			P. O.												
g.	KINGSWOOD HOMES			P. O.												
39.	OAKWOOD MOBILE HOMES CORP.2)	P.O. Box 371 Wilkesboro, NC 28697 (919) 667-1157	-	H. O.	-	1	1,295		54--		1	W	A	16,478,	297	57
a.	HOMES BY FISHER, INC.			P. O.												
40.	PARKWOOD HOMES, INC.1)2)	E. Cty. Rd. 8 Box 237 Bristol, IN 46507 (219) 848-4421	Ray Bassett	H.&P.	12,14,DW	5	4,950	5,300	27-28		1	W	C	32,366,	148	35
a.	B.& J WOODCRAFT, INC.			P. O.												
b.	MONTEREY HOMES			P. O.												
41.	POLORON HOMES, INC.2) (MHMA) (Modular also)	74 Ridge Road Middleburg, PA 17842 (717) 837-1515	Ron A. Johnson	H.&P.	-	1	4,600		29--	Poloron Products	8	B	F	25,700,	193	45

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
42.	PRICE MEYERS CORPORATION 1)2) (MHMA)	1135 Kent Box 36 Elkhart, IN 46514 (219) 264-0761	George E. Price	H.&P.	12,14,EX,DW	3	3,700	2,760	38-49		1	W	A	18,490,	267	54
a.	HOLIDAY HOUSE, INC.			P. O.												
b.	LONDON HOMES			P. O.												
43.	REDMAN MOBILE HOMES, INC. 1) (MHMA)	Redman Plaza Dallas, TX 75229 (214) 350-3761	Lee Posey	H. O.	12,14,DW	21	39,620	49,630	2-2	Redman Industries	1	B	A	--	--	--
a.	HALLMARK HOMES	Box 5237, D. Bowles Augusta, GA 30901 (404) 798-0043	A.T. Mulherin,Jr.	H.&P.												
b.	CLEARSPAN COMPONENTS	P.O. Box 4195 Meridian, MS 39301 (601) 483-3941	J.L. McRae	H.&P.												
c.	LAS BRISAS HOMES			P. O.												
44.	REPUBLIC-HENSLEE, INC. 2)3)	1100 Mercantile Bank Blg. Dallas, TX 75201 (214) 748-0431	George Guthrie	H. O.	-	4	2,557	-	45--	Republic Housing Corp.	1	W	C	25,735,	192	44
45.	RICHARDSON HOMES CORPORATION 1)2) (MHMA)	2421 S. Nappanee St. Elkhart, IN 46514 (219) 523-1030	S.F. Stitgen	H.&P.	12,14,DW	8	10,500	11,000	14-15	Great Southwest Corp. (Penn Central)	1	W	A	47,700,	85	23
46.	SCHULT MOBILE HOME CORPORATION 3) (MHMA)	P.O. Box 151 Middlebury, IN 46540 (219) 522-2850	Walter E. Wells	H.&P.	12,14,DW	7	8,200	9,000	17-17	Inland Steel	8	W	A	95,000,	--	--
a.	PRESIDENTIAL HOMES	Arney's Mt. Rd. Pemberton, NJ 08068 (609) 894-8201	R.L. Duffield	H.&P.												

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry	
															All Companies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
47.	SHELTER RESOURCES CORPORATION1) 2)	Leader Bldg. Cleveland, OH 44114 (216) 861-4600	Carl Glickman	H. O.	12,14,DW	16	13,670	17,000	9-6		1	B	A	102,779,	28	11
a.	LANCER MOBILE HOMES			P. O.												
b.	MONTEREY HOMES			P. O.												
c.	WINSTON-DELAWARE, INC.	315 Main St. Noel, MO 64854 (417) 475-3171	C.A. Fiford	H.&P.												
48.	SKYLINE CORPORATION1) 2) (MHMA)	2520 ByPass Rd. Elkhart, IN 46514 (219) 294-6521	V. Dale Swikert	H. O.	12,14,DW	33	57,000	62,000	1-1		1	W	A	338,000,	2	2
a.	ACADEMY MOBILE HOMES			P. O.												
b.	BUDDY MOBILE HOMES	17th & Hively Elkhart, IN 46514 (219) 293-2581	Tommy Thompson	H.&P.												
49.	C.O. SMITH INDUSTRIES, INC.1) 2) (MHMA) (Modular also)	P.O. Box 490 Moultrie, GA 31768 (912) 985-7717	Cecil Alvis	H.&P.	12,14,DW	3	3,750	4,000	35-36		8	B	C	26,402,	187	42
a.	TALL OAKS HOMES			P. O.												
b.	PEACHTREE HOUSING			P. O.												
50.	TAYLOR HOMES1)	110 Leslie St. Troy, NC 27371 (919) 576-6411	Fred Taylor	H.&P.	12,DW	4	2,500	3,200	46-42		1	W	C	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry	
															All Com- panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
51.	TIDWELL INDUSTRIES 1)	P.O. Box 679 Haleyville, AL 35565 (205) 486-9221	Gus Garrard	H. O.	12,14,DW	6	9,180	12,500	14-11		1	B	A	--	--	--
a.	BRISTOL HOMES			P. O.												
b.	DOLPHIN HOMES			P. O.												
c.	MARION HOMES			P. O.												
d.	MIDLAND HOMES			P. O.												
52.	TOWN & COUNTRY MOBILE HOMES, INC. 1) 2)	P.O. Box 5003 Wichita Falls, TX 76307 (817) 723-5523	Barry Donnell	H. O.	12,DW	6	3,290	3,300	40-41		1	B	C	28,529,	167	38
a.	QUALITY MOBILE HOMES			P. O.												
53.	U.S. INDUSTRIES 1) 2) (MHMA) (Modular also)	250 Park Ave. New York, NY 10017 (212) 697-4141	-	H. O.	12,14,DW	8	8,486	10,800	15-16		8	W	A	60,013,	63	18
a.	A&S STEEL BUILDINGS	P.O. Box 49900A Houston, TX 77040 (713) 466-7521	J.J. Warmuth	H.&P.												
b.	CENTRAL HOMES	237 22nd St. Greely, CO 80631 (303) 353-3533	Chas. A. Rymes	H.&P.												
c.	ISEMAN MOBILE HOMES			P. O.												
d.	GERRING IND., INC.	Route 1, Box 1-B Shipshewana, IN (219) 768-4133	Hal Gerring	H.&P.												
e.	SHAR-LO HOMES			P. O.												
f.	WESTERN MOBILE HOMES	1185 Oak St. Denver, CO 80215 (303) 238-8191	-	H.&P.												
54.	UNITED HOUSING OF NEW MEXICO 3)	P.O. Box 2424 Hobbs, NM 88240 (505) 392-6567	Jesse Johncox	H.&P.	-	1	1,000	-	57--		8	W	A	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
55.	VINDALE CORPORATION 1) 2) (MHMA) (Modular also)	4999 Northcutt Pl. Dayton, OH 45414 (513) 278-0691	Paul S. Riedel	H. O.	12,14,DW	4	3,800	4,100	34-33		1	-	-	35,699,	126	32
a.	CROSSLAND HOMES	615 Davis St. Crossville, TN 38555 (615) 484-7511	Paul S. Riedel	H.&P.												
56.	VINTAGE HOMES, INC. 1) 2)	3825 NE Expressway Atlanta, GA 30340 (404) 455-3144	T.S. Cheek	H. O.	12,DW	4	4,600	5,000	30-31		1	B	C	26,000,	189	43
a.	VINTAGE ENTERPRISES, INC.			P. O.												
57.	WICK BUILDING SYSTEMS 1) 2) (Packaged also)	P.O. Box 398 Mazomanie, WI 53560 (608) 795-2221	John F. Wick	H. O.	12,14,DW	9	8,300	8,620	16-18		2	W	S	86,962,	37	15
a.	ARTCRAFT HOMES			P. O.												
b.	MARSHFIELD HOMES	P.O. Box 1479 Henderson, NC 27536 (919) 492-3031	Jack R. Porter	H.&P.												
58.	WICKES CORP. 1) 2) (MHMA)	110 W. A St. San Diego, CA 92101 (714) 238-0304	-	H. O.	12,14,DW	11	10,600	12,000	12-12		1	W	A	101,605,	12	30
a.	KAINAI IND., LTD.			P. O.												
b.	WICKES HOMES			P. O.												
c.	WICKES MFTRD HOMES			P. O.												
59.	ZIMMER HOMES CORPORATION 1) 2) (MHMA) (Modular also)	777 SW 12 Ave. Pampano Beach, FL 33060 (305) 943-7600	Paul Zimmer	H.&P.	12,14,DW	5	5,300	5,500	23-27		1	B	C	36,190,	124	31
a.	PRINCESS HOMES			P. O.												
b.	WINDSOR MOBILE HOMES, INC.			P. O.												

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
TOTAL NUMBER OF PLANTS						470										
AVERAGE NUMBER OF PLANTS PER COMPANY						8										
NUMBER OF "GIANTS" AMONG 50 LEADING MANUFACTURERS																43
PERCENT																86

SUMMARY STATISTICS
FOR 50 LEADING COMPANIES WITH REPORTED AND PROJECTED PRODUCTION RATES FOR 1972 AND 1973

		1972	1973	PROJECTED % INCREASE
TOTAL NUMBER OF UNITS		457,289	529,300	16
AVERAGE NUMBER OF UNITS PER COMPANY		9,146	10,586	16
TOTAL NUMBER OF PLANTS	458			
AVERAGE NUMBER OF PLANTS PER COMPANY	9			
AVERAGE NUMBER OF UNITS PER PLANT		998	1,156	16
MEDIAN NUMBER OF PLANTS PER COMPANY	5			
MEDIAN NUMBER OF UNITS PER COMPANY		4,850	5,950	

EXPLANATORY NOTES TO APPENDIX III-A

THE LEADING MOBILE HOME MANUFACTURERS, THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

Column	Item	Example	Source of Information	Explanation
a	ID #	1.	Alphabetical sequence	ID # identifying alphabetically parent companies on table & map
		a.	"Corporate Who's Who" Directory/Census of Manufactured Housing, Section 1, 1974	Letter identifying alphabetically subsidiaries owned by respective parent co.
b	Company Name	Apeco[1]	"Top 50 Mobile Home Producers" Manufactured Housing Newsletter, Mfrd. Housing, Section 6, Nov. 73	One of 50 mfrs. leading in terms of projected prod. of units in 1973
		Castle Industries[2]	"Housing's Giants," Professional Builder, July 1973	One of the 419 companies leading in terms of total $ volume in 1972
		Majestic Industries[3]	Joint Venture's Survey	One of the mfrs. who expressed interest in this study re. Joint Venture's nationwide request for info.
c	Address & Phone		Directory/Census of Manufactured Housing, Section 2-6, 1973	Location of firm
d	Chief Exec.		same	Chief executive of firm
e	Facility Here	H. O. H & P P. O.	same	Headquarters Only Headquarters & Plant Plant Only * * The table only lists "Plants Only" for subsidiaries who have no headquarters of their own
f	Products	12, 14, DW	same	12 ft. wide mobile homes 14 " " " " double " " "
g	# Plants	6	"Top 50 Mobile Home Producers"	No. of manufacturing facilities

Column	Item	Example	Source of Information	Explanation
h	Units Produced 1972	5,440	same "Housing's Giants"	Number of units produced in 1972
i	Units Projected 1973	8,400	"Top 50 Mobile Home Producers"	In source referred to as "Current Rate of Annual Production"
j	Rank 72 73	31-35	Based on prod. #'s in columns h & i	Numerical ranking of 72 and 73 production
k	Subsidiary of	National Gypsum	"Corporate Who's Who," Directory/Census of Mfrd. Housing, Section 1, 1974	
l	Type of Units	1 2 3 4 5 6 7* 8	Directory/Census of Mfrd. Housing, Section 2-6, 1973	Single family Single/Multi-family Multi-family Vacation Single/Multi & Vacation Single/Multi & Light Commercial Light Commercial Double Wide Mobiles * Excluded from study
m	Material	W M C* B P	same	Wood Metal Concrete Combination Plastic * Excluded from study
n	Code	F A S C	same	FHA, BOCA ANSI, 119.1 State/Local Combination
o	$ Volume 1972 (In 000's)	28,091	"Housing's Giants"	Total volume of co.; may include income from other sources plus income from mfrd. housing
	Rank Among "Housing's Giants"		Based on "Housing's Giants"	
p	All Companies	86		All builders and mfrs.
q	Mfrs. Only	24		Only manufacturers and builders with manufacturing facilities.

