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Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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MOBILE HOMES - AN EXAMPLE OF ASSEMBLY-LINE PRODUCED LOW-INCOME HOUSING 1/

by

Torben C. Hansen
Professor of Building Materials
The Technical University of Denmark
Copenhagen, Denmark

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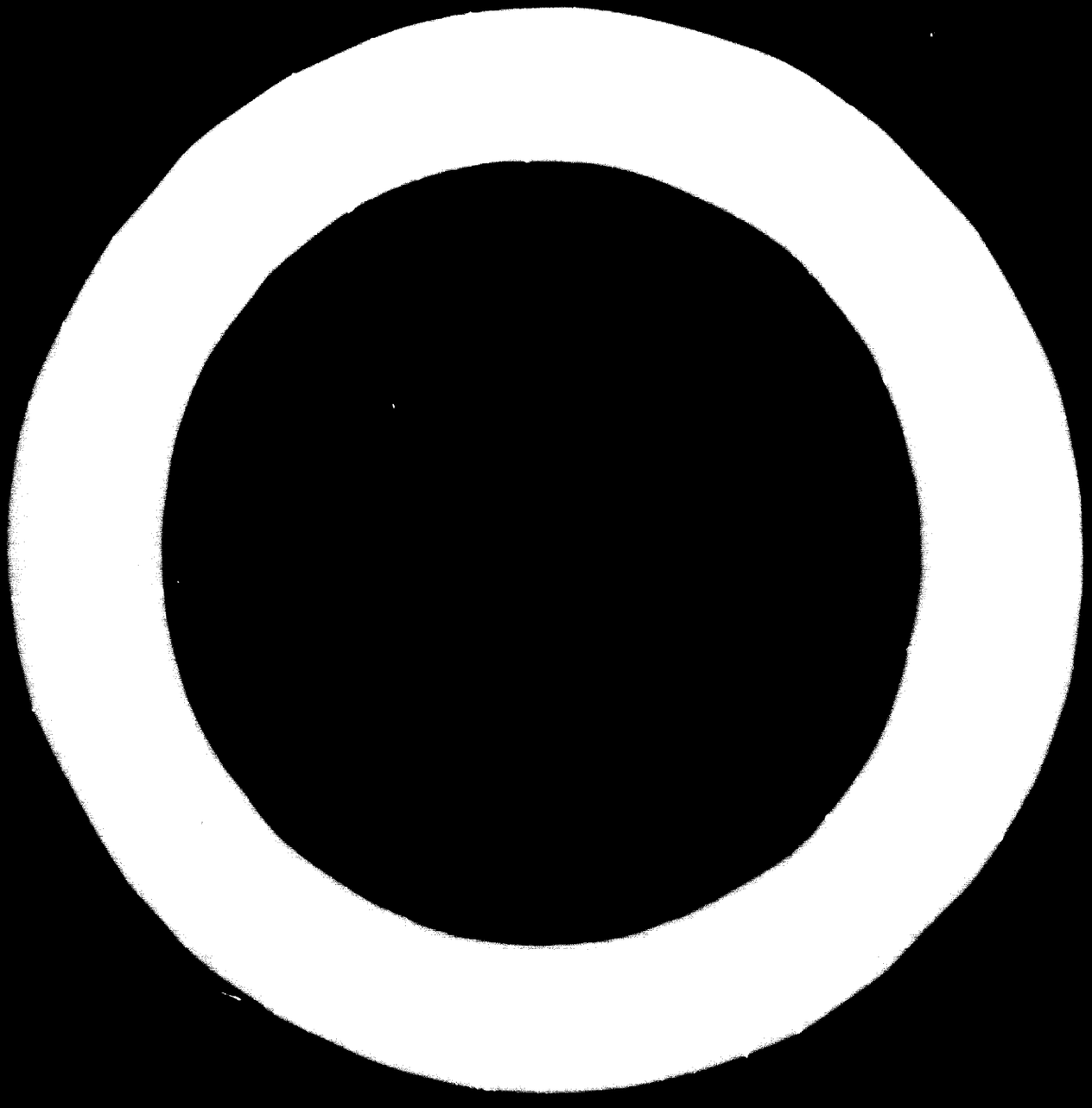

Introduction

The mobile home industry is currently the only large scale producer of factory assembled housing in the U.S. and probably in the world. The resulting low cost of production is the fundamental reason for the success of the product. It should seriously be considered applying the technology of mass production used by the american mobile home industry, in a somewhat modified form, in order to alleviate the housing shortage of many developing countries.

In 1969, the mobile home industry in the United States reported sales of 413.000 homes with a retail value of $ 2.5 billion. This was more-than 30 percent of all housing starts and 48 percent of all single-family houses built in the United States in 1969. An estimated 7 million people live permanently in mobile homes.

The mobile home industry has demonstrated that assembly-line production can reduce costs by more than 50 percent over conventional construction. Moreover, the price of mobile homes has only increased slightly over a period where conventional construction costs have increased sharply.

The rapid growth of the mobile home industry represents a revolution in American housing and may well lead to a breakthrough in industrialized housing all over the world.

The industry has been quick to realize the tremendous size of the potential market for low-cost housing not only in the form of mobile homes, but also modular fixed-site town houses, row houses, duplexes and high-rise buildings. The mobile home industry is getting organized to adapt its manufacturing processes to the needs of low and middle income urban multi-family housing.

Although so far there are no real giants in the mobile home industry, there is a far greater concentration than in

conventional home building, where the top 15 companies in the United States account for less than 4 percent of the total output. If operating at full capacity, the industry is at present capable of producing well over 500.000 mobile homes per year.

Development of the Mobile Home and the Mobile Home Industry

Mobile living has a long tradition in the United States, beginning with the covered wagons which carried many american families across the continent in the mid-19th century. The house trailer industry has been around for decades. The old trailer of the 30's and 40's was used by transients as a means of economic shelter, traveling from job to job and base to base, a necessity during the Depression and War Years.

1955 marks the beginning of the mobile home as an industrialised house. A 10 foot wide mobile home unit was introduced which could not be pulled behind the family automobile. The unit had to be moved by a professional trucker. Mobility started giving way to the new immobile home, which is entirely different from a travel trailer. The 10 foot wide unit offered more variety of room arrangement and more privacy than the 8 foot models. Thus, it was better able to compete with conventional housing. 12-foot wide mobile homes came into mass production in 1962 and 14-foot wide homes in 1969. The effect of these and other new developments indicate that 1 000 000 mobile homes or similar assembly-line produced single family homes will be produced by 1975.

Mobile homes and travel trailers are very different to-day, although they both developed from the old house trailer. Basically, the two types of vehicles are built for different kinds of use. A mobile home is normally occupied as a permanent or semipermanent home. A travel trailer on the other hand, is intended as a temporary dwelling for use during vacations, or other times when short-term accomodations are required.

Mobile homes always include one or more complete bathrooms, and the home must be connected to utilities. Fig. 1 shows mobile homes in an American mobile home park.

Mobile homes and similar modules are transported to their sites by trucks or they are shipped on railroad flatcars, see fig. 2.

