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HOMES FROM PRE-ASSEMBLED WALL PANELS

A New Cost-Saving Concept of Home Construction Developed by the Small Homes Council, University of Illinois, Urbana, Illinois, as Part of a Research Project Sponsored by the Lumber Dealers Research Council

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REDUCING COSTS BY PRE-CUTTING AND PRE-ASSEMBLING

Use of pre-cut and pre-assembled wall panels and roof trusses reduces home-building costs because it eliminates waste in the use of materials and speeds up erection of the shell of the house. When parts of a house are cut and assembled as a mass production operation and trucked to the site, the construction work is primarily one of putting the parts together to form the house. Erection of the shell of the house is hastened because: 1) building materials do not have to be cut and fitted on the job; and 2) the carpenter works with parts of the house rather than with pieces of material.

While many houses have been panelized (that is, built from pre-cut and pre-assembled wall panels instead of individual pieces such as studs and plates), the panelization systems in use today are generally tied to a specific house design or to the operations of a specific builder.

To help all homeowners benefit from the cost savings which are possible by speeding erection time through use of pre-cutting and pre-assembly methods, the University of Illinois Small Homes Council undertook to develop a wall panel system which 1) would be suitable for use by the small builder, 2) would be simple and flexible enough to be used in a variety of house plans, and 3) would allow panels to be made on a mass production basis in lumber yards or builders' shops.

To illustrate the flexibility of the panels, five house plans were designed. These are shown in this book. All five plans can be easily varied in appearance. Each has at least three elevations with different roof slopes. Each can be built on a slab, over a crawl space, or over a basement. Any of a number of window types and exterior finish-materials can be selected.

These house plans are merely examples. The panels can also be used in other house plans with equal flexibility.

Open-Room Construction

While the wall panels can be used with various types of roof framing, the use of roof trusses speeds up construction inasmuch as it not only permits pre-cutting and pre-assembly of the roof parts, but also offers the economies of open-room construction.

Roof trusses — triangular frames of wood — are designed to span the house from outside wall to outside wall without need of load-bearing interior walls. This means that when the exterior wall panels are tipped into place and the roof trusses, sheathing and covering are installed, the house is one large open room. This room provides an excellent area for the workmen to continue their operations and, since the area is enclosed, inclement weather does not interfere. By having the one large room, it is possible to apply finish-material to the ceiling, walls, and floor with less cutting and fitting than is required when surfaces are interrupted by partitions. After the interior has been finished, partitions can be tipped into place.

Because the partitions do not have to carry any of the weight of the roof, they can be merely dividing walls to separate the various rooms or areas of the house. Since the placement of the partitions is not determined by structural requirements, the designer has considerable freedom in planning the house; moreover, when visual privacy only is required, the partitions do not need to extend to the ceiling but may be partial screens. By thus “opening up” a house plan, a more spacious feeling can be given to a relatively small house.

In many cases the partitions can also provide storage space. Box-like structures of studless thin-wall construction can be built to serve as both partitions and as storage units, such as linen and clothes closets.
CONSTRUCTION AND TYPES OF WALL PANELS

The wall panels developed in this project consist basically of a stud-wall framework which is covered with a sheathing material and siding. The panels are 4 feet wide and 8 feet high. They are tied together into a wall by a double 2" x 6" continuous header supported every 4 feet around the entire perimeter of the house. For economical and structural reasons, the panels are:

**Modular** in order to benefit from the economics which are possible when dimensions of the house and its parts are coordinated with those of building materials. The panels (4' x 8') are multiples of the 4-inch module, the accepted unit of measurement for building materials. Nearly all sheet materials are 4 feet in width. Such materials (interior-finish as well as sheathing and siding), therefore, fit the panels with a minimum of cutting. The 4-foot width is also a multiple of the common stud spacing used in house construction — 16 inches or 24 inches.

**Simple in design and assembly** so that 1) the panels can be constructed without expensive equipment, and 2) they can be easily erected.