APPENDIX III-B-1

THE LEADING MODULAR HOME MANUFACTURERS, THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

THE GEOGRAPHIC LOCATIONS OF HEADQUARTERS AND PLANTS OF THE MANUFACTURERS LISTED ON THIS TABLE ARE SHOWN ON MAP **2,6**

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry: All Companies	Rank Among Giants of The Industry: Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
1.	ATLAS PORTABLE BUILDING CO.1)	4034 Canyon Dr. Amarillo, TX 79109 (806) 335-1693	G.R. Campbell	H.&P.	M	1	520	520	26-43		6	B	F	--	--	--
2.	AURORA MODULAR INDUSTRIES1)	16831 Krameria Riverside, CA 92504 (714) 688-9710	R.J. Kothlow	H.&P.	M;MB	1	1,200	1,200	5-12	U.S. Financial (In bankruptcy proceedings)	6	W	S	--	--	--
3.	BOISE CASCADE MFTD. HOUSING1)2)3)4) WESTERN OPERATIONS	P.O. Box 8358 Boise, ID 83707 (208) 384-6460	Larry C. Geyer	H. O.	M/S	10	(1,800) Prof. Builder	3,650	(2)-1	Boise Cascade Corp.	5	W	C	172,000,	15	7
a	KINGSBERRY HOMES3)4) (NABM)	61 Perimeter Pk. Atlanta, GA 30341 (404) 458-9411	Rudy A. Brown	H. O.	M/S	(4)										
4.	BUTLER HOMES, INC.1)	P.O. Box 667 Butler, GA 31006 (912) 862-3889	Phil Carroll,Jr.	H.&P.	M	1	530	630	25-37		2	W	F	--	--	--
5.	CAPITAL INDUSTRIES, INC.1)2) (NABM)	P.O. Box 326 Avis, PA 17721 (717) 398-2062	Jack W. Croes	H.&P.	M	1	1,100	825	6-27	UGI Development Company	1	W	F	14,367,	330	62
6.	CARDINAL INDUSTRIES1)3)4) (NABM)	2040 S. Hamilton Rd. Columbus, OH 43227 (614) 861-3211	Austin Guirlinger	H.&P.	M;P	1	1,000	1,550	8-7		2	W	F	--	--	--
7.	CENTURY MODULAR HOMES1)	P.O. Box 737 Ft. Morgan, CO 80701 (303) 867-8547	D.H. Hawkins	H.&P.	M;MB	1	380	650	36-35		6	W	F	--	--	--
8.	COMMUNITY TECHNOLOGY CORP.1)3)4)	1 Space Park, Bldg. El Redondo Beach,CA 90278 (213) 536-2233	A.V. Sommer	H. O.	M;P	1	210	980	41-20	TRW Systems	2	B	F	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro-jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com-panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
9.	CONSTRUCTION MODULES, INC. 1)	Box 2570 San Antonio, TX 78299 (512) 226-5263	R.E. Hood	P. O.	M	1	824	900	13-24	H.B. Zachry Co. P.O. Box 21130 San Antonio, TX 78221	6	W	F	--	--	--
10.	COORDINATED BUILDING SYSTEMS 1)	8500 Glendale Milford Rd. Camp Dennison, OH 45111 (513) 831-9725	G.L. Crump	H.&P.	M	1	--	1,000	--14		-	-	-	--	--	--
11.	CRAFTMARK HOMES, INC. 1)3)4) (NABM)	Box 175 4595 Morgan Liverpool, NY 13088 (315) 457-8900	J.S. Caldwell, III	H.&P.	M/S;P	2	210	500	42-50		2	W	F	--	--	--
12.	DELTONA CORPORATION 1) 2)	8430 Bradenton Rd. Sarasota, FL 33580 (813) 756-1861	F.E. Mackle	H. O.	M	1	610	500	21-49		1	-	F	128,689,	24	9
13.	DELUXE HOMES OF PA., INC 1)3)	P.O. Box 323 Berwick, PA 18603 (717) 752-5914	Tom Cox	H.&P.	M/S	1	200	640	--36	Previously Fleetwood; since 6/73 Donald E. Meske Enterprises, Berwick	5	B	C	--	--	--
14.	DEVELOPMENT INTER-NATIONAL CORP. 1) 2)	2801 Ponce De Leon Coral Gables, FL 33100 (305) 445-9611	Fred Epstein	H.&P.	M	1	1,050	900	7-23		2	B	F	26,659,	182	40
15.	DONN BUILDING SYSTEMS 1)	1000 Crocker Rd. Cleveland, OH 44145 (216) 871-1000	D.L. Foss	H.&P.	M	1	1,000	1,000	9-19	Donn Products	6	B	F	--	--	--
16.	DUKOR MODULAR SYSTEMS, INC. 1) (discontinued modular production)	2525 El Camino Real Redwood City, CA 94061 (415) 368-2912	G.K. Bissell	H.&P.	(M)	1	700	500	18-48	Sobey Dev. Co.	2	W	F	--	--	--
17.	ELITE MODULE SYSTEMS 1)	14 Alleyne St. Quincy, MA 02169	E.H. Wood	H.&P.	M	1	--	780	--29		6	W	F	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry	
															All Companies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
18.	ENDE CO., INC.1)	3270 W 2196 S Salt Lake City,UT 84119 (801) 487-5856	G.C. Jenkins	H.&P.	M;P	1	497	550	32-39		5	W	C	--	--	--
19.	ENVIROHOUSING, INC.1)	P.O. Box 67 Birdsboro, PA 19508 (215) 582-2255	Harlan Cohen	H.&P.	M	1	200	600	44-38		5	W	F	--	--	--
20.	ENVIRONMENTAL COMMUNITIES3)4)	14296 E. 6 St. P.O. Box 1700 Corona, CA 91720 (714) 734-1010	J.I. Moon	H.&P.	M;MB	1	200	--	46--		5	W	C	--	--	--
21.*	FCE-DILLON1)2)	1730 Akron Penn Rd. Akron, OH 44303 (216) 929-4244	Thomas J. Dillon	H.&P.	M	1	2,133	3,600	1-2	Forest City Enterprises, Cleveland, OH	3	C	F	95,080,	31	13
a.	PRECISION PRECAST			P. O.												
b.	TECON PACIFIC			P. O.												
22.*	FORMIGLI CORPORATION1)	P.O. Box F Berlin, NJ 08009 (609) 769-1111	Paul W. Gleason	H.&P.	M	1	--	1,500	--8		3	C	C	--	--	--
23.	GIBRALTER INDUSTRIES, INC.1)	725 North Point Rd. Baltimore, MD 21237	Fred Painter	H.&P.	M	1	800	500	14-47		1	W	F	--	--	--
24.	GLEN MANOR HOMES3)4) GLENWOOD HOUSING CORP. (POST COACH, INC.)	R.D. 2, Box 89 Danville, PA 17821 (717) 437-2044	Robert E. Paterson	H.&P.	M/S	3	1,000	--	12--	Post Coach Inc	5	W	F	--	--	--
25.	GRUMMAN MODULAR BUILDINGS3)	600 Old Country Rd. Garden City, NY 11530 (516) 741-3500	Robert J. Farren	H. O.	M	2	--	--	- -	Grumman Corp.	5	B	S	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
㉖.	GUERDON INDUSTRIES, INC.1)2)3)4) (NABM) (Mobile also)	P.O. Box 1259 Louisville, KY 40201 (502) 583-3931	Jack Dahl	H. O.	M/S;MB	7	800	1,000	15-18	City Investing Co., New York	8	W	C	172,447,	14	6
a.	INTRA AMERICA HOMES			P. O.												
b.	LONERGAN CORP.			P. O.												
c.	MAGNOLIA HOMES MFG. CORP.			P. O.												
27.	HALLAMORE HOMES1)	18060 Euclid Fountain Valley, CA, 92708 (714) 540-1583	L.G. Hallamore	H.&P.	M	2	700	700	19-34		6	W	F	--	--	--
28.	HECKAMAN INDUSTRIES1)	Box 229, RR 1 Nappanee, IN 46550 (219) 773-4167	Ivo Heckaman	H.&P.	M	1	450	550	33-41		6	W	F	--	--	--
29.	HESSEE INDUSTRIES, INC.1) (DOMINO HOMES)	20300 Civic Ctr Dr. Southfield, MI 48076 (313) 352-3250	Claude T. Hessee	H. O.	M	1	1,250	1,250	3-10		3	W	F	--	--	--
30.	HODGSON HOUSES, INC.2)	540 Madison Ave New York, NY 10022 (212) 355-0200	R.D. Silver	H. O.	M;MB;P	4	225	1,100	40-13		5	W	C	--	--	--
a.	SALEM HOUSE			P. O.												
31.	HOME BUILDING CORPORATION1)	P.O. Box 1213 Sadalia, MO 65301 (816) 826-4550	Neil Reyburn	H.&P.	M	1	725	725	17-31		2	W	F	--	--	--
32.	LSI HAWAIIAN HOMES1)	91250 Kalaelae Ewa, Oahu, HI 96707 (808) 682-4511	K.A. Ruck	H.&P.	M	1	--	700	--33	Lear Siegler	6	B	F	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	 Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(g)
33.	LENOIR INDUSTRIES, INC.1)	Box 190 Town Cr. Rd. Lenoir City, TN 37771 (615) 986-8056	William Hall	H.&P.	M	1	500	2,000	27-5		6	W	F	--	--	--
34.	LESTER HOMES3)	P.O. Box 2188 Barrows Mill Rd. Martinsville, VA 24112 (703) 632-2234	Lawson Lester	H.&P.	M	1	-	-	- -		-	-	-	--	--	--
㉟	MANUFACTURED HOMES, INC.3)4)	40 Lexington Pk. Dr. Elkhart, IN 46514 (219) 294-5463	Robert Willard	H. O.	M/S;MB	1	400	-	34--		8	W	F	--	--	--
36.	MARLETTE HOMES, INC.1)2)	3305 Wilson St. Marlette, MI 48453 (517) 635-7521	Wayne L. Swett	H.&P.	M;MB	2	-	3,200	--4		8	W	C	80,000,	43	16
37.	MOD-U-KRAF HOMES, INC.3) (NABM)	P.O. Box 573 Rocky Mount, VA 24151 (703) 483-0291	R.K. Fitts	H.&P.	M;P	2	200	-	47--		1	W	F	--	--	--
㊳	MODULAGE/ALBEE HOMES, INC.1)3)4)	931 Summit St. Niles, OH 44446 (216) 652-5861	Wm. Gross	H.&P.	M/S	1	600	800	22-28		6	W	F	--	--	--
39.	MODULAR CORP. OF AMERICA1)3)	P.O. Box 2756 Charlotte, NC 28210 (704) 376-0272	H.S. Wenal	H.&P.	M	2	300	3,500	--3		6	W	C	--	--	--
㊵	NBC MODULAR HOMES1)3)4)	P.O. Drawer 1069 WACO, TX 76703 (817) 772-3010	Ross Kimmel, Jr.	H. O.	M/S	5	500	500	28-45	National Building Centers (Lone Star)	1	W	F	--	--	--
41.	NATIONAL HOMES CORPORATION1)2)3)4) (Phased out modular plants)	Earl Ave. & Wallace Lafayette, IN 47902 (317) 447-3131	George E. Price	H.&P.	(M);MB;P	2	542	546	24-42		5	W	F	242,655,	7	5

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry	
															All Companies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
42.	NATIONWIDE HOMES, INC.1) (NABM)	1100 Rives Rd. Martinsville, VA 24112 (703) 632-7101	J.W. Severt	H.&P.	M	1	800	850	16-26		2	W	F	--	--	--
43.	NEW ENGLAND HOMES, INC.1) (NABM)	P.O. Box 464 Portsmouth, NH 03801 (603) 436-8830	Dan J. Donahue	H.&P.	M;P	2	250	850	37-25		5	B	F	--	--	--
44.	PARKLINE1)	62 & Winfield Lock Road Winfield, WV (304) 586-2113	D. Hofstetter	H.&P.	M;P	1	-	975	--21		6	M	F	--	--	--
45.	PARKWOOD HOMES, INC.1)2)	E. Cty. Rd. 8 Box 237 Bristol, IN 46507 (219) 848-4421	Ray Bassett	H.&P.	M;MB	3	226	500	39-44		8	B	F	32,366,	148	35
46.	POLORON PRODUCTS1)2) (NABM)	165 Huguenot St. New Rochelle, NY 10801 (914) 636-5300	-	H. O.	M;MB	1	1,000	1,152	10-13		8	B	F	25,700,	193	45
a.	POLORON HOMES			P. O.												
47.*	RELBEC CORP.1)	P.O. Box AZ Rio Piedras, PR 00928 (809) 765-4370	F.F. Sanchez	H.&P.	M	1	-	908	--22		6	C	F	--	--	--
48.	ROYCRAFT INDUSTRIES, INC.1)	117 First St. Chesaning, MI 48616 (517) 845-3011	K.H. Crone	H.&P.	M	1	557	557	23-40	Mark IV Homes	6	W	F	--	--	--
49.*	SHELLEY SYSTEMS, INC.1)	400 Park Ave. New York, NY 10022 (212) 486-9424	S.W. Shelley	H. O.	M	1	-	1,000	--17		3	C	C	--	--	--
a.	SHELLEY ENTERPRISES	GPO Box 4465 San Juan, PR 00936 (809) 769-1313	Dan Shelley	H.&P.												