Mobile homes, though basically transportable, are moved only rarely. The types of mobile homes now being sold are ten, twelve, or fourteen feet in width, or multiples thereof and few are under 40 feet in length. The larger models are built in two or three sections which fit together to make a single home, but can be separated from each other for transportation purposes. There are in addition a variety of other plans available that offer telescopic or fold-out rooms for additional floor space.

Sizes and Accommodations

Ninety-five per cent of all mobile homes are shipped from the factory equipped with major appliances, furniture, draperies, lamps, carpeting and sanitary facilities. Optional features are available such as air-conditioning, automatic dishwashers, and garbage disposals. The homes are centrally heated by gas, oil or electric furnace. The choice of decor, i.e., Early American, French Provincial, Oriental, Mediterranean, Traditional or Contemporary is also available to the mobile home owner. Some buyers choose to custom order their mobile home, much as they would a conventional house.

Mobile homes range in area from about 600 to 2,000 sq. feet although the bulk of sales is in models of about 1,000 sq. ft. The number of rooms range from three to seven, excluding bathroom, but most standard models have a spacious living room, dining room, kitchen or kitchen-dinette, one or two bedrooms, and one or two bathrooms with custom designed

cabinetry and closets. Mobile homes are usually displayed fully furnished, but they can be purchased unfurnished or partially furnished. Most mobile homes are built to accomodate up to four persons with comfort, but the usual household consists of two people.

Exterior dimensions of mobile homes range from 8 feet to over 30 feet in width, and from 29 to 70 in length when put in place. Ten, twelve, fourteen, twenty, twenty-four and twenty-eight feet width are becoming standard, with twelve ft. wides accounting for about 85 percent of the market. As more and more states permit the passage of 14-wide homes on their highways, the market share of 14-wides is expected to grow rapidly. Lengths are somewhat less standard than widths, but 50-60 foot lengths are by far the most popular.

The exterior appearance of mobile homes is straight forward, as shown in fig. 1. Many find their tin-can look plain ugly, but manufacturers have found most customers unwilling to pay for improved appearance. Nevertheless, the exterior appearance keeps many potential customers from buying a mobile home and there is a growing trend toward making mobile homes appear more like the conventional houses with gabled or mansard roofs, fake shutters and fake leaded windows, siding and skirting that gives the appearance of being a foundation, as shown in fig. 3. Porches or screened rooms are popular additions. It is expected that manufacturers eventually will learn to take better advantage of the special architectural possibilities which the box unit offers. Fig. 4 is an example.

Mobile home manufacturers are faced with a variety of design and construction problems which are somewhat similar to those involved in the building of conventional low and medium cost housing. The problem of space is acute. Retention of mobility dictates rigid length and width requirements. The problem has been solved by efficient and intelligent use of the space available. The floor plans of modern mobile homes show considerable architectural imagination. There is an emphasis on "free flow" from area to area within the unit, and on

elimation of non-utilitarian partitions chipping space into into inflexible segments. There is also careful protection of privacy in areas where privacy is desired. Examples of a typical floor plan is shown in fig. 5. Many techniques, such as use of mirrors, create illusions of space, depth and separation of functional areas. Sliding or accordeon doors are almost universal in mobile homes. Large window areas blend indoors with outdoors to add to apparent roominess. In addition, mobile home manufacturers have been ingenious in placement of fixtures and use of color to make the most of room available. Intense competition and modern production methods within the industry keep mobile homes well ahead of conventional housing in many ways. The mobile home industry, not the builders of conventional housing, pioneered such desirable features as the counter top stove and the waist-high oven. Fig. 6 shows an interior from a mobile home selling for approximately $ 6000 completely furnished including two bedrooms, bath, living room and kitchen-dinette.

Prices

Prices of mobile homes range from $ 4000 to $ 8000. The current average retail price is $ 6050. (12' x 60' overall size; 12' x 57' or 684 sq.ft. living area) or about $ 8.85 per square foot, depending upon furnishings and appliances. By comparison, the average unfurnished site-built home costs about $ 16.00 per square foot, exclusive of land. The larger mobile homes ranging from 1000 to 1440 sq.feet retail from $ 8000 to 15000, fully equipped and furnished. According to the U.S. Department of Commerce, the medium price of a 1969 comparable site-built home was $ 25600 including land and excluding furniture and appliances.

When financing is required it is usually arranged through the mobile home dealer who operates much like an auto dealer. He takes trade-ins, sells used homes, bargains about his prices,

provides services and engages in the same kinds of financial arrangements.

Engineering Design and Materials

Mobile homes are constructed to American National Standard A 119.1 for mobile homes, ref(1). The Standards cover body and frame design and construction requirements, plumbing systems, heating systems and electrical systems. The standard for design and construction covers the minimum requirements for materials, products, equipment and workmanship needed to assure that the mobile home will provide structural strength and rigidity, protection against corrosion, decay and insects, reasonable protection against the hazards of fire and windstorm, resistance to the elements, durability and economy of maintenance.

The mobile home is designed and constructed as a completely integral structure capable of sustaining the design load requirements of the standard, and transmitting the loads to piers, foundations or wheel assembly without causing any unsafe deformation or abnormal internal movement of the structure or its integral parts on site or on transit.

Fig. 7 illustrates the design and materials of a typical mobile home structure. The roof is built of 2 x 6 in. wooden rafters insulated by 2 in. of glass fiber and covered with asphalt impregnated hemp board and 30-gage galvanized steel. ½ in.ceiling panels are fastened to the wooden rafters. The walls are built of 2 x 2 and 2 x 3-in.studs with 1½ in. steel bracing insulated with 5/8 in. glass fiber and covered with painted aluminum siding or steel siding with baked enamel finish which is easy to hose down. Chipboard or decorated easy-to-clean vinyl, formica or wooden sidewall panels are fastened internally to the wooden studs. Spaces within outside walls and ceilings are either ventilated to prevent condensation or walls and ceilings are provided with corrosion

resistant vapor barriers on the warm side. Exterior surfaces are sealed to prevent entrance of rodents. The floor is built of 10-in. joist between two layers of 5/8-in. plywood with vinyl flooring and it is often provided with wall to wall carpeting. The undercarriage is made of welded 7-in. steel channels. Windows are double-glazed and aluminum framed. Often unconventional design and materials are used.

Production Process

The production of mobile homes is described in a paper by H. Rowland et al (ref.2), from which much of the following information has been derived.

Mobile homes are built in a process similar to the production of automobiles. Raw materials and products are received in railroad car and truckload quantities, taking advantage of original equipment manufacturer prices. The manufacturer plans his material inventory for a rapid turnover, often as little as two weeks for materials and products used in large volume. Labor is unskilled to semi-skilled due to the relatively narrow scope of individual work operations. One of the real advantages of the industry is that it pays on the basis of industrial wage rather than a building-craft wage.