**Flexible** — that is, adaptable to a variety of building materials and to a variety of house designs. With a 4-foot panel, most design problems can be readily handled. A half panel (2 feet wide) has been provided for use in those places where needed.

**Basic Panels**
Several different types of panels were designed in order to accommodate various types of siding, standard windows, and doors. The basic panels are:

- **Vertical panels for use with all types of siding.** This 4' x 8' panel has a 2" x 4" stud at each edge of the panel and one in the center. (An extra stud can be placed in the panel to give a 16-inch spacing if this is required by the building code.) Sheathing material in 4' x 8' sheets, such as 25/32" insulation board or 3/8" plywood, is recommended because diagonal bracing is not required. Plywood sheathing is required for vertical siding in order to provide a nailing base.

- **Horizontal panels for use with vertical siding only.** This 4' x 8' panel also has a 2" x 4" stud at each edge. Horizontal 2" x 4" girts are placed 2 feet on center from top to bottom between the studs. The wall can be covered with sheathing in sheet form and the vertical siding attached.

- **Panels for houses with sloped roof-ceilings.** This panel is the same as the horizontal panel except that it is shorter — 4' x 7'-8". It has 7-foot studs.

**Window Panels**
Panels have been designed to receive various types of windows: fixed glass, awning, hopper, double-hung, casement, and horizontal gliding. All windows are centered within each panel. Windows can be installed when the panels are assembled, thus eliminating another task at the site. Panels accommodate windows of different heights, principally:

- **Privacy windows** for bathrooms, bedrooms and kitchens. These are large enough so that one can see out of them easily even though they are set high in the wall.

- **View windows** for living and dining areas. Space is left under the window for the installation of baseboard heating units in the event these are desired.

**Door Panels**
Door openings can be centered in the door panel or set off-center to the right or left, as is required by the design of the house.
The type of roof selected for a house affects not only the appearance of the house but also its construction. In general, the most economical construction is obtained when the room height is 8 feet and the ceiling is flat. This allows the builder, in finishing the house, to use standard sizes of wallboard, closet doors, etc.

**Trussed Gable Roofs**

Gable roofs, which slope 3 or more inches in 12, can be built from roof trusses, thus taking advantage of the open-room construction technique with its resulting benefits of over-all economy in construction and flexibility in design. Next to the flat roof, the gable roof which utilizes trusses placed 2 feet on center is the most economical roof.

Roof-rafter and ceiling-joist framing can also be used for these roofs, but a central-bearing partition is necessary to carry some of the weight of the roof. Such construction restricts somewhat the flexibility of the "open plan."

Trusses must be especially designed for a particular slope and span. In this study, slopes of 3 inches in 12, and 4 inches in 12 are used.

The slope affects the selection of roofing materials. Shingle roofing should be used only on roofs sloping at least 4 inches in 12. A built-up roofing, composed of alternate layers of roofing felt and coal-tar pitch or asphalt, should be used for slopes of 3 inches in 12 or less.

**Low-Sloped Roof-Ceiling**

A popular type of construction in contemporary houses today is the open-ceiling roof wherein the slope of the ceiling follows the slope of the roof. The added space gained by the sloping ceiling gives a pleasing appearance to the rooms of the house.

In this study, a slope of 2 inches in 12 was used for such roofs. For economic reasons, rafter construction was selected. The rafters rest on a central-bearing partition or beam, and on the exterior walls. Roof truss construction is not feasible when roof slopes are 2 inches in 12 or less.

Due to the sloping ceiling, it is necessary to cut and fit varying stud lengths for partitions.

**Flat Roof**

The flat roof can be the most economical of all types of roof construction if it is built with roof joists spaced 2 feet on center and extending from exterior walls to a central-bearing partition. This partition is required unless the house has an extremely narrow span.
FOUNDATIONS AND FLOORS

The panelization system described in this book can be used with three different types of floor construction — slab floor, crawl space, or basement.