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry: All Companies	Rank Among Giants of The Industry: Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
50.	C.O. SMITH INDUSTRIES, INC.[2]	P.O. Box 490 Moultrie, GA 31768 (912) 985-7717	Cecil Alvis	H.&P.	M;MB	2	200	-	45--		8	B	C	26,402	187	42
a.	TALL OAKS HOMES			P. O.												
51.	SPEARS MFG. & ENG. CORP.[1]	1904 Byrd Ave. Richmond, VA 23230 (703) 358-6858	P.G. Spears	H.&P.	M	1	500	1,250	29-11		6	B	S	--	--	--
52.	STARRETT MODULAR CONSTRUCTION[1]	880 3rd Ave. New York, NY 10022 (212) 751-3100	Henry Benach	H. O.	M	2	700	1,000	20-16		3	B	F	--	--	--
53.	STILES-HATTON, INC.[1]	3050 Breton Rd. Grand Rapids, MI 49508 (616) 364-8335	F.C. Stiles	H.&P.	M	1	1,000	1,000	11-15		2	W	C	--	--	--
54.	STYLEX HOMES, INC.[1]	1200 Airport Rd Aliquippa, PA 15001 (412) 375-7758	Chas. Pelkey	H.&P.	M	2	-	750	--30		6	W	-	--	--	--
55.	SUBURBAN HOMES CORPORATION[1] (NABM)	P.O. Box 428 Valparaiso, IN 46383 (219) 762-2118	L. Paul Saylor	H.&P.	M	-2	500	700	30-32		2	W	F	--	--	--
56.	TEK HOMES[3]	RR #3, Box 13A Elkhart, IN 46514 (219) 293-7551	Alex Seskin	H.&P.	M	1	400	-	35--		2	B	F	--	--	--
57.	TIMELY CORP.[1]	P.O. Box 18165 San Antonio, TX 78218 (512) 655-5660	D.L. Sutton	H.&P.	M	1	500	525	31-46		1	W	F	--	--	--
58.	UNITIZED SYSTEMS COMPANY (USCO)[1][2][3] (NABM) (phasing out modular production)	P.O. Box 127 South Hill, VA 23970 (703) 447-3165	I.L. Hauenstein	H.&P.	(M);MB	1	1,228	1,500	4-9	Universal Leaf Tobacco Co.	6	B	F	12,239,	365	67

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro-jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com-panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
59.	VALLEY FORGE CORPORATION1) 2)	750 E. Swedes-ford Valley Forge, PA 19471 (215) 687-5000	Jas. A. Parker	H. O.	M;P	2	250	500	38-47	Certain-teed Products Corp.	2	W	F	50,605,	79	21
a.	CONCORD HOMES (NABM)			P. O.												
b.	LEXINGTON HOMES (NABM)			P. O.												
60.	WEIL-McLAIN COMPANY	10400 N. Central Exp. Dallas, TX 75231 (214) 369-1777	J. Sommer-halder	H. O.			1,593	1,593	2-6		-	-	-	34,756,	107	28
ⓐ	CONTINENTAL HOMES1) 2) 3) 4) (NABM)	Box 1800 Roanoke, VA 24008 (703) 334-5000	R.D. Wilson	H. O.	M/S;P	4										

TOTAL NUMBER OF PLANTS	102	
AVERAGE NUMBER OF PLANTS/COMPANY	1.7	
NUMBER OF "GIANTS" AMONG 50 LEADING MANUFACTURERS		14
PERCENT		28%

SUMMARY STATISTICS
FOR 42 LEADING COMPANIES WITH REPORTED AND PROJECTED PRODUCTION RATES FOR 1972 AND 1973

		1972	1973	PROJECTED % INCREASE
TOTAL NUMBER OF UNITS FOR 42 COMPANIES		28,860	41,193	+43%
AVERAGE NUMBER OF UNITS PER COMPANY		687	981	+43%
TOTAL NUMBER OF PLANTS	63			
AVERAGE NUMBER OF PLANTS PER COMPANY	1.5			
AVERAGE NUMBER OF UNITS PER PLANT		458	654	+43%

EXPLANATORY NOTES TO APPENDEX III-B1

THE LEADING MODULAR HOME MANUFACTURERS,
THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

Column	Item	Example	Source of Information	Explanation
a	ID #	10.	Alphabetical sequence	ID # identifying alphabetically parent companies on table and map.
		③	Joint Venture's survey, February 1974	Mfr. of mod./sect. homes inc. in Table & Map 11.
		a.	"Corporate Who's Who" Directory/Census of Manufactured Housing, Section 1, 1974	Letter identifying alphabetically by parent co. the subsidiaries who produce modular homes.
		*	Directory/Census of Manufactured Housing, Section 2-6, 1973	Heavy-weight system (concrete); not included in Map 8.
b	Company Name	Atlas Portable[1]	"Top 50 Modular Producers"; list prep. by Mr. S.D. Robinson, publisher, Directory/Census of Manufactured Housing	One of 50 mfrs. of modular housing leading in terms of projected production of units in 1973 (based on Summer '73 counts).
		Boise Cascade Mfrd. Hsg.[2]	"Housing's Giants," Professional Builder, July 1973	One of the 419 companies leading in terms of total dollar volume in 1972.
		Grumman Modular Bldgs.[3]	Joint Venture's nationwide request for information, November 1973	Expressed interest in Joint Venture's study & submitted info. on housing system.
		Community Technology[4]	Joint Venture's survey of interested mfrs., 2/74	Responded and submitted detailed information.
		NABM	1973 Builders' Guide to Manufactured Homes	One of the 99 Active Members of the National Association of Building Mfrs.
c	Address & Phone	-	Directory/Census of Manufactured Housing	Self-explanatory.
d	Chief Exec.	-	Same	Self-explanatory.
e	Facility Here	H. O. H.&P. P. O.	Same	Headquarters Only. Headquarters & Plant. Plant Only. (The table only lists P.O. for subsidiaries w/o own headquarters.)
f	Products	M M/S MB P ( )	Same; Joint Venture's survey of interested mfrs. of permanent homes, 2/74	Modular Modular/Sectional Mobile also Packaged also Production discontinued

Column	Item	Example	Source of Information	Explanation
g	No. Plants	3	Directory/Census of Manufactured Housing, Section 2-6, 1973	Only plants producing modular units, subsidiaries and affiliates included.
h	Units Prod. 1972	1500	Same	Total prod. modular units.
		X	Same	Info. not available.
i	Units Proj. 1973		"Top 50 Modular Producers"	In source lists: "Current Rate of Annual Production."
j	Rank 72-73		Based on prod. #'s in Columns h and i	
k	Subsidiary of	Universal Leaf Tobacco Co.	"Corporate Who's Who," Directory/Census of Mfrd. Housing, Sec. 1, 1974	Self-explanatory.
l	Type of Units	1 2 3 4 5 6 7 8	Directory/Census of Manufactured Housing, Section 2-6, 1973	Single-family Single-Multifamily Multifamily Vacation Single/Multi & Vacation Single/M & Light Com. Light Commercial Double Wide Mobiles
m	Material	W M C B P	Same	Wood Metal Concrete Combination Plastic
n	Code	F S C	Same	FHA, BOCA State/Local Combination
o	$ Volume 1972	172,000,	"Housing's Giants"	Total $ volume of co.; may inc. income from other sources plus income from mfrd. hsg.
p	Rank Among "Housing's Giants" All Companies	15	Based on "Housing's Giants"	Rank among all builders and mfrs.
q	Mfrs. Only	7		Rank among mfrs. and builders with manufacturing facilities.

APPENDIX III-B-2

THE LEADING PACKAGED HOME MANUFACTURERS, THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

THE GEOGRAPHIC LOCATIONS OF HEADQUARTERS AND PLANTS OF THE MANUFACTURERS LISTED ON THIS TABLE ARE SHOWN ON MAP 2,7

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry: All Companies	Rank Among Giants of The Industry: Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
1.	AMERICAN CLASSIC HOMES1) 2) (NABM)	3802 Raeford Rd. Fayetteville, NC 28305 (919) 485-7178	Johnny Hughes	H.&P.	P	1	1,500	1,550	24-30	American Classic Ind.	5	W	S	13,700,	341	64
2.	AMERICAN STANDARD HOMES1)	700 Commerce Ct. Martinsville, VA 24112 (703) 638-3991	M.B. Eanes	H.&P.	P	1	1,500	1,800	25-23		2	W	C	--	--	--
3.	BARNS LUMBER & MANUFACTURING COMPANY1)	2813 Lombardy Ln Dallas, TX 75220 (214) 358-5131	Ralph Humphrey	H.&P.	P	1	300	5,800	45-5		4	W	C	--	--	--
4.	BERNARD LUMBER COMPANY1) 2)	Box 13726, 4333 New Orleans, LA 70125 (504) 833-5140	-	H. O.	P	1	-	1,166	--43		2	W	-	--	--	--
5.	BOISE CASCADE MANUFACTURED HOUSING1) a. KINGSBERRY HOMES	P.O. Box 8358 Boise, ID 83707 (208) 384-6460	Larry C. Geyer	H. O.	P,M	4	17,392	18,150	2-2	Boise Cascade Corp.	5	W	C	172,000,	15	7
6.	BROWN-GRAVES COMPANY1)	191 E. Miller Ave. Akron, OH 44301 (216) 434-7111	Harold Graves	H.&P.	P	1	878	1,038	41-49		5	W	F	--	--	--
7.	BUILDERS COMPONENTS SUP.1)	210 W Haven Salt Lake City, UT 84107 (801) 486-1031	John Gunther	H.&P.	P	1	-	1,200	--40		-	W	F	--	--	--
8.	BUILDING SYSTEMS, INC.1)	3113 Prospect Ave. Cleveland, OH 44115 (216) 432-2400	S. Rothenfeld	H.&P.	P	1	1,500	1,500	26-31		2	B	S	--	--	--
9.	CHASE BARLOW LUMBER CO.1)	4600 Robards Ln Louisville, KY 40218 (502) 452-2686	C.T. Barlow	H.&P.	P	1	1,300	1,000	9-50		2	W	F	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro-jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry	
															All Com-panies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
10.	CLARY CORP.[1]	P.O. Box 5627 Arlington, TX 76011 (817) 261-1841	H.G. Cooley	H. O.	P	2	1,500	1,500	27-32		6	W	F	--	--	--
a.	CLARY COMPONENT CORP.			P. O.	P											
b.	WOOD TECH CORP.	130 Byasee Dr. Hazelwood, MO 63047 (314) 966-2132	J.T. Hover	H.&P.	P											
11.	CLEARSPAN COMPONENTS[1]	P.O. Box 4195 Meridian, MS 39301 (601) 483-3941	J.L. McRae	H.&P.	P	2	4,500	4,500	4-6	Redman Building Products	6	W	F	--	--	--
12.	COMPONENTS, INC.[1]	5800 Pecos Denver, CO 80221 (303) 433-7265	Stan Dixon	H.&P.	P	1	3,000	3,000	9-11		5	W	F	--	--	--
13.	COMPONENTS, INC.[1] (NABM)	4400 Homerlee Ave. E. Chicago, IL 46312 (219) 397-3950	R.J. Dye	H.&P.	P	1	4,150	4,150	5-8		6	B	F	--	--	--
14.	COMPONENT SYSTEMS, INC.[1]	P.O. Box 188 Rogers, MN 55374 (612) 428-4111	W.F. Feyersen	H.&P.	P	1	2,000	2,100	16-20		5	W	S	--	--	--
15.	CONOTECH, INC.[3]	P.O. Box 537 Santee, SC	B.W. Renninger	H.&P.	P	1	-	-	-		-	-	-	--	--	--
16.	CONSTRUCTION COMPONENTS[1]	Box 555 245 Bypass Greenville, AL 36037 (205) 382-2658	H.B. Shirley	H.&P.	P	1	1,500	1,350	28-36		2	W	C	--	--	--
17.	DAVIDSON INDUSTRIES, INC.[1] (NABM)	108 Union St. Southport, IN 46227 (812) 787-3211	M.W. Boeke	H.&P.	P	1	2,400	2,700	14-14		2	W	C	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro- jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com- panies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
18.	DAVIDSON SASH & DOOR 1) (NABM)	P.O. Box 1162 Jennings, LA 70546 (318) 824-4865	R.O. Boisture	H.&P.	P	1	1,615	1,615	20-28		5	W	F	--	--	--
19.	ENGINEERED COMPONENTS1)	924 E. State St. Clarinda, IA 51632	R.A. Michal	H.&P.	P	2	2,100	1,900	15-22		1	B	S	--	--	--
a.	BUILDERS COMPONENTS			P. O.												
20.	EVANS PRODUCTS1)	1121 SW Salmon Portland, OR 97205 (503) 222-5592	E.M. Preim	H. O.	P	7	-	12,000	--4		1	W	F	--	--	--
a.	CAPP HOMES, INC. (NABM)	3355 Hiawatha Ave. Minneapolis,MN 55406 (612) 721-5581	Hillard Madway	H.&P.												
b.	INTERNATIONAL HOMES	3939 E. 46 St. Minneapolis,MN 55406 (612) 724-5403	Hillard Madway	H.&P.												
c.	L. GROSSMAN & SONS	200 Union St. Braintree, MA 02814 (617) 848-0100	Mike Grossman	H.&P.												
d.	RIDGE HOMES (NABM)			P. O.												
21.	HALLMARK HOMES1)2) (NABM)	5237, D. Bowles Augusta, GA 30901 (404) 798-0043	A.T. Mulherin	H.&P.	P	1	1,600	1,750	21-25		2	W	F	10,860,	394	70
22.	HOMECRAFT CORP.1)	P.O. Box 35 South Hill, VA 23970 (703) 447-3186	H.R. Legg	H.&P.	P	1	1,157	1,445	35-35		6	W	C	--	--	--
23.	IMPERIAL HOMES, INC.1) (NABM)	P.O. Box 35 Griffin, GA 30223 (404) 228-8477	M.O. Gustafson	H.&P.	P	1	600	2,300	44-18		2	W	F	--	--	--
24.	INLAND SYSTEMS, INC.1) (Inland Homes)	1950 Covington Ave. Piqua, OH 45356 (513) 773-7550	John McVeigh	H.&P.	P	1	-	1,200	--41		2	W	F	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Pro- jected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Com- panies	Rank Among Giants of The Industry Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
25.	JORDAN HOMES 1)	4656 Hungerford Rd. Memphis, TN 38118 (901) 363-2126	R.B. Haynes	H.&P.	P	1	1,091	1,150	38-44	Orgill Brothers & Company	2	W	C	--	--	--
26.	LINDAL CEDAR HOMES 1) 2) (NABM)	P.O. Box 24426 Seattle, WA 98178 (206) 246-7800	S.W. Lindal	H.&P.	P	1	1,800	1,850	18-24		4	W	S	15,210,	308	59
27.	MARYLAND HOUSING CORPORATION 1) (NABM)	5820 South-western Baltimore, MD 21227 (301) 242-1600	M.J. Macks	H.&P.	P	2	1,977	2,400	17-17	Olin Corp.	2	W	C	--	--	--
28.	MAYHILL HOMES, INC. 3)4)	221 Washington Gainsville, GA 30501 (404) 536-9871	John Odegaard	H.&P.	P	1	-	-	- -		2	W	F	--	--	--
29.	MILES HOMES 1) 2)	4500 Lyndale, No. Minneapolis, MN 55412 (612) 521-2400	Miles Fiterman	H.&P.	P	1	1,400	1,700	31-26	Insilco Corp.	5	W	F	25,000,	197	47
30.	MILLER HOMES 1)	Box 1356 Richmond, VA 23211 (703) 232-4551	C.A. Pritchard	H. O.	P	1	-	1,100	--46	Miller Mfrg. Company	2	W	-	--	--	--
31.	NATIONAL HOMES CORP. 1)2)3)1)	Earl Ave. & Wallace Lafayette, IN 47902 (317) 447-3131	George E. Price	H.&P.	(M);MB;P	7	21,000	22,038	1-1		5	W	F	242,655,	7	5
	a. W.G. BEST HOMES CORP. (NABM)			P. O.												
32.	NEW ENGLAND HOMES, INC. 1) (NABM)	P.O. Box 464 Portsmouth, NH 03801 (603) 436-8830	Dan J. Donahue	H.&P.	M;P	1	800	1,070	42-47		5	B	F	--	--	--
33.	PACIFIC BUILDINGS 1) (NABM)	Covington Road Marks, MS 38646 (601) 326-8104	Wm. King Self	H.&P.	P	1	1,157	1,300	36-38		2	W	C	--	--	--