A manufacturer tends to conform to one of two basic methods of operation. The Indiana Method is to purchase as many pre-cut and pre-assembled parts as possible. Elkhart, Indiana, is the capital of the mobile home industry, and this concentration of manufacturers has resulted in a large number of component manufacturers who supply the mobile home manufacturer in Elkhart and ship to his outlying plants and to manufacturers who do not want to invest in the equipment necessary to process raw material. The Michigan Method is to convert as much raw material as possible to finished product; it predominates when the plant is located in an isolated area to utilize a source of low cost labor.

Plants vary widely in layout. Some plants utilize an end-to-end assembly line some a side-by-side assembly line, and some a combination of the two. The flow chart shown in fig. 8 is from a layout of a typical mobile home plant producing twelve units per day on an end-to-end line.

The process involved in producing a mobile home is made up of a combination of on-line and off-line production. Off-line operations include assembly of raw materials into components in the lumber cutting mill, the cabinet shop, the metal shop and other sub-assembly departments.

Off-Line Operations

The LUMBER CUTTING MILL converts raw lumber into dimensioned pieces to supply the sub-assembly stations. Material is fed to the framing jigs where it is positioned, glued, nailed or stapled, and the surface material applied for floor framing, sidewalls, endwalls and roof.

Material from the mill is also received at the CABINET SHOP where kitchen cabinets, vanitories, built-in furniture, counter tops and interior partitions are fabricated.

The METAL SHOP converts coiled steel and aluminum into formed and sized panels for ductwork, siding, roofing and trim. The metal line begins with a decciling reel from which a continuous ribbon of metal is fed through a former, through an automatic shear that cuts it to predetermined lengths, and finally to a stacking machine where the panels are palletised for transfer to the sub-assembly department or the line. The roof metal is joined to form af single sheet to the size required and is transferred to the line so it can be installed in one operation.

Smaller sub-assembly departments are duct assembly, plumbing pipe work, electrical, doors, windows, etc. Plumbing pipe

assemblies occurring in the floor are fed to the line, and assemblies occurring in partitions are fed to the cabinet shop.

On-Line Operations

The final assembly process starts in the WELDING SHOP where steel parts are welded together to form the steel underframe. It is then moved to the next station where the running gear, tires, wheels, axles and springs are attached and the unit is turned over. From this point on the unit moves on its own wheels. The frame is then moved into a paint room where it is spray painted. Next the steel underframe is mated to the wood floor assembly. This is jig built using 2 x 6 joists two feet on center and is built in an upside down position. An exterior grade fiberboard is stapled to the joists for bottom weatherproofing, and a transfer mechanism picks up the floor assembly, rotates it 180° and positions it onto the steel frame where they are lag bolted together, and insulation, ductwork and water supply and drain assemblies are installed. Then the plywood decking is applied, secured and sanded. At the next station, the plywood deck is covered with carpet or resilient flooring, and loading and installation of the cabinets, interior partitions, furnace and plumbing fixtures is begun.

The unit then moves into the next stations where the four exterior walls are positioned and secured to the floor. Moving to the next station, the wood roof assembly, built as a single unit to the size required, is crane carried from its jigs, positioned and secured to the sidewalls. Then the rough electrical wiring is installed, insulation is completed, and the roof is sheathed with an exterior composition board. The unit then moves through stations where the aluminum exterior cladding and the metal roof are installed, windows and exterior doors are mounted, and clearance and tail lights are secured. Inside the unit, bath fixture installation and

securing of cabinets and partitions is completed, and the finish electrical installation has begun. At the next station, interior doors are hung, moulders apply all of the interior wood, plastic and chromium mouldings, and electricans install the fuse box, light fixtures and electrical trim. The unit then moves to the appliance bay where the range, refrigerator and other appliances are installed. The plumbing lines are then inspected for leaks and the electrical system for shorts. The last station includes cleanup, touchup, installation of furniture, drapes, and pictures and a final check.

Wet material processes are avoided on the line to eliminate drying time lag and damage to pre-installed finished surfaces. Jigs and fixtures are used for accuracy of assembly, and powered equipment is used to ease and speed material handling. A constant effort is made to maximize the amount of off-line assemblies in order to minimize the labor required for final assembly, which results in shorter on-line cycle time - the controlling factor of a plant's volume. Audit of labor and material utilization is a continuing process, and a new material or tool is evaluated on a pure cost/benefit basis.

Cost Breakdown

The following tables show an approximate distribution of labor and sales and administrative costs involved in mobile home production.

Table 1 Indirect Labor

	Number of Men	Dollars Per Hour	Total
Plant Superintendent	1	$ 6.00	$ 6.00
Assistant Superintendent	1	5.00	5.00
Material Foreman	1	3.00	3.00
Material Handling	10	2.00	20.00
Tool Room	2	2.50	5.00
Warehouse and Inventory	5	2.00	10.00
Inspectors	2	3.00	6.00
Equipment Maintenance	4	3.00	12.00
Plant Cleanup	4	1.50	6.00
Product Cleanup	2	1.50	3.00
Shipping Foreman	1	3.00	3.00
Shipping Clerk	2	2.00	4.00
Security	4	2.00	8.00
TOTAL INDIRECT LABOR	39		$ 91.00

39 men at $ 91.00 per hour times 8 hours per day = $ 728.00 ÷ 12 units per day is $ 60.67 indirect labor per unit.

Table 2 Direct Labor

PRODUCTION GROUPS	Number of Men	Dollars Per Hour	Total
Foreman	1	$ 4.00	$ 4.00
Group Leaders	5	3.00	15.00
Welding Shop	5	3.00	15.00
Frame Paint Shop	1	2.00	2.00
Floor Frame Jig	6	2.00	12.00
Sidewall and Endwall Jigs	14	2.00	28.00
Truss Assembly	2	2.00	4.00
Roof Jig	4	2.00	8.00
Stations 4-9, inclusive	50	2.00	100.00
Foreman	1	4.00	4.00
Group Leaders	4	3.00	12.00
Metal Shop	5	2.00	10.00
Ductwork Assembly	1	2.00	2.00
Plumbing Assembly	1	3.00	3.00
Electrical Assembly	2	3.00	6.00
Window Assembly	2	2.00	4.00
Door Assembly	2	2.00	4.00
Drapery Shop	4	2.00	8.00
Stations 10-15, inclusive	40	2.00	80.00
Foreman	1	4.00	4.00
Group Leaders	3	3.00	9.00
Lumber Cutting Mill	6	2.00	12.00
Cabinet Shop	7	2.00	14.00
TOTAL DIRECT LABOR	167		$360.00

167 men at $ 360.00 per hour times 8 hours per day = $ 2880.00 ÷ 12 units per day is $ 240.00 direct labor per unit.

Table 3 General & Administrative & Sales

	Annual Salary
General Manager	$ 24,000
Production Manager	15,000
Secretary	6,000
Industrial Engineer	12,000
Draftsman	8,000
Draftsman	6,500
Draftsman	6,500
Interior Decorator	10,000
Purchasing Agent	8,000
Secretary	5,000
Secretary	5,000
Controller	10,000
Accountant	6,500
Accountant	6,500
Secretary	5,000
Sales Manager	16,000
Salesmen Commissions	120,000
TOTAL	$ 270,000

The three previous tables, which were derived by Rowland from the cost figures of a number of manufacturers, indicate that the costs of indirect and direct labor for one day of plant operation are about $ 3600. With a plant output of at least 12 units a day, the total labor cost per mobile home unit is $ 300, or about $ 60 for indirect labor and $ 240 for direct labor. The cost for general, administration and sales averages $ 1125 per day based upon a work year of 250 days. When at least 12 units per day are produced, this cost is under $ 100 per unit.