For high, well-drained lots which require a minimum of fill, the concrete slab has been shown to be the most economical. If quantities of fill are needed to bring a lot to the desired finished grade, crawl-space construction or a basement is recommended.

Floor construction is conventional. In installing panels on concrete slab floors, a two-by-four should be set flush with the concrete floor in order to provide nailing space for the panels.

INTRODUCTION TO HOUSE PLANS

The five house plans, presented on the following pages as examples of how the pre-cut and pre-assembled wall panels can be used, are all designed to make the best possible use of space within the house and of outdoor living possibilities.

Cross-traffic through the living room is kept to a minimum and in several plans is eliminated entirely, the dead-end living room being recognized as particularly desirable from a sociability standpoint.

In all five of the houses, the sleeping area is removed from the living and working areas. All of the houses have three bedrooms — a master bedroom with two closets, a double bedroom, and a single bedroom. The master and double bedrooms have cross-ventilation. All bedroom windows are set high in the wall panels for privacy and for convenience in placing furniture, yet low enough for vision to the outside.

Space for automatic laundry equipment is provided on the living level of all the houses regardless of whether or not there is to be a basement. This is done to ease the homemaker’s work.

An eating space in the kitchen for informal use is included in all plans having a more formal dining area in the living room.

Storage space is generous for all living needs. For houses without basements, storage for bulky items and garden and lawn equipment should be built into the garage or carport.

Garages or carports can be attached to the houses in a variety of positions as is shown by the illustrations on the following pages. In most cases, a breezeway connects the house and the garage.

Floor plans for each of the five houses include a basement version and a no-basement version. To show the flexibility possible, all houses have been given at least three different roof slopes and, in two cases, four. The numbering system for the elevations is keyed to the amount of roof slope.

For illustration purposes, certain window types and siding have been used but other types can be selected. In the low-sloped (2/12) roof-ceiling elevations, clerestory windows are used in some places instead of view windows.

While orientations are not specified for each plan, the houses should be placed so that all large expanses of glass are on the south.

The house plans shown may be taken to an architect for preparation of working drawings, or working drawings can be secured through lumber and building material dealers. Other plans utilizing the pre-assembled panels can be developed by architects.
WP1-4. The flat-roofed garage is set forward of this house to form an enclosed play yard in the area between the garage and the combined utility-play room. This area has a trellis-covering. Several outdoor-living areas are provided. Roof of house is 4/12 in slope; windows are fixed, hopper, and awning types; siding is vertical.

HOUSE PLAN
WP — SERIES ONE

FLOOR PLAN

Plan shows stairway to basement.
A combined playroom and utility room off the kitchen is one of the many features which makes this house extremely desirable for a family with children. This 7'-10" x 12'-2" room can be entered directly from the outdoors, through the front entrance hall, from the kitchen, or from the sleeping area.

The living room is highly recommended from a standpoint of social enjoyment since it has no cross traffic. Because of the visual extension of space into the hall and the dining area, the living room appears larger than its actual dimensions.

The dining alcove is placed to provide family privacy despite playmates and business callers who come during meals. The alcove can be as easily serviced as if it were a part of the kitchen; at the same time, it offers gracious dining free from a background of pots and pans.

Space for laundry equipment is included in the playroom. The service entrance for the kitchen is through this room.

The front foyer is another luxury feature not often found in houses of this size, 1,088 square feet. Outside dimensions of the house are 24'-8" x 52'-8".

Economical roofs for this house are the 4/12 "W" truss, the 3/12 truss, or a flat construction.
WP2-2. The 2/12-sloping roof of this house continues to form a carport at the service side. The fixed windows have hopper-type windows below them. Other windows are the awning type. Clerestory fixed-glass is used in the gable end. Panels are covered with vertical siding.

HOUSE PLAN
WP — SERIES TWO

FLOOR PLAN

Plan shows stairway to basement.

Floor plan for houses of this series built without basements.
Rooms in this compact floor plan have been arranged to simplify the every-day living of a family. The house has a very good traffic pattern — the sleeping area, the kitchen, and the living room are all easily and directly accessible to each other and to the entrances.