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry: All Companies	Rank Among Giants of The Industry: Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(1)	(m)	(n)	(o)	(p)	(q)
34.	PALEVSKY INDUSTRIES, INC.1)	5111 Richmond Rd. Cleveland, OH 44146 (216) 292-2500	-	H.&P.	P	1	2,800	2,600	11-16		-	B	F	--	--	--
35.	PEASE COMPANY1) 2) (NABM)	900 Forest Ave Hamilton, OH 45012 (513) 867-3333	J.L. Pease, Jr.	H.&P.	P	1	3,000	3,100	10-10		6	W	F	42,000,	98	26
36.	PERDUE HOUSING INDUSTRIES1)	Box 1324 Chickasha, OK 73018 (405) 224-6640	C.V. Perdue	H.&P.	M;P	2	1,250	1,250	34-39		2	W	F	--	--	--
37.	RICHMOND HOMES, INC.1)	P.O. Box 336 Richmond, IN 47374 (317) 962-1561	Arnie Dietz	H.&P.	P	1	1,300	2,000	33-21	Zimmer Homes Corp.	2	W	F	--	--	--
38.	RYCENGA HOMES, INC.1) (NABM)	1053 Jackson St Grand Haven, MI 49417 (616) 842-8040	Chas. Rycenga	H.&P.	P	1	255	1,000	46-51		2	W	S	--	--	--
39.	SANFORD CO., INC.1)	P.O. Box 399D Vernon, AL 35592 (215) 695-7188	E.C. Sanford, Jr.	H.&P.	P	1	10,000	13,000	3-3		2	W	C	--	--	--
㊵	SCHOLZ HOMES, INC.1) 3) 4) * (Inland-Scholz) (NABM)	2001 N. Westwood Ave. Toledo, OH 43607 (419) 531-1601	O.A. Thomas	H.&P.	M/S;P	2	800	1,350	43-37	Inland Steel	2	W	C	--	--	--
41.	STERLING CUSTOM HOMES1) 3) (NABM)	225 W. McWilliams St. Fond Du Lac, WI 54935 (414) 921-3780	Earl T. Hunt	H.&P.	P	1	950	1,050	40-48		5	W	S	--	--	--
42.	SUMMIT BUILDING, INC.1)	140 Amelia St. Gretna, LA 70053 (504) 367-7770	C. Ray Grein	H.&P.	P	1	2,700	2,900	12-12		2	W	F	--	--	--
	*Modular/Sectional Plant: INLAND SCHOLZ HOUSING SYSTEMS	800 County St. Milan, MI 48160 (313) 439-1511														

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	(In 000's) Dollar Volume 1972	Rank Among Giants of The Industry All Companies	 Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
43.	SUMMEY BUILDING SUPPLY GROUP[1]	Phil. Church Rd. Dallas, NC 28034 (704) 922-7886	D.W. Hoyle	H.&P.	M;P	1	1,500	1,500	29-33	Wix Corp.	5	W	C	--	--	--
44.	SWIFT INDUSTRIES, INC.[1][2] (NABM) (Mobile & Modular also)	241 Curry Hollow Rd. Pittsburgh, PA 15061 (412) 892-0700	Ira H. Gordon	H. O.	M;MB;P	1	1,500	2,200	30-19		5	B	C	38,075,	115	30
a.	HERRLI IND., INC.	2801 Oakland Ave Elkhart, IN 46514 (219) 294-5635	George Terlep	H.&P.												
45.	THRIFT BUILT HOUSING SYSTEMS[1]	624 Sargent Rd. Manchester, NH 03103 (603) 669-5440	Donald Greenbaum	H.&P.	P	1	1,000	1,200	39-42		3	W	C	--	--	--
46.	U.S. STEEL HOMES[1][3][4]	2549 Charlestown Rd. New Albany, IN 47150 (812) 944-7711	R.E. McDaniel	H.&P.	P	2	3,075	4,500	8-7		6	M	F	--	--	--
47.	VALLEY FORGE CORP.[1][2] (NABM)	750 E. Swedesford Valley Forge, PA 19471 (215) 687-5000	Jas. A. Parker	H. O.	M;P	3	1,600	2,700	22-15		2	W	F	50,605,	79	21
a.	CONCORD HOMES (NABM)			P. O.												
b.	FISCHER & FRICHTEL	Bridgeton, MO 63042 (314) 739-1980	J.J. Fischer	H.&P.												
c.	LEXINGTON HOMES (NABM)			P. O.												
48.	WAUSAU HOMES[1][2] (NABM)	901 N. Cherry Wausau, WI 54401 (715) 675-2311	Earle Schuette	H.&P.	P	4	3,085	3,176	7-9		5	W	F	38,344,	113	29
a.	WESTON HOMES, INC.[3][4] (NABM)			P. O.	P	(2)										

ID # (a)	Company Name (b)	Address and Phone (c)	Chief Executive (d)	Facility Here (e)	Products (f)	No. Plants (g)	Units Produced 1972 (h)	Units Pro-jected 1973 (i)	Rank 72-73 (j)	Subsidiary of (k)	Type Units (l)	Material (m)	Code (n)	(In 000's) Dollar Volume 1972 (o)	Rank Among Giants of The Industry: All Com-panies (p)	Rank Among Giants of The Industry: Mfrs. Only (q)
49.	WEST COAST MILLS, INC.1)	666 State Chehalis, WA 98532 (206) 748-3351	Ben L. Jones	H.&P.	P	1	1,650	1,700	19-27		2	W	S	--	--	--
50.	WICK BUILDING SYSTEMS, INC.1) 2)	P.O. Box 398 Mazomanie, WI 53560 (608) 795-2221	John F. Wick	H. O.	MB;P	3	1,121	1,121	37-45		2	W	S	86,962,	37	15
	a. WICK HOMES			P. O.												
51.*	WILSON CONCRETE CO.1)	100 S. Broadway Red Oak, IA 51566 (712) 623-2573	-	H.&P.	P	3	2,700	1,450	13-34		6	C	F	--	--	--
52.	WOOD COMPONENTS CO.1)	2125 Cross St. Eugene, OR 97402 (503) 688-7611	G.S. Moshofsky	H.&P.	P	1	4,000	2,800	6-13		2	W	C	--	--	--
53.	WOOD FABRICATORS1)	1550 Marietta Way Sparks, NV 89431 (702) 358-8755	W.E. Dennis	H.&P.	M;P	2	1,600	1,600	23-29		6	B	F	--	--	--
	a. DENCO, INC.			P. O.												

TOTAL NUMBER OF PLANTS	102	
AVERAGE NUMBER OF PLANTS/COMPANY	1.6	
NUMBER OF "GIANTS" AMONG 50 LEADING MANUFACTURERS		11
PERCENT		22%

SUMMARY STATISTICS
FOR 46 LEADING COMPANIES WITH REPORTED AND PROJECTED PRODUCTION RATES FOR 1972 AND 1973

		1972	1973	PROJECTED % INCREASE
TOTAL NUMBER OF UNITS FOR 46 COMPANIES		121,148	145,153	+20%
AVERAGE NUMBER OF UNITS PER COMPANY		2,634	3,156	+20%
TOTAL NUMBER OF PLANTS	72			+20%
AVERAGE NUMBER OF PLANTS PER COMPANY	1.6			
AVERAGE NUMBER OF UNITS PER PLANT		1,683	2,016	

EXPLANATORY NOTES TO APPENDIX III-B-2

THE LEADING PACKAGED HOME MANUFACTURERS,
THEIR SUBSIDIARIES AND SELECTED SMALLER MANUFACTURERS

Column	Item	Example	Source of Information	Explanation
a	ID #	10.	Alphabetical sequence	ID # identifying alphabetically parent companies on table and map.
		㊵	Joint Venture's Survey, February 1974	Mfr. of mod./sect. homes inc. in Table & Map 11.
		a.	"Corporate Who's Who" Directory/Census of Manufactured Housing, Section 1, 1974	Letter identifying alphabetically by parent co. the subsidiaries who produce packaged homes.
		*	Directory/Census of Manufactured Housing, Section 2-6, 1973	Heavy-weight system (concrete); not included in Map 10.
b	Company Name	Barns Lumber[1]	"Top 50 Packaged Housing Producers"; list prep. by Mr. S.D. Robinson, publisher, Directory/Census of Manufactured Housing	One of 50 mfrs. of packaged housing leading in terms of projected production of units in 1973 (based on Summer '73 counts).
		American Classic Homes[2]	"Housing's Giants," Professional Builder, July 1973	One of the 419 companies leading in terms of total dollar volume in 1972.
		Mayhill Homes[3]	Joint Venture's nationwide request for information, November 1973	Expressed interest in Joint Venture's study & submitted info. on housing system.
		National Homes Corp.[4]	Joint Venture's survey of interested mfrs., 2/74	Responded and submitted detailed information.
		NABM	1973 Builders' Guide to Manufactured Homes	One of the 99 Active Members of the National Association of Building Mfrs.
c	Address & Phone	-	Directory/Census of Manufactured Housing	Self-explanatory.
d	Chief Exec.	-	Same	Self-explanatory.
e	Facility Here	H. O.	Same	Headquarters Only.
		H.&P.		Headquarters & Plant.
		P. O.		Plant Only. (The table only lists P.O. for subsidiaries w/o own headquarters.
f	Products	M	Same; Joint Venture's survey of interested mfrs. of permanent homes, 2/74	Modular also
		M/S		Modular/Sectional also
		MB		Mobile also
		P		Packaged
		( )		Production discontinued