Materials Costs

Material costs are accounted for by cross-indexing:
1) the raw material category in which the material is purchased, and
2) the assembly category in which it is used.
Following is an approximation of the material content of a typical $ 4000 factory price mobile home according to the assembly categories. Costs include allowance for waste, obsolescence and other variables.

Table 4 Materials Cost Breakdown

	Cost Per Unit
steel underframe	$ 400.00
floor assembly	245.00
cabinets and partitions	205.00
exterior walls	170.00
ceiling and roof assembly	120.00
metal	240.00
windows	105.00
doors	110.00
plumbing	130.00
electrical	95.00
appliances and furnace	345.00
fasteners, adhesives, paints	90.00
hardware	50.00
mouldings	75.00
draperies and furnishings	300.00
TOTAL	$ 2680.00

It is obvious that the industry gets a large discount. Even a small producer of 2000-3000 mobile homes is a volume buyer. It has been estimated that producers pay only $ 345 for the major household appliances and furnace; and $ 300 for the draperies and furnishings that go into a typical unit. Suppliers to the industry find it an attractive market. The opportunity for sales volume on a large scale to a comparatively small number of manufacturers lends itself to contract selling matched by few other industries. In furnishings, the mobile home manufacturers are the largest contract buyers after the federal government. In the 70's industry purchases of steel, aluminum, plywood, lumber, appliances, furniture, carpeting and other items will exceed $ 2 billion a year.

If plant production is consistent at 12 units per day, assuming a $ 4000 factory sale price for each unit, total direct and indirect labor cost per unit is about $ 300 or 7.5% of factory sale price. Material cost is 67% of factory sale price. The ratio of 7.5% labor to 67% material will vary with the degree of purchase of pre-assembled components; that is, the cost of material will rise, and labor costs will decrease, though on a much smaller proportion. It is interesting to note that much more can be spent for the highest quality materials without a significant increase in labor content. This is not the case in conventional construction.

In addition to general and administrative and sales, overhead includes payroll taxes, insurance and benefits, plant operation expense and depreciation on plant and equipment. The industry average for overhead is slightly below 15%. There are hundreds of small operations whose costs do not reflect the efficiencies shown here; however, lower overhead helps them maintain their competitive position. This hypothetical plant is modeled from facilities of the larger manufacturers with multi-plant operations. But for simplicity, the following

breakdown reflects an independent plant operating a single shift at 250 working days per year, producing 3000 units per year at an average factory price of $ 4000 per unit. Capital investment in the plant, fully equipped, is approximately $ 1,500,000.

Table 5 Cost Percentages of Mobile Home Production

	Percent of Cost	Annual Cost
Overhead	15.0%	$ 1,800,000
Direct and Indirect Labor	7.5%	900,000
Materials	67.0%	8,040,000
Profit	10.5%	1,260,000
TOTAL	100%	$12,000,000

Mobile Home Parks

Mobile homes belong in a mobile home park not in a back-yard or on a single site among conventional homes. When mobile homes are placed on individually owned properties in rural or small town locations, the result is less desirable. Fig. 9 shows a site plan for a typical mobile home park.

A modern mobile home development provides a package including maintenance, landscaped lots, paved streets with curbs and side walks, adequate street lighting, off-street parking, underground utilities, laundry facilities, green areas, swimming pool, putting greens, community center and other recreational facilities. Some have day-care centers, cable TV, man-made lakes and shopping centers. Each home is jacked up and placed on concrete blocks which rest on a concrete slab about the size of the overall area of the home. Standard connections are provided in the foundation to the sewage, water, electricity and telephone mains, and for gas, oil, and

TV antenna. It is normally up to the dealer to transport the mobile home to its site, set it up on blocks and make the necessary connections to utilities. Fig. 10 shows a typical landscape plan for a mobile home site.

Mobile homes make it possible to operate with dynamic city plans instead of the traditional static plans where the priority once assigned to land use often remains unchanged for a century or more. Use of mobile homes makes it possible in a constructive way temporarily to utilize land between commercial and residential districts of a city which frequently lies idle or develops slowly between the two districts. The mobile home park also makes possible intelligent interim use of land which will later be needed for other purposes. A city holding land or wishing to buy land in advance of immediate need can lease it for a mobile home park or develop and operate it as a municipal mobile home park. A long-range investor can operate a mobile home park on land while he waits for the area around it to develop before conversion for instance to a shopping center.

Barring economic instability and based on a conservative growth forecast of 10 percent per year, which is considerably less than the growth of the industry experienced in the past, it is estimated that 1974-production could reach 665.000 mobile homes in the three last mentioned areas alone. If the industry succeeds in moving into areas of urban renewal and sectionalized housing in big scale, far greater growth is assured.

Fig.11 illustrates what can be done to-day. It is a modular house project which replaced a pocket of slum shacks in Vicksburg, Miss. The modules were manufactured within 17 days in a mobile home plant 10 miles from the city, and carried to the building site by flatbed trucks. The units were hoisted in place by crane. Erection of the units took 8 days. The townhouse units consist of a first floor 12-foot by 32-foot module, containing living-room, kitchen and

dining area, storage space and stair well; a 12-foot by 34-foot second floor with two bedrooms, full bathroom and storage closets. Each two-storey townhouse was produced for $ 6000 or $ 10 per square foot, representing a 15-20 percent savings over comparable conventional construction. Most of the tenants are former residents of the same district. It is a case in point that prohibitions of plastic plumbing by the local building code added $ 600 per unit in cost. Copper plumbing had to be used.

Other examples of stacked mobile home units are described in some detail in ref(5) see fig. 11.

Closure

It is suggested that it be studied now the production techniques used by the American mobile home industry possibly could be applied in mass production of low-income housing for developing countries.

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TEXT OF FIGURES

FIG. 1 MOBILE HOMES IN AMERICAN MOBILE HOME PARK.

FIG. 2 TRANSPORT OF MOBILE HOME.

FIG. 3 MOBILE HOME RESEMBLING CONVENTIONAL HOME.

FIG. 4 ARTISTS CONCEPTION OF MOBILE HOMES IN THE FUTURE.

FIG. 5 TYPICAL FLOOR PLAN OF MOBILE HOME.

FIG. 6 INTERIOR OF MOBILE HOME.

FIG. 7 DESIGN AND MATERIALS OF MOBILE HOME. (FROM REF. (3)).

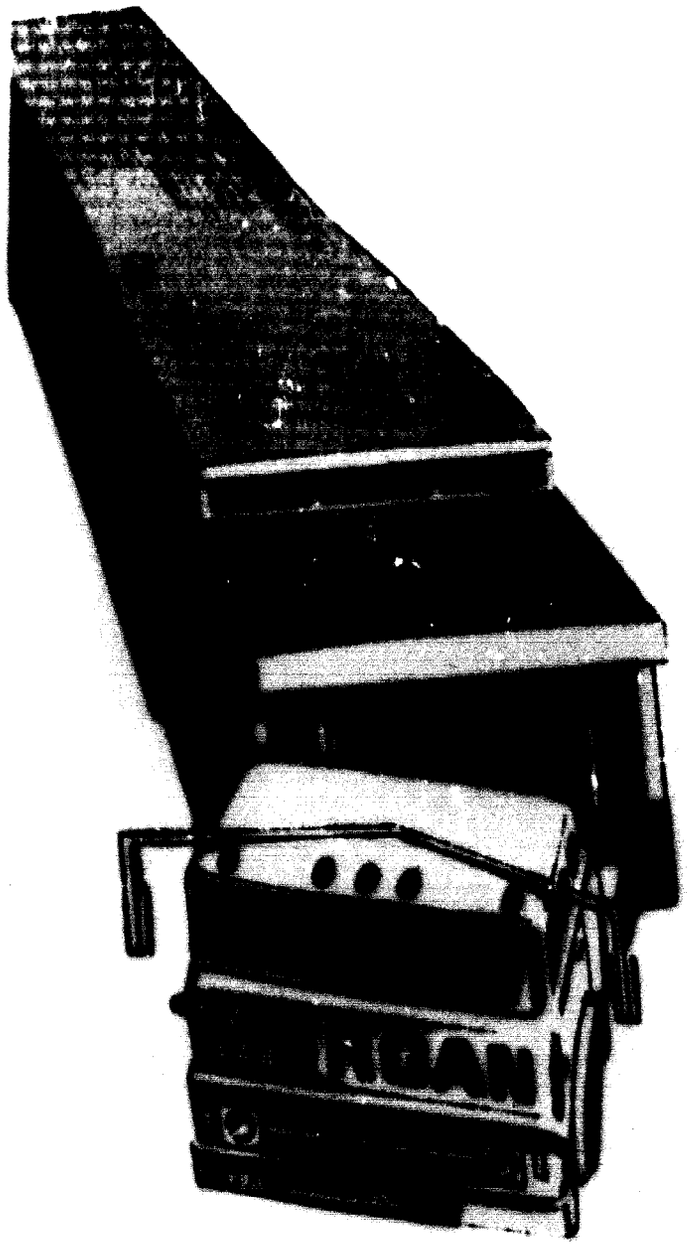
FIG. 8 GENERAL OUTLINE OF TYPICAL MOBILE HOME MANUFACTURING PLANT. (FROM REF. (4)).

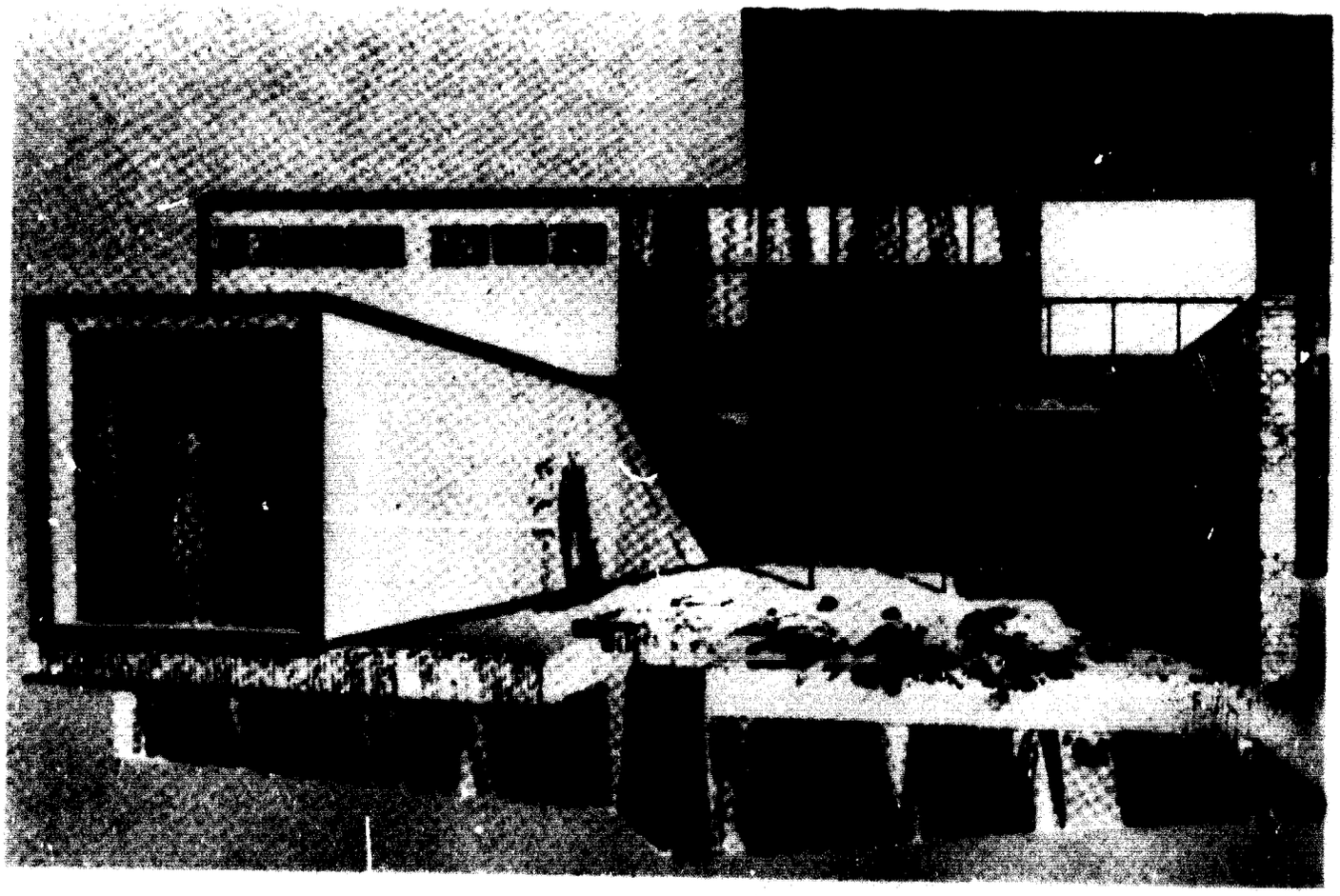
FIG. 9 SITE PLAN OF MOBILE HOME PARK. (FROM PROFESSIONAL BUILDER NOV. 1969).