Column	Item	Example	Source of Information	Explanation
g	No. Plants	3	Directory/Census of Manufactured Housing, Section 2-6, 1973	Only plants producing packaged units, subsidiaries and affiliates included.
h	Units Prod. 1972	1500	Same	Total prod. packaged units.
		X	Same	Info. not available.
i	Units Proj. 1973		"Top 50 Packaged Housing Producers"	In source lists: "Current Rate of Annual Production."
j	Rank 72-73		Based on prod. #'s in Columns h and i	
k	Subsidiary of	Inland Steel Corporation	"Corporate Who's Who," Directory/Census of Mfrd. Housing, Sec. 1, 1974	Self-explanatory.
l	Type of Units	1	Directory/Census of Manufactured Housing, Section 2-6, 1973	Single-family
		2		Single/Multifamily
		3		Multifamily
		4		Vacation
		5		Single/Multi & Vacation
		6		Single/M & Light Com.
		7		Light Commercial
		8		Double Wide Mobiles
m	Material	W	Same	Wood
		M		Metal
		C		Concrete
		B		Combination
		P		Plastic
n	Code	F	Same	FHA, BOCA
		S		State/Local
		C		Combination
o	$ Volume 1972	172,000,	"Housing's Giants"	Total $ volume of co.; may inc. income from other sources plus income from mfrd. hsg.
	Rank Among "Housing's Giants"		Based on "Housing's Giants"	
p	All Companies	15		Rank among all builders and mfrs.
q	Mfrs. Only	7		Rank among mfrs. and builders with manufacturing facilities.

APPENDIX III-C

MANUFACTURERS OF SPECIAL RELOCATABLE SYSTEMS

ID # (a)	Company Name (b)	Address and Phone (c)	Chief Executive (d)	Facility Here (e)	Products (f)	No. Plants (g)	Units Produced 1972 (h)	Units Pro-jected 1973 (i)	Rank 72-73 (j)	Subsidiary of (k)	Type Units (l)	Material (m)	Code (n)	
1.	MANUFACTURERS OF RELOCATABLE SYSTEMS DEVELOPED FOR THE MILITARY (AEROSPACE MANUFACTURERS ONLY - NOT MAPPED)													
1.	GOODYEAR AEROSPACE CORP.	Litchfield Pk, AZ 85340		P. O.	3b	2			- -		6	B	F	-
2.	NORTH AMERICAN ROCKWELL CORP.	P.O. Box 51308 Tulsa, OK 74151 (918) 835-3111	E.A. Nielsen	H.&P.	Prototype				- -		6	B	F	-
3.	NORTHROP CORP.	3901 W. Bway Hawthorne, CA 90250 (213) 675-4611		H. O.	Report				- -					
2.	MANUFACTURERS OF RELOCATABLE HOUSING SYSTEMS DEVELOPED FOR THE PRIVATE MARKET THE GEOGRAPHIC LOCATIONS OF HEADQUARTERS AND PLANTS OF THE MANUFACTURERS LISTED ON THIS TABLE ARE SHOWN ON MAP 4,8													
2.1	CAMP SYSTEMS													
1.	ATCO INDUSTRIES LTD.	1243 McKnight Blvd. Calgary, Alberta, CANADA CAL-276-1101	R.D. Southern	H.&P.	1a 3b		4,000		- -		6	B	C	-
2.	ATLANTIC INTERNATIONAL	P.O. Box 412 Cockeysville,MD 21030 (301) 666-3060	W.H. Gowl	H. O.	1a 3a	5			- -		6	W	C	-
3.	ELDER INTERNATIONAL	P.O. Box 2061 Houston, TX 77001 (713) 695-6811		H.&P.	1a 3a	1			- -		6	B	-	-
4.	PORTA-KAMP	P.O. Box 7064 Houston, TX 77008 (713) 869-3293	F.E. Bigelow	H.&P.	1a 3a	2			- -		6	W	S	-
2.2	HONEYCOMB PANEL SYSTEMS													
1.	ENDURE PRODUCTS INC.	Box 66 Miami, FL 33166 (305) 885-9901	Irvine Kimmel	H.&P.	3b	1	100		- -		6	B	F	-

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	Dollar Volume 1972
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
2.	PANELFAB	1600 NW Le- Jeune Rd. Miami, FL 33126 (305) 871-2100	Milton Fisher	H.&P.	1a 2a 3b	1	115		- -		6	B	-	-
2.3 DOME SYSTEMS														
1.	CIRCLE CONSTRUCTION	571 E. 4 St. Winona, MN 55987 (507) 454-3565	Donald McNally	H.&P.	4a				- -		-	B	-	-
2.	DOME EAST CORP.	325 Duffy Ave. Hicksville, NY 11801 (516) 938-0545	W.R. Wendel	H.&P	4a				- -		-	B	-	-
3.	GEODESIC STRUCTURES INC.	P.O. Box 176 Heightstown, NJ 08520 (609) 443-4440	P.G. Tobia	H.&P.	4a				- -		-	B	-	-
4.	TENSION STRUCTURES INC. (O'DOME)	9800 Ann Arbor Rd. Plymouth, MI 48170 (313) 455-5800	R. Rowland	H.&P.	4a				- -		-	B	-	-
2.4 MISCELLANEOUS SYSTEMS														
1.	ALTAIR INDUSTRIES INC.	255 Channel St. San Francisco, CA 94107 (415) 863-4700	J.C. Walker	H.&P.	2a				- -		-	W	-	-
2.	ATLAS PORTABLE BUILDING CO.	S. Second St. Raton, NM (505) 445-3693	G.R. Campbell	H.&P.	5b				- -		-	B	-	-
3.	INTERDESIGN INC.	1409 Willow St. Minneapolis,MN 55403 (612) 335-7878	D. Thorbeck	H. O.	Proposal				- -		-	-	-	-

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	Dollar Volume 1972
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
4.	UNIVERSAL HOUSING SYSTEMS	360 E. 65 St. New York, NY 10021 (212) 472-0373	E. Tobman	H.&P.	5b				- -		-	B	-	-
3.	SELECTED MANUFACTURERS OF OTHER COMMERCIAL RELOCATABLE SHELTER SYSTEMS (NOT MAPPED)													
3.1	AIR STRUCTURES													
	For further information, see Directory	CANVAS PRODUCTS ASSOC. INT'L 600 Endicott Bldg. St. Paul, MN 55101												
1.	AIR-O-STRUCTURES INC.	P.O. Box 296 Auburn, ME 04210 (207) 782-0200	R.L. Raymond	H.&P.	4b				- -		-	-	-	-
2.	BIRDAIR STRUCTURES INC.	2015 Walden Ave. Buffalo, NY 14225 (716) 684-9500	J.R. Burke	H.&P.	4b				- -		-	-	-	-
3.2	METAL STRUCTURES													
	For further information, see Directory	METAL BUILDERS MFG. ASSOC. 2130 Keith Bldg. Cleveland, OH 44115												
1.	ARMCO STEEL CORP.	P.O. Box 1268 Englewood Cliffs, NJ 07632 (201) 947-8477	K. Thompson	H.&P.	5a				- -		-	B	-	-
2.	CONCOR CO. INC.	145 Meadow St. P.O. Box 3297 Framingham, MA 01701 (617) 877-4336	N. Toffolon	H.&P.	5a				- -		-	B	-	-
3.	STRAN STEEL CORP.	P.O. Box 14205 Houston, TX 77021 (713) 644-3441	M.E. Nagel	H.&P.	5a				- -		-	B	-	-
3.3	CONTAINER VANS for directory of container manufacturers see	CONTAINER NEWS 461 Eighth Ave. New York, NY 10001												

EXPLANATORY NOTES TO APPENDIX III-C

SELECTED RELOCATABLE HOUSING MANUFACTURERS

Column	Item	Example	Source of Information	Explanation
a	ID #	II-Al	Alphabetical Sequence	ID # identifying companies on table and map.
b	Company Name	ATCO	Joint venture's own survey.	-
		II-Al	-	Included in Directory/Census of Manufactured Housing
c	Address & Phone	-	Directory/Census of Manufactured Housing and joint venture's own survey.	-
d	Chief Exec.		Same	-
e	Facility Here	H. O.	Same	Headquarters Only.
		H.&P.		Headquarters & Plant.
		P. O.		Plant Only.
f	Products	1a	Joint venture's own survey.	General Rigid Box.
		b		Containerized Rigid Box.
		2a		General Fold Out Box.
		b		Fold Out Container.
		3a		Panelized (KD) Box.
		b		Core and Panel.
		4a		Dome Systems
		b		Air Structures
		5a		Metal Systems
		b		Miscellaneous

Column	Item	Example	Source of Information	Explanation
g	No. Plants	II-Al	Directory/Census of Manufactured Housing and joint venture's own survey.	All plants in continental USA and Canada.
h	Units Prod. 1972	4000	Same	Includes modulars, mobiles and packaged systems.
i	Units Projected 1973		N.R.	-
j	Rank 72-73		N.R.	-
k	Subsidiary of		N.R.	-
l	Type of Units	6	Directory/Census of Manufactured Housing	Single/multi and light commercial
m	Material	W B	Same	Wood Combination
n	Code	F S C	Same	FHA, BOCA State, local Combination

APPENDIX III-D

MANUFACTURERS OF SELECTED SUBSYSTEMS ("PLUG-IN" MECHANICAL CORES ONLY)

ID #	Company Name	Address and Phone	Chief Executive	Facility Here	Products	No. Plants	Units Produced 1972	Units Projected 1973	Rank 72-73	Subsidiary of	Type Units	Material	Code	Dollar Volume 1972	Rank Among Giants of The Industry	
															All Companies	Mfrs. Only
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
1.	Alcoa Construction Systems, Inc.	2 Allegheny Center Pittsburgh, Pa. 15212 (412) 553-4545	T.J. Lannen	H.O	Mechanical Cores							BF				
2.	Computerized Building Systems	9401 85th Ave. N. Minneapolis, Minn. 55445 (617) 425-3123	R.T. Cornelius	H&P.	Mechanical Cores						5	WC				
3.	Modenco Corp.	P.O. Box 8070 Erie, Pa. 16505 (814) 833-1123	M.A. Pitt	H.O.	Mechanical Cores						1	BC				
4.	Tappan Company	P.O. Box 606 Mansfield, Oh. 44901 (419) 529-4411	P.C. Brunk	H.O.	Mechanical Cores							BF				
5.	Westinghouse Electric Corp.	501 Marilin St. Eaton Rapids, Mich. 48827 (517) 663-8163			Mechanical Cores							BF				

APPENDIX IV

MINIMUM LIVABILITY REQUIREMENTS FOR TEMPORARY HOUSING

APPENDIX IV - A

RECOMMENDATIONS FROM ENVIRONMENTAL PSYCHOLOGISTS FOR MINIMUM LIVABILITY STANDARDS

A review of the proposed interior space standards with faculty members from the Department of Environmental Psychology of the Graduate Center of the City University of New York, elicited the following comments with respect to specific areas and items:

Plan

A relatively unified space sense for living, dining and kitchen functions would be desirable in a minimum floor area house.

Bathroom

Should be flexible and slightly larger than minimum; care should be taken to make it usable as it is a very important room to most people. The bathroom should be seen as another room to go to. A shower enclosure and mirror should be included.

Kitchen

The kitchen should provide for ample food storage and the option for eating-in. Ample space for a high-chair is important. The goal should be to achieve the normal family ideal in terms of function and basic equipment in less space than is usually required.

Furniture

Furniture should be movable so the family can make its imprint on the space to some degree. Shelves for display should be provided in the living room; possibly used as a divider. A loft might be considered for sleeping space for children - it is efficient and fun.

Outdoor Space

Some special visual attention should be given to the entrance and private outdoor space, (e.g., use a canopy or canvas). Some private space for only the family should be next to the unit with some public spaces near the dwellings.