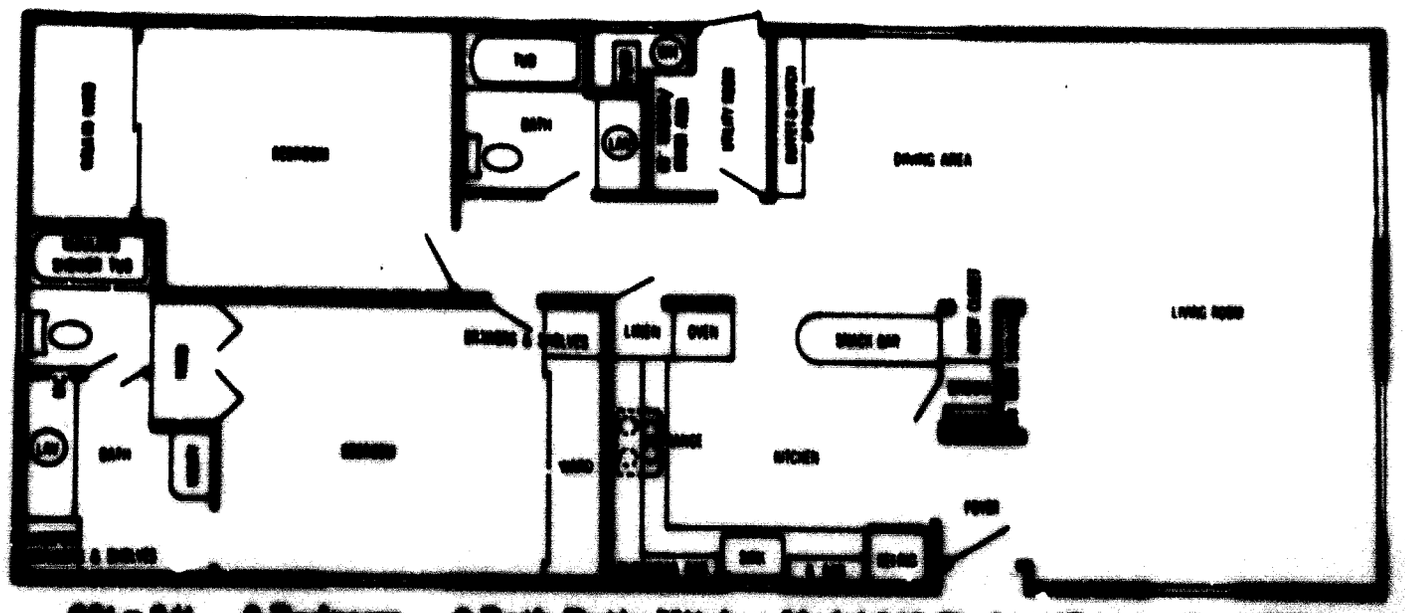
FIG. 10 LANDSCAPE PLAN FOR MOBILE HOME SITE. (FROM REF. (5)).

FIG. 11 APARTMENTS IN VICKSBURG, MISS., BUILT FROM MOBILE MODULES.

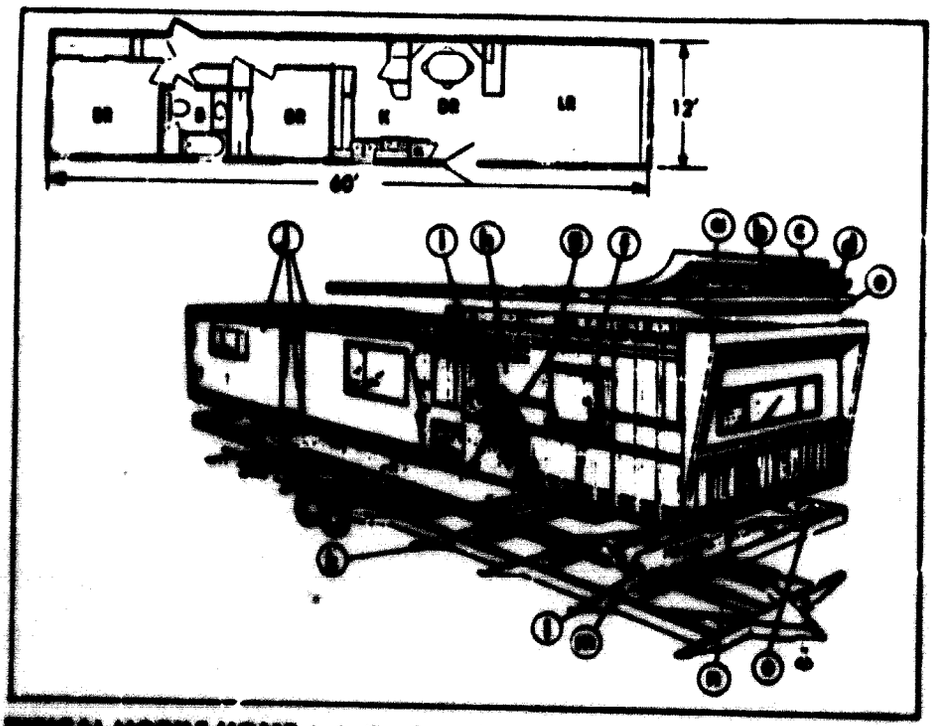
FIG. 12 STACKED MOBILE HOMES.





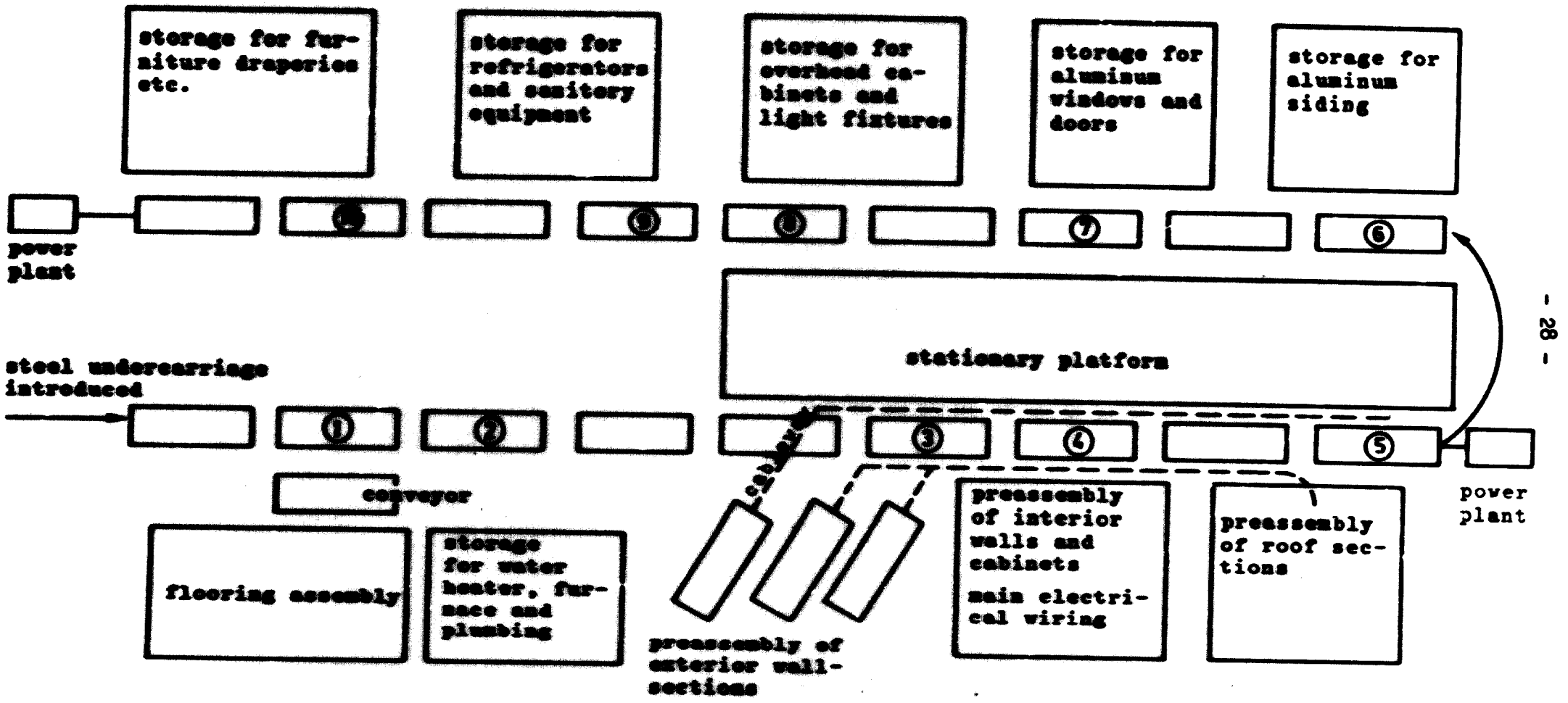


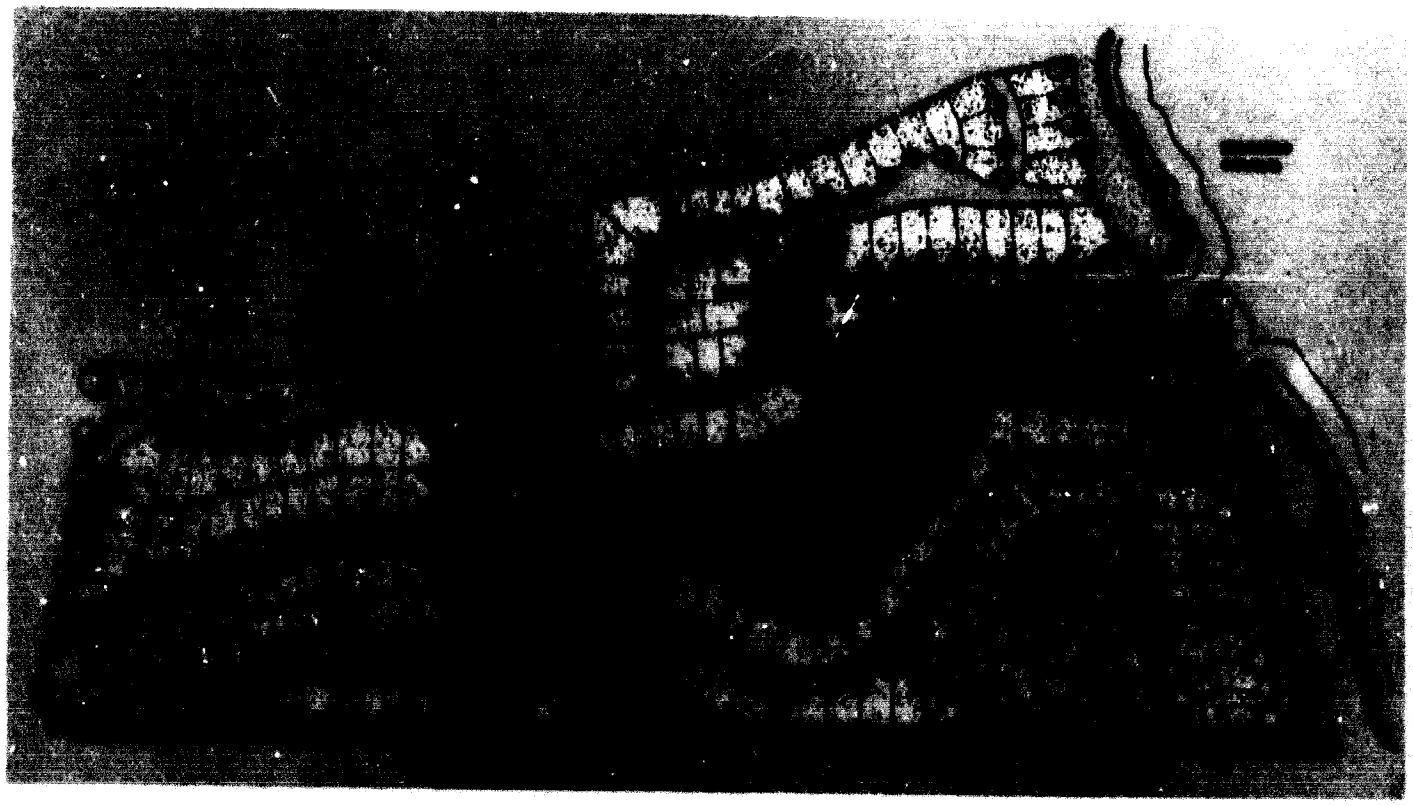
60' x 24' — 2 Bedroom — 2 Bath Patio Kitchen Model 648 Budget Twenty-Four Wide