Community Facilities

Consider the following:

- pre-school center for about 100 children.
- indoor and outdoor space for teenagers.
- meeting rooms, shops, etc., for adults.
- community laundries.
- possibility of a canteen or similar place.
- bulk storage for private possessions accessible and possibly adjacent to dwellings - important for families who have salvaged furniture, etc., but will not have space for it in the temporary housing.
- playground: movable parts, equipment for older children, use of attractions of site; adventure playground for pre-school children, give elementary school children a place to build things.

Site Planning

Create sub-clusters of units for safety and visual interest. Avoid typical mobile home, parking-lot-look.

Outdoor spaces should be clearly private or public. Avoid anonymous and unpoliced spaces.

Recreational areas should be combined but not too close to living units.

Use site as fully as possible for recreational interest since children quickly lose interest in organized playgrounds.

APPENDIX IV - B
MINIMUM FURNITURE AND APPLIANCE KIT

MINIMUM ACCOMMODATIONS TO BE PROVIDED WITHIN EACH TEMPORARY HOUSING UNIT.

1. Living room:

    Seating for 6 people:
    - 1 couch - (seats 3) - 7'-0" x 2'-6"
    - 1 love seat - (seats 2) - 5'-0" x 2'-6"
    - 1 side chair - (seats 1) - 2'-6" x 2'-6"

    Tables:
    - 1 side table - 2'-6" x 2'-6"
    - 1 coffee table - 15" diameter

    Storage:
    - Built-in shelving - 4 l.f. (to hold TV and books)

2. Dining Area:

    It is recommended that space for daily eating be provided as a part of the kitchen. This may be in the kitchen proper, or as an alcove off the kitchen. Space for a high-chair must be provided

    Table: - minimum eating table sizes (based on individual spaces with a frontage of 24 inches)
    - 5-6 persons - seating on 2 sides - 30" x 72"
    - 5-6 persons - seating on 4 sides - 40" x 48"
    - 5-6 persons - round - 48"

    The table designated for seating on 2 sides are generally larger than those for seating on 4 sides; however, seating on 2 sides require less room space, as can be seen in the following drawings.

    Clearances:
    - For chairs, plus access thereto - 26" *
    - For chairs, plus access & passage - 30"

    *The 26" clearance is not sufficient for an individual to pass behind, once the chair is occupied.

3. Kitchen:

    Appliances:
    - 30" 4 burner range w/broiler oven
    - double sink - 2'-8"
    - refrigerator - 14 cu.ft. - 2'-4" wide

    Storage:
    - minimal shelf area - 44 sq. ft.
    - minimal drawer area - 10 sq. ft.
    - broom closet - 2'-0" x 1'-0"
    - 4 l.f. clear counter

4. Bathroom:

    Fixtures:
    - 1 lavatory
    - 1 commode with top and seat
    - 1 tub/shower and shower curtain

    Accessories:
    - 1 hamper
    - 1 tumbler & toothbrush holder
    - 1 soap dish
    - 1 toilet paper holder
    - 1 towel bar

    Storage:
    - cabinet under sink
    - linen closet - 2'-0" x 1'-0"; 5'-0" high minimum

5. Master Bedroom:

Beds:
1 double bed 4'-6" x 6'-6"
1 crib 2'-4" x 4'-5"

Storage:
1 storage chest (built-in or free-standing) 3'-6" x 1'-10"
1 closet 2'-0" x 5'-0"

Mirror:

Light Fixture:

6. Bedroom for 2 children:

Beds:

2 bunk beds 3'-3" x 6'-6" ea.

Storage:
1 chest (built-in or free-standing) 3'-0" x 1'-10"
1 closet 2'-0" x 3'-0"
1 desk 1'-6" x 2'-6"

Chairs:
1 or 2 - 1'-6" x 2'-6" ea.

Mirror:
Light Fixture:

7. Utility Space:

Complete HVAC
Water Heater
Electrical Distribution Center

8. Laundry Center:

Stacked washer/dryer - 24" wide
Ironing center - built-in

9. Family Coat Closet: 3'-0" x 2'-0" x 5' high

10. General Family Storage: 140 cu.ft.

APPENDIX IV - C
MANUFACTURERS AND PRODUCTS FILE FOR INTERIOR COMPONENTS AND MATERIALS

1. Wet Core Module Manufacturers (Kitchens/Baths)
   - a. Alcoa Construction Systems
   - b. Computerized Building Systems
   - c. Westinghouse
2. Compact Kitchens
   - a. Dwyer
   - b. Acme
3. Bathrooms (Fiberglas/Pre-Fabricated)
   - a. Owens-Corning
   - b. American Standard
   - c. Eljer
   - d. Crane
   - e. Kohler
4. Accessories - Bathrooms
   - a. Conceal-All
5. Plumbing Trees
   - a. Modular Hydronics
   - b. Genova Products
   - c. GSR-Above Floor Systems
6. Laundry Center
   - a. Westinghouse (only full size stackable unit)
   - b. Frigidare
   - c. Hotpoint
   - d. General Electric
   - e. Whirlpool
   - f. Iron-A-Way Fold-Out Ironing Boards
7. Heating, Ventilating and Cooling Equipment
   - a. Dunham-Bush Space Pak
   - b. Trane Co.
   - c. Williamson
   - d. Central Air Conditioning & Heating
   - e. General Electric TC-K (all electric)
8. Furniture
   - a. Simmons - Stor-Robe
   - b. Simmons - Wall-A-Bed
   - c. Murphy Bed
   - d. Interlubke
   - e. Habitat
   - f. Weather Wear - Cantiliver Wall Storage
   - g. Childrens Work Bench
9. Storage Systems
   - a. Power Glide - sliding storage
   - b. Lundia - pre-fabricated adjustable wood shelving
   - c. X-Panda - metal shelving
   - d. Closet Maid - vinyl coated steel
   - e. Amsco
   - f. Weather Wear - cantiliver wall storage
   - g. Simmons - Stor-Robe
10. Wall Systems (Partitions/Operable)
    - a. Panel Fold - wood folding
    - b. Coil Wall - side coiling wood, metal
11. Doors, Windows, Glass and Siding
    - a. Climate Guard - Reynolds
    - b. Sunliners
    - c. Boise Cascade
    - d. Redwood
12. Electrical - Wiring Systems
    - a. Slater
    - b. Switchpak - surface mounted switching systems

APPENDIX IV - D
FURNITURE & APPLIANCE REPLACEMENT SCHEDULE

AREA	RETAINABLE	DISPOSIBLE
I. LIVING ROOM	Sofa & Chair Frames Tables, if surfaced in formica	All cushions
II. DINING	Table & Chairs	--
III. KITCHEN	Appliances	Dishes & Utensils
IV. BATH	All Fixtures	Shower Curtain & Rod All Bath Linen
V. BEDROOMS	All Bed Frames Desk & Chair	All Mattresses & All Bed Linen

RECOMMENDED FINISHES

AREA	FLOOR	WALLS	CEILING
I. LIVING ROOM	Vinyl Asbestos Tile (area rug)	Heavy-duty Laminated Plastic Wall Panels.	Acoustical Tiles
II. DINING	V.A.T.	"	Painted Ceiling (Semi-gloss Enamel)
III. KITCHEN	V.A.T.	"	"
IV. BATH	Abrasive 1"x 1" Floor tiles	Glazed 4"x4" cer. wall tiles (Wainscot) (Painted semi-gloss enamel)	"
V. BEDROOMS	V.A.T. with	Heavy-duty laminated plastic wall panels.	Acoutical Tiles

NOTES:

I. All doors to be heavy-duty laminated plastic. Exterior door to have screen and "Lexan" plexi-glas window.
II. All windows to be "Lexan" plexi-glas; (non-breakable & shatterproof) Storm & screen window units.
III. Each bedroom to have full length Plexi-glas mirror on back of door.
IV. Recommended side chair - the GF 40/4 by General Fireproofing. This chair is durable, is available in a variety of finishes and is easily stored (stackable)

APPENDIX V

MECHANICAL SUBSYSTEMS REPORT

DATA AND CALCULATIONS

I. Heating Load

For the purpose of this report, it will be assumed that the building construction is as follows:

- Walls - $U = 0.1$ BTU/Hr/Ft^2
- Glass - Double glazing, $U = 0.58$
- Infiltration - 0.57 CFM per linear foot of crack

Design Temperatures

Inside design temperature	70°F
Outdoor design temperature	
Wilkes-Barre	6°F
Miami	47°F
Baton Rouge	30°F
Oklahoma City	15°F
San Jose	36°F

The above criteria results in the following calculated heating loads:

	Type "A"	Type "B"
Wilkes-Barre	24,000 BTU/Hr	31,000 BTU/Hr
Miami	8,750 BTU/Hr	11,100 BTU/Hr
Baton Rouge	15,200 BTU/Hr	19,360 BTU/Hr
Oklahoma City	31,000 BTU/Hr	26,600 BTU/Hr
San Jose	13,000 BTU/Hr	16,400 BTU/Hr

II. Domestic Hot Water

Domestic hot water loads are calculated as follows:

20 gallons/per day x 3 people x 7 days/wk
x 4.33 wks/mo = 1819 gal/mo.

1819 gal/mo/D.U. x 8.33 lbs./gal x 100°F
1 BTU/°F/# = 443 KWHR/Mo/D.U.

III. Apartment Lighting Consumption

600 sq. ft. x 3w/sq. ft. x 50% of lights x 12 hr/day x 7 days/wk x 4.33 wk/mo = 327.3 KWHR/Mo/D.U.

IV. Apartment Cooking Consumption

2500 watts x 2 hrs/day x 7 days/wk x 4.33 wks/mo = 151 KWHR/Mo/D.U.

V. Washer/Dryer Consumption

1500 watts x 1/2 hr/day x 7 days/wk x 4.33 wks/mo = 22.7 KWHR/Mo/D.U.

VI. Propane and Electric Head Load Calculations

a. Gas Calculations

Method based on 70% efficiency, month of January as sample calculation (ASHRAE Guide 1967, Chapter 16)

$$F = U \times N \times D \times Cf$$

F = Therms

U = Unit fuel consumption per degree day

D = Number of degree days

N = Heat load (1000's BTU)

Cf = Correction factor for outside design temperature

2,500 BTU/ft^3 of propane

36 ft^3/gal of propane

Wilkes-Barre

$.0049 \times 24 \times 1156 \times 1.16 = 157,7$ therms

$$2175.1 \text{ therms} \times 100,000 \text{ BTU/therm} \quad \frac{1}{\frac{2500 \text{ BTU}}{\text{ft}^3}} \times \frac{1}{\frac{36 \text{ ft}^3}{\text{gal}}}$$

175.2 gallons propane

b. <u>Electric Calculation</u>

NEMA formula, month of January as sample:

$$\text{KWHRS} = \frac{\text{HL} \times \text{DD} \times \text{C}}{\text{T D}}$$

$$\text{H L} = \frac{24,000 \text{ BTU}}{3413 \text{ BTU/KW}} = 7.03 \text{ KW}$$

$\text{D} = $ Degree days $= 1156$

$\text{C} = $ Utilization factor $= 18.5$

$\text{T D} = $ Temp. Diff. $= 64^{\circ}\text{F}$ $(70^{\circ} - 6^{\circ}$

$$\text{KWHRS} = \frac{7.03 \times 1156 \times 18.5}{64} = 2405.6 \text{ KWHR/Mo}$$

ELECTRIC RATE SCHEDULE

The following rate schedules were used to calculate the operating costs:

Wilkes-Barre (net two months rate)

First 28 KWH	$2.60
Next 120 KWH	$0.057 KWH
Next 252 KWH	$0.0295 KWH
Next 1800 KWH	$0.0189 KWH
All Additional	$0.0154 KWH

Miami (monthly rate)

First 35 KWH	$2.00
Next 25 KWH	$0.0444 KWH
Next 100 KWH	$0.0323 KWH
Next 340 KWH	$0.0212 KWH
All Additional	$0.0192 KWH

Baton Rouge (monthly rate)

	Summer	Winter
First 40 KWH	$0.0555 KWH	$0.0555 KWH
Next 60 KWH	$0.0457 KWH	$0.0457 KWH
Next 300 KWH	$0.0260 KWH	$0.0260 KWH
Next 200 KWH	$0.0238 KWH	$0.0238 KWH
All Additional	$0.0173 KWH	$0.0136 KWH

Oklahoma City (monthly rate)

	Summer
First 16 KWH	$1.00
Next 24 KWH	$0.0380 KWH
Next 100 KWH	$0.0330 KWH
Next 460 KWH	$0.021 KWH
Next 900 KWH	$0.0185 KWH
Next 1000 KWH	$0.0180 KWH
All additional	$0.0150 KWH

	Winter
First 16 KWH	$1.00
Next 24 KWH	$0.038 KWH
Next 100 KWH	$0.033 KWH
Next 460 KWH	$0.021 KWH
Next 1900 KWH	$0.010 KWH
All Additional	$0.009 KWH

Electric water heating service. The rate stated above shall be applied to the total KWH used with modifications as follows:
First 120 KWH or less billed regular billing.
Next 240 KWH or less billed at $0.095/KWH.
All additional billed regular billing.

San Jose (monthly rate)

Customer Charge	$1.32
First 150 KWH	$0.032 KWH
Next 250 KWH	$0.0214 KWH
Next 600 KWH	$0.0189 KWH
All Additional	$0.0169 KWH

NATURAL GAS RATE

Wilkes-Barre

0 - 10 Ft^3/Month	$3.00
10 - 60 Ft^3/Month	$0.16/$Ft^3$
60 - 90 Ft^3/Month	$0.13/$Ft^3$
Above 90 Ft^3/Month	$0.09/$Ft^3$

SUMMARY OF ANNUAL OPERATING COSTS

		WILKES-BARRE	MIAMI	BATON ROUGE	OKLAHOMA CITY	SAN JOSE
Scheme 1	A	$ 475.20	$ 248.80	$ 307.10	$ 310.51	$ 286.84
	B	$ 536.68	$ 248.80	$ 330.27	$ 357.58	$ 343.80
Scheme 2	A	$ 610.52		$ 388.12	$ 428.00	$ 377.24
	B	$ 730.00		$ 388.12	$ 475.00	$ 402.84
Scheme 3	A	$ 628.00		$ 349.10	$ 444.00	$ 375.84
	B	$ 730.00		$ 373.00	$ 491.16	$ 373.00
Scheme 2 *	A					
	B	$ 270.73				

* Natural gas heating, cooking and domestic water heating

WILKES-BARRE ALL ELECTRIC 1-A

Tot. Deg. Days 6254

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION	2405	2140	1860	1040	405				275	900	1585	2300
COOKING, LIGHTING DOM. H.W. CONSUMP. (KWHRS/MO)	944	944	944	944	944	944	944	944	944	944	944	944
AIR CONDITIONING (KWHRS/MO)												
TOTAL CONSUMPTION (KWHRS/MO)	3,349	3,084	2,804	1,984	1,349	944	944	944	1,219	1,844	2,529	3,244
MAX. DEMAND (KW)												
COST: DEMAND												
COST: ENERGY												
TOTAL (ELECT.) $	60.42	55.66	53.14	37.60	30.76	22.52	22.52	22.52	25.55	38.65	46.39	59.52
TOTAL (PROPANE) $												
GRAND TOTAL $												

$475.20/Year

WILKES-BARRE

PROPANE HEATING, COOKING
AND
HOT WATER HEATING

2-A

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION (GALLON)	175	156	135	76	30				20	66	116	168
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	201	182	161	102	56	26	26	26	46	92	142	194
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17
COST OF GAS $	76.38	69.16	61.18	38.76	21.28	9.88	9.88	9.88	17.48	34.96	54.00	73.70
TOTAL COST $	87.55	80.33	72.38	49.93	32.45	21.05	21.05	21.05	28.65	46.13	65.17	84.87

$610.52/Year

WILKES-BARRE

PROPANE HEATING, ELECTRIC COOKING AND HOT WATER HEATING

3-A

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION (GALLON)	175	156	135	76	30				20	66	116	168
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	944	944	944	944	944	944	944	944	944	944	944	944
COST OF ELECTRICITY $	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50
COST OF GAS $	66.50	59.30	57.30	28.90	11.40				7.60	25.10	44.10	63.80
TOTAL COST $	89.00	81.80	79.80	51.40	36.90	22.50	22.50	22.50	30.10	47.60	66.60	86.30

$628.00/Year

WILLKES-BARRE

ALL ELECTRIC

1-B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION (GALLON)	3102	2760	2400	1340	522				354	1161	2044	2965
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	4046	3704	3344	2284	1466	944	944	944	1228	2105	2988	3910
COST OF ELECTRICITY $												
COST OF GAS $												
TOTAL COST $	79.39	74.06	60.42	52.19	37.01	22.52	22.52	22.52	33.84	49.09	63.03	77.23

WILKES-BARRE

PROPANE HEATING, COOKING
AND
HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION (GALLON)	226	201	174	97	38				26	85	150	216
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	252	227	200	123	64	26	26	26	52	111	176	242
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17
COST OF GAS $	96.00	88.00	76.00	47.00	24.00	10.00	10.00	10.00	19.80	42.30	67.00	92.20
TOTAL COST $	107.17	99.17	87.17	58.17	35.17	21.17	21.17	21.17	30.97	53.47	78.17	103.37

$715.04/Year

WILKES-BARRE

NATURAL GAS HEATING, COOKING
AND
HOT WATER HEATING

2-B*

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION (GALLON)	203000	18100	15700	8800	3400				2300	7600	13500	19400
COOKING, DOM. H.W. (GALLON)	2318	2318	2318	2318	2318	2318	2318	2318	2318	2318	2318	2318
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	22618	20318	17918	11018	5618	2218	2218	2218	5518	9818	15718	21618
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17
COST OF GAS	23.07	21.33	19.17	12.96	8.18	5.04	5.04	5.04	8.01	11.88	17.27	22.58
TOTAL COST	34.24	32.40	30.34	24.13	19.35	16.21	16.21	16.21	19.18	23.05	28.44	33.75

$270.73/Year

WILKES-BARRE

PROPANE HEATING, ELECTRIC COOKING
AND
HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	1156	1028	893	498	195				132	434	762	1104
HEATING CONSUMPTION (GALLON)	226	201	174	97	38				26	85	150	216
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	944	944	944	944	944	944	944	944	944	944	944	944
COST OF ELECTRICITY $	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50
COST OF GAS $	85.88	76.38	66.12	36.86	14.44				9.88	32.30	57.00	82.00
TOTAL COST $	108.38	98.88	88.62	59.36	36.94	22.50	22.50	22.50	32.38	54.80	79.50	104.50

$730.00/Year

MIAMI

ALL ELECTRIC

1-A & B

Tot. Degree Days - 214

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	74	56	19									65
HEATING CONSUMPTION	155	120	40									135
COOKING, LIGHTING DOM. H.W. CONSUMP. (KWHRS/MO)	944	944	944	944	944	944	944	944	944	944	944	944
AIR CONDITIONING (KWHRS/MO)												
TOTAL CONSUMPTION (KWHRS/MO)	1,099	1,064	988	944	944	944	944	944	944	944	944	1,079
MAX. DEMAND (KW)												
COST: DEMAND												
COST: ENERGY												
TOTAL (ELECT.) $	22.06	22.06	22.06	22.06	22.06	22.06	22.06	22.06	22.06	22.06	22.06	22.06
TOTAL (PROPANE) $												
GRAND TOTAL $												

NO HEATING INSTALLATION IS REQUIRED

$264.77/Year

MIAMI

COOKING AND HOT WATER HEATING

3-A & B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	74	56	19									65
HEATING CONSUMPTION (GALLON)												
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36
COST OF GAS $	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40
TOTAL COST $	20.76	20.76	20.76	20.76	20.76	20.76	20.76	20.76	20.76	20.76	20.76	20.76

$249.12/Year

BATON ROUGE

ALL ELECTRIC

1-A

Total Degree Days - 1560

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	409	294	208	33						31	216	369
HEATING CONSUMPTION	850	610	435	70						65	450	770
COOKING, LIGHTING DOM. H.W. CONSUMP. (KWHRS/MO)	944	944	944	944	944	944	944	944	944	944	944	944
AIR CONDITIONING (KWHRS/MO)												
TOTAL CONSUMPTION (KWHRS/MO)	1,794	1,554	1,379	1,014	944	944	944	944	944	1,009	1,390	1,714
MAX. DEMAND (KW)												
COST: DEMAND												
COST: ENERGY												
TOTAL (ELECT.) $	33.73	30.47	28.09	23.13	21.60	21.60	21.60	21.60	21.60	23.06	28.24	32.87
TOTAL (PROPANE) $												
GRAND TOTAL $												

$307.60/Year

BATON ROUGE

PROPANE HEATING, COOKING
AND
HOT WATER HEATING

2-A

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	409	294	208	33						31	216	369
HEATING CONSUMPTION (GALLON)	53	38	270	4						4	28	47
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	80	65	53.5	31						31	52.5	75
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66
COST OF GAS $	36.80	29.90	24.60	14.30	11.96	11.96	11.96	11.96	11.96	14.26	24.15	34.50
TOTAL COST $	46.46	39.56	24.26	23.96	21.62	21.62	21.62	21.62	21.62	23.92	33.81	44.16

$388.12/Year

BATON ROUGE

PROPANE HEATING, ELECTRIC COOKING
AND
HOT WATER HEATING

3-A

MONTH OF YEAR		JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS		409	294	208	33						31	216	369
HEATING CONSUMPTION		53	38	27	4						4	28	47
COOKING, LIGHTING DOM. H.W. CONSUMP. (KWHRS/MO)		944	944	944	944	944	944	944	944	944	944	944	944
AIR CONDITIONING (KWHRS/MO)													
TOTAL CONSUMPTION (KWHRS/MO)													
MAX. DEMAND (KW)													
COST: DEMAND													
COST: ENERGY													
TOTAL (ELECT.)	$	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60
TOTAL (PROPANE)	$	23.46	17.02	11.96	1.84						1.84	12.42	21.16
GRAND TOTAL	$	45.06	38.62	33.56	23.64	21.60	21.60	21.60	21.60	21.60	23.44	34.02	42.76

$349.10/Year

BATON ROUGE

ALL ELECTRIC

1-B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	409	294	208	33						31	216	369
HEATING CONSUMPTION (GALLON)	1076	772	550	89						82	570	975
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	2020	1716	1494	1033	944	944	944	944	944	1026	1514	1919
COST OF ELECTRICITY $	36.83	32.69	29.67	23.40	23.47	23.47	23.47	23.47	23.47	24.88	29.92	35.55
COST OF GAS $												
TOTAL COST $												

$330.27/Year

BATON ROUGE

PROPANE HEATING, COOKING
AND
HOT WATER HEATING

2-B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	409	294	208	33						31	216	369
HEATING CONSUMPTION (GALLON)	67	47	34	5						35	35	60
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	93	73	60	31	26	26	26	26	26	31	61	86
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66	9.66
COST OF GAS $	42.78	35.58	27.60	14.26	11.96	11.96	11.96	11.96	11.96	14.26	28.06	39.56
TOTAL COST $	52.44	42.24	37.26	23.92	21.62	21.62	21.62	21.62	21.62	23.92	37.72	49.22

$375.82/Year

BATON ROUGE

PROPANE HEATING, ELECTRIC COOKING
AND
HOT WATER HEATING

3-B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	409	294	208	33						31	216	369
HEATING CONSUMPTION (GALLON)	67	47	34	5						5	35	60
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)												
COST OF ELECTRICITY $	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60	21.60
COST OF GAS $	30.82	21.62	15.64	2.30						2.30	16.10	27.60
TOTAL COST $	52.42	43.22	37.24	23.90	21.60	21.60	21.60	21.60	21.60	23.90	37.70	49.20

$373.00/Year

OKLAHOMA CITY

ALL ELECTRIC

1-A

TOT. DEG. DAYS - 3725

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	868	664	527	189						164	498	766
HEATING CONSUMPTION	1805	1380	1100	395						340	1035	1600
COOKING, LIGHTING DOM. H.W. CONSUMP. (KWHRS/MO)	944	944	944	944	944	944	944	944	944	944	944	944
AIR CONDITIONING (KWHRS/MO)	2,749	2,324	2,044	1,339	944	944	944	944	944	1,284	1,979	2,544
TOTAL CONSUMPTION (KWHRS/MO)												
MAX. DEMAND (KW)	10.9	10.9	9.9	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	9.5
COST: DEMAND												
COST: ENERGY												
TOTAL (ELECT.) $	36.11	32.11	29.31	22.26	21.23	21.23	21.23	21.23	21.23	21.71	28.66	34.26
TOTAL (PROPANE) $												
GRAND TOTAL $												

$310.57/Year

OKLAHOMA CITY

GAS HEATING, COOKING
AND
HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	868	664	527	189						164	498	766
HEATING CONSUMPTION (GALLON)	112	85	68	24						21	64	99
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	138	111	94	50	26	26	26	26	26	47	90	125
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62
COST OF GAS $												
TOTAL COST $												

$428.00/Year

OKLAHOMA CITY

GAS HEATING & ELECTRIC HOT WATER HEATING
AND
COOKING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	868	664	527	189						164	498	768
HEATING CONSUMPTION (GALLON)	112	85	68	24						21	64	99
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	112	85	68	24						21	64	99
TOTAL ELECTRICAL CONSUMPTION (KWHR)	944	944	944	944	944	944	944	944	944	944	944	944
COST OF ELECTRICITY $	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23
COST OF GAS $	44.80	34.00	27.20	9.60						8.40	25.60	39.60
TOTAL COST $	66.03	55.23	48.46	30.83	21.23	21.23	21.23	21.23	21.23	29.63	46.83	60.83