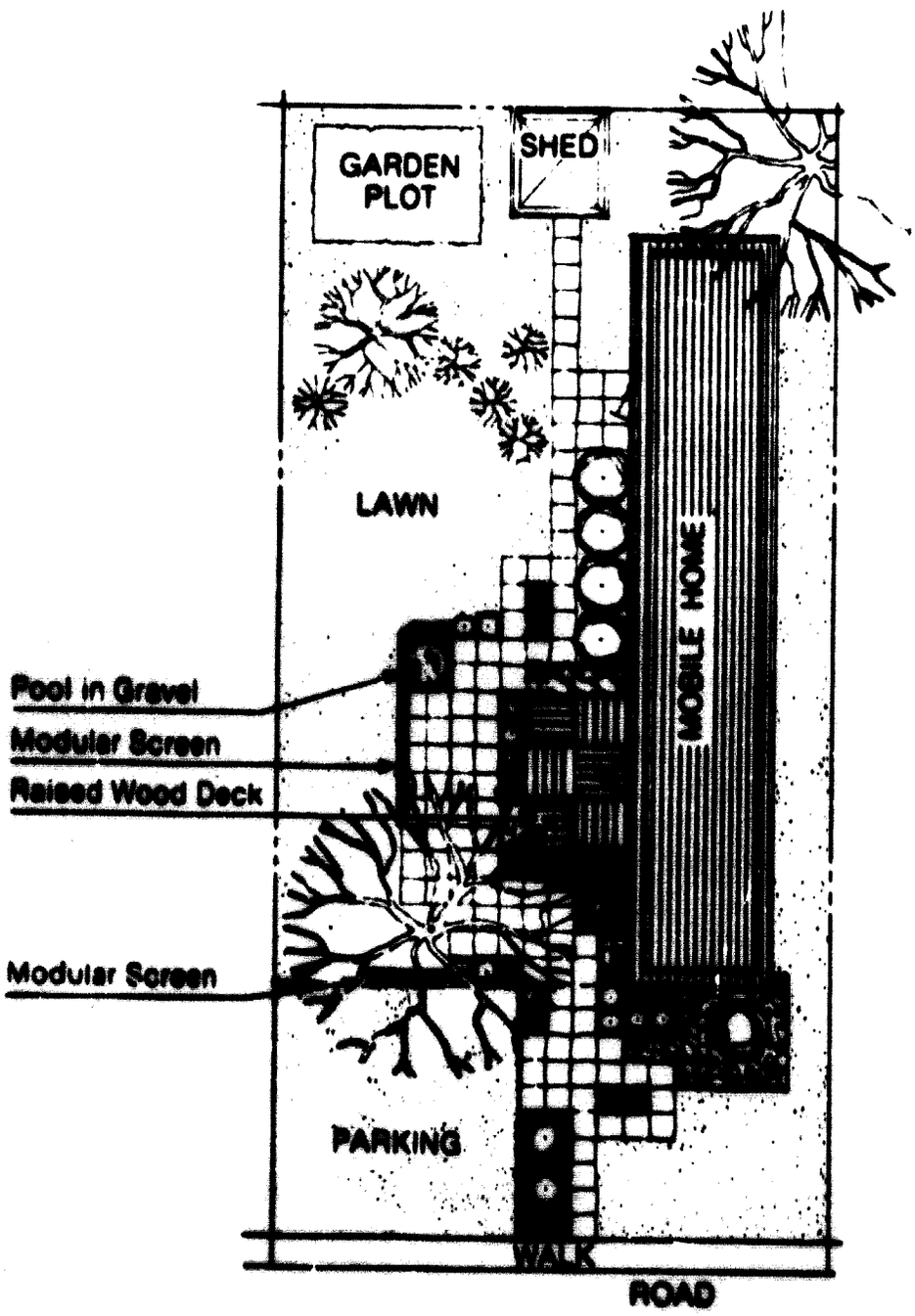


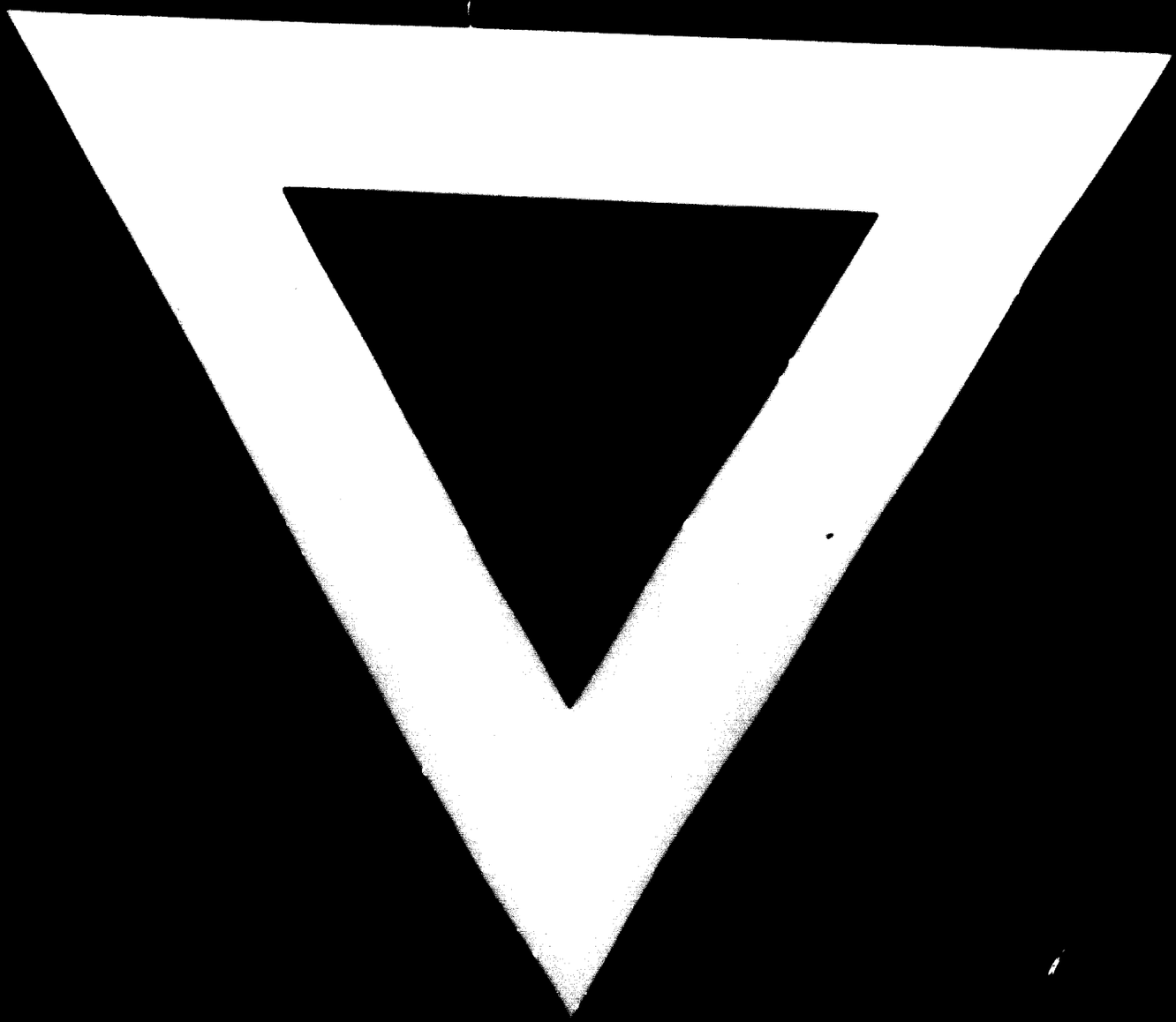
TYPICAL MOBILE HOME is built of: a—30-gage galvanized steel, b—asphalt impregnated hemp board, c—2 in. of glass fiber, d—2 x 6-in. rafters, e—½-in. ceiling panels, f—2 x 2- and 2 x 3-in. studs, g—1¼-in. steel bracing, h—sidewall panels, i—½-in. glass fiber, j—aluminum siding, k—chassis of 7-in. channels, l—1½-in. glass fiber, m—10-in. joist, n—⅝-in. plywood, o—vinyl flooring. Floor plan above is an average mobile home layout.

Fig. 13 General outline of floor plan of typical mobile home manufacturing plant (based on H. Weber and W. Berthold: "Fliessfertigung in der Bauelementproduktion. Industrialisierung des Bauens. Heft 2/3 1970, and field studies made by the author).






GARDEN PLOT
SHED
LAWN
MOBILE HOME
Pool in Gravel
Modular Screen
Raised Wood Deck
Modular Screen
PARKING
WALK
ROAD



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