$444.00/Year

OKLAHOMA CITY

ALL ELECTRIC

1-B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	868	664	527	189						164	498	766
HEATING CONSUMPTION (GALLON)	2234	1708	1362	490						420	1281	1980
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	3178	2652	2306	1434	944	944	944	944	944	1364	2225	2924
COST OF ELECTRICITY $	44.20	39.45	36.14	27.72	21.23	21.23	21.23	21.23	21.23	26.72	35.33	41.89
COST OF GAS $												
TOTAL COST $												

$357.58/Year

OKLAHOMA CITY

PROPANE HEATING, COOKING
AND
HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	868	664	527	189						164	498	766
HEATING CONSUMPTION (GALLON)	139	106	85	30						26	80	122
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	165	132	111	50	26	26	26	26	26	52	106	148
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62
COST OF GAS $	66.00	52.80	44.40	22.40	10.40	10.40	10.40	10.40	10.40	20.80	42.40	59.20
TOTAL COST $	75.62	62.42	54.02	32.02	20.02	20.02	20.02	20.02	20.02	30.42	52.02	68.82

OKLAHOMA CITY

3-B

PROPANE HEATING AND ELECTRIC HOT WATER HEATING
AND
COOLING

MONTH OF YEAR		JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS		868	664	527	187						164	498	766
HEATING CONSUMPTION		139	106	85	30						26	80	125
COOKING, LIGHTING DOM. H.W. CONSUMP. (KWHRS/MO)		944	944	944	944	944	944	944	944	944	944	944	944
AIR CONDITIONING (KWHRS/MO)													
TOTAL CONSUMPTION (KWHRS/MO)		944	944	944	944	944	944	944	944	944	944	944	944
MAX. DEMAND (KW)													
COST: DEMAND													
COST: ENERGY													
TOTAL (ELECT.)	$	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23	21.23
TOTAL (PROPANE)	$	55.60	42.40	34.00	12.00						10.40	32.00	50.00
GRAND TOTAL	$	76.83	63.63	55.23	33.23	21.23	21.23	21.23	21.23	21.23	31.63	53.33	71.23

$491.16/Year

SAN JOSE

ALL ELECTRIC

1-A

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	508	395	363	279	214						306	462
HEATING CONSUMPTION (GALLON)	1052	818	752	578	443						634	957
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	1996	1762	1696	1572	1387	944	944	944	944	944	1578	1901
COST OF ELECTRICITY $	34.29	30.34	29.22	27.13	23.96	16.40	16.40	16.40	16.40	16.40	27.22	32.68
COST OF GAS $												
TOTAL COST $												

$286.84/Year

SAN JOSE

2-A

PROPANE HEATING
AND
HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	508	395	363	279	214						306	462
HEATING CONSUMPTION (GALLON)	58	43	41.6	32	24.5						35	53
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	84	69	67.6	58	50.8	26	26	26	26	26	61	79
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47
COST OF GAS $	33.60	27.60	27.00	23.20	20.20	10.40	10.40	10.40	10.40	10.40	24.40	31.60
TOTAL COST $	45.07	39.07	38.47	34.67	31.67	21.87	21.87	21.87	21.87	21.87	35.87	43.07

$377.24/Year

SAN JOSE

PROPANE HEATING, ELECTRICAL COOKING
AND
HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	508	395	363	279	214						306	462
HEATING CONSUMPTION (GALLON)	58	43	41.6	32	24.5						35	53
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	58	43	41.6	32	24.5						35	53
TOTAL ELECTRICAL CONSUMPTION (KWHR)	944	944	944	944	944	944	944	944	944	944	944	944
COST OF ELECTRICITY $	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75
COST OF GAS $	23.20	17.20	16.64	12.80	9.80						14.00	21.20
TOTAL COST $	44.95	38.95	38.39	34.55	31.55	21.75	21.75	21.75	21.75	21.75	35.75	42.95

$375.85/Year

1-B

ALL ELECTRIC

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	508	395	363	279	214						306	462
HEATING CONSUMPTION (GALLON)	1293	993	925	710	545						780	1177
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)												
TOTAL ELECTRICAL CONSUMPTION (KWHR)	2237	1937	1869	1654	1490	944	944	944	944	944	1724	2121
COST OF ELECTRICITY $	43.20	38.60	37.40	33.80	31.60	16.40	16.40	16.40	16.40	16.40	35.00	41.70
COST OF GAS $												
TOTAL COST $												

$343.80/Year

SAN JOSE

PROPANE HEATING, COOKING
AND
HOT WATER HEATING

2-B

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	508	395	363	279	214						306	462
HEATING CONSUMPTION (GALLON)	71	53	50	39	30						43	65
COOKING, DOM. H.W. (GALLON)	26	26	26	26	26	26	26	26	26	26	26	26
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	97	79	76	65	56	26	26	26	26	26	69	91
TOTAL ELECTRICAL CONSUMPTION (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
COST OF ELECTRICITY $	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47
COST OF GAS $	38.80	31.60	30.40	26.00	22.40	10.40	10.40	10.40	10.40	10.40	27.60	36.40
TOTAL COST $	50.27	43.07	41.87	37.47	33.87	21.87	21.87	21.87	21.87	21.87	39.07	47.87

$402.84/Year

SAN JOSE

PROPANE HEATING,
ELECTRIC COOKING & HOT WATER HEATING

MONTH OF YEAR	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
DEGREE DAYS	508	395	363	279	214						306	462
HEATING CONSUMPTION (GALLON)	71	53	50	39	30						43	65
COOKING, DOM. H.W. (GALLON)	594	594	594	594	594	594	594	594	594	594	594	594
LIGHTING K.W. AND W/D (KWHR)	350	350	350	350	350	350	350	350	350	350	350	350
TOTAL GAS CONSUMPTION (GALLON)	71	53	50	39	30						43	65
TOTAL ELECTRICAL CONSUMPTION (KWHR)	944	944	944	944	944	944	944	944	944	944	944	944
COST OF ELECTRICITY $	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75	21.75
COST OF GAS $	28.40	21.20	20.00	15.60	12.00						17.20	26.00
TOTAL COST $	50.15	42.95	41.75	37.35	33.75	21.75	21.75	21.75	21.75	21.75	38.95	47.75

$401.40/Year

APPENDIX VI

MANUFACTURED BUILDING PROGRAMS

ENABLING LEGISLATION

Margin to bind

TABLE 18 MANUFACTURED BUILDING PROGRAMS - ENABLING LEGISLATION

	APPLICABILITY					OCCUPANCIES COVERED												PREEMPTION			STATE ADVISORY COMMITTEE						CODES AND STANDARDS CITED								
														RESIDENTIAL																					
STATE	MANUFACTURED BUILDINGS	MOBILE HOMES	BUILDING COMPONENTS	BUILDING MATERIALS	OTHER	ASSEMBLY	EDUCATION	BUSINESS	MERCANTILE	INSTITUTIONAL	FACTORY-INDUSTRIAL	HAZARDOUS	STORAGE	1 & 2 FAMILY	MULTI-FAMILY	OTHER		PREEMPTS LOCAL CODES	MFG. OPTION FOR LOCAL APPROVAL		ESTABLISHED	RECOMMENDATIONS MANDATORY	RECOMMENDATIONS ADVISORY ONLY	PROVIDES APPEAL PROCEDURES	PROVIDES FOR INTERSTATE RECIPROCITY	PROVIDES FOR CRIMINAL PENALTIES	BUILDING CODE	MECHANICAL CODE	PLUMBING CODE	ELECTRICAL CODE	1 & 2 FAMILY DWELLING CODE	OTHER	REMARKS	INFORMATION REPORTED AS OF (DATE)	STATE
ALABAMA	●	○	●	●										●	●	●		●	●		●		●	●	●	●	H	H	H	H				[illegible]/72	ALABAMA
ALASKA																																			ALASKA
ARIZONA	●		●	●		●	●	●	●	●	●	●	●	●	●	●		●	○		●		●	●	●	●	U-70	U-70	U-70	NE-68				1/72	ARIZONA
ARKANSAS																																			ARKANSAS
CALIFORNIA	●	○	●	○						●				●	●	●		●	●		●		●	●	●	●	U-70	U-70	U-70	NE-71				3/72	CALIFORNIA
COLORADO	●		●	●										●	●	●		●	○		●	●		●	●	●	H	H	H	H				7/72	COLORADO
CONNECTICUT	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●		●			●		●	●	○	●	B	B	B	B				7/72	CONNECTICUT
DELAWARE																																			DELAWARE
FLORIDA	●	○												●	●	●		●			●		●	●	●	●			ST-68					7/72	FLORIDA
GEORGIA	●	○	●	●										●	●	●		●	○		●		●				H	H	H	H				7/72	GEORGIA
HAWAII	●	○	●											●	●			●			●		●		●	●	U-67	U-67	U-67	NE-68				1/73	HAWAII
IDAHO	●		●											●	●	●		●	○		●		●	○	●	●	U	U	U	NE				5/73	IDAHO
ILLINOIS																																			ILLINOIS
INDIANA	●		●	●		●	●	●	●	●	●	●	●	●	●	●		●	○		●	●		●	●	●	H	H	H	H				8/72	INDIANA
IOWA																																			IOWA
KANSAS																																			KANSAS
KENTUCKY																																			KENTUCKY
LOUISIANA																																			LOUISIANA
MAINE	●	●	●											●	●			●						●	●	●	U-70	B-70	ST-70	NE-71				8/72	MAINE
MARYLAND	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●		●	○		●		●	●	●	●	H	H	H	H				7/72	MARYLAND
MASSACHUSETTS	●					●	●	●	●	●	●	●	●	●	●	●		○	●		●		●	●	○	●	ST	ST	ST	ST				9/72	MASSACHUSETTS
MICHIGAN																																			MICHIGAN
MINNESOTA	●	○	●	●		●	●	●	●	●	●	●	●	●	●	●		●			●		●	●	●	●	ST-72	ST-72	ST-69	NE-71			STATE BUILDING CODE REFERENCES UBC	9/72	MINNESOTA
MISSSISSIPPI																																			MISSSISSIPPI
MISSOURI																																			MISSOURI
MONTANA																																			MONTANA
NEBRASKA																																			NEBRASKA
NEVADA	●		●											●	●	●		○			○			●		●	U-(1)	U-(1)	U-(1)	NE-(1)			(1) LATEST EDITIONS CITED	6/72	NEVADA
NEW HAMPSHIRE																																			NEW HAMPSHIRE
NEW JERSEY																																			NEW JERSEY
NEW MEXICO	●					●	●	●	●	●	●	●	●	●	●	●		●			●	●		●	●		(NOT CITED IN AMENDED ACT)							6/73	NEW MEXICO
NEW YORK	●	○	●	●										●	●	●		●	○		○			●	●	●	H	H	H	H				7/72	NEW YORK
NORTH CAROLINA	●	●	●			●	●	●	●	●	●	●	●	●	●	●		●	○		●	●		●	●	●	ST-71	ST-71	ST-70	NE-71			DEPT. HAS LIMITED COVERAGE TO SINGLE FAMILY DWELLINGS		NORTH CAROLINA
NORTH DAKOTA																																			NORTH DAKOTA
OHIO	●	○	●	●		●	●	●	●	●	●	●	●	●	●	●		●			●	●		●	○	○	ST-69	ST-69	ST-69	ST-69	ST			9/72	OHIO
OKLAHOMA																																			OKLAHOMA
OREGON																																			OREGON
PENNSYLVANIA	●	○	●											●	●	●		●			●		●	●	●	●	H	H	H	H				8/72	PENNSYLVANIA
RHODE ISLAND																																			RHODE ISLAND
SOUTH CAROLINA	●		●	●										●	●	●		●			○			○	○	○	H	H	H	H				7/72	SOUTH CAROLINA
SOUTH DAKOTA																																			SOUTH DAKOTA
TENNESSEE																																			TENNESSEE
TEXAS																																			TEXAS
UTAH																																			UTAH
VERMONT																																			VERMONT
VIRGINIA	●	●	●	●										●	●	●		●	○		○			●	○	●	B-70	B-70	S-67	NE-68				[illegible]	VIRGINIA
WASHINGTON	●		●							●				●	●	●		●			●		●	●	●	●	U-67	U-67	U-67	NE-68					WASHINGTON
WEST VIRGINIA	●		●	●										●	●												H	H	H	H			PROGRAM NOT IMPLEMENTED	[illegible]	WEST VIRGINIA
WISCONSIN																																		[illegible]	WISCONSIN
WYOMING																																			WYOMING
DIST. OF COLUMBIA																																			DIST. OF COLUMBIA
PUERTO RICO																																			PUERTO RICO
VIRGIN ISLANDS																																			VIRGIN ISLANDS

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