A liberal amount of storage space is provided. In addition to the recommended amount of cabinets for storage of dishes, utensils and food, the kitchen has a large storage section for multi-purpose use.

An eating space by a window is included in the kitchen. There is also space for a dining table in the living area. Space is allotted near the back door for automatic laundry equipment.

Windows in the bedrooms are high for privacy and convenience in furniture arrangement.

For a house having only 960 square feet of floor space, the individual rooms are relatively large. The outside dimensions of the house are 24'-8" x 40'-8".

A choice of four roof types are possible for this house under the framing system presented in this book: 4/12 slope utilizing the "W" truss, a 3/12 slope also utilizing a truss, low-slope (2/12) with a sloping ceiling, or flat.

**WP2-3.** This house with its 3/12-sloping roof has a covered breezeway and flat-roofed garage attached to the service side of the house. The breezeway is extended to form a living terrace which is screened for privacy. Siding is board-and-batten. Windows are fixed, hopper, and awning types.

**WP2-4.** A flat roof covers the garage and extends out to form a terrace-breezeway near the living area. Roof of the house has a 4/12 slope. The house has vertical siding. Windows are fixed, hopper, and awning types.

**WP2-0.** The garage in this flat-roofed house is set back on the living-area side of the house. Casement windows were selected. Board-and-batten siding is used.
WP3-3. In this "L"-shaped house, the garage is attached to the house at the kitchen. An outdoor-living area is provided in the rear. Roof slope is 3/12; siding is horizontal; and windows are the casement type.

HOUSE PLAN
WP — SERIES THREE

Floor plan for houses of this series built without basements.

FLOOR PLAN

Plan shows stairway to basement.
An outdoor-living area is adjacent to the living area of this house which has a 4/12 roof. A flat roof covers the garage and the breezeway which are near the kitchen. Siding is vertical; windows are fixed, awning, and hopper.

Front entrance

An unusually large living-dining area, 24'-0" x 11'-10", is provided in this house even though it is small. The dining section can be partitioned off by folding doors, thus making the living area a dead-end room.

An eating space for informal use is also included in the kitchen, as is space for automatic laundry equipment. The kitchen can be easily enlarged if desired. The “L”-shaped hall makes all the rooms easily accessible to each other and to the entrances.

Floor area is 1,008 square feet. Outside dimensions of the house are 36'-8" x 36'-8".

Roof types which are suitable for this house include the 4/12 “W” truss, the 3/12 truss, and the flat roof.

WP3-0. An entrance court is formed by attaching the garage to the bedroom side of this flat-roofed house. An outdoor-living area is to the left. A fence screens the service entrance from the street. Siding is vertical; windows are casement.
WP4-3. An extension of the flat roof on the garage forms a covered breezeway-entrance. The garage is placed near the front entrance. The house has board-and-batten siding; windows are the fixed, hopper, and awning types; roof slope is 3/12.

HOUSE PLAN
WP — SERIES FOUR

FLOOR PLAN

Plan shows stairway to basement.
The end-entrance in this plan allows the house to be positioned on lots in a variety of ways so that the glass areas in the living room can be oriented for privacy or sun. Traffic through this entrance does not interfere with activities in the kitchen or the living room.

The single dining space within the house is separate from the kitchen, but is as convenient as though it were a part of the food preparation center. In addition, the dining space is positioned to offer family privacy despite meal-time interruptions.

Space for automatic laundry equipment is assigned to the inner area of this room. The equipment is enclosed by a folding door.

Storage space is plentiful throughout the house, which has a floor area of 1,120 square feet. Outside dimensions are 28'-8" x 40'-8".

Types of roofs which can be used on this house include the 4/12 "W" truss, the 3/12 truss, and the 2/12 sloped roof-ceiling.
WP5-O. An open breezeway and carport form a covered entrance and living terrace for this flat-roofed house. Vertical siding is used. Windows are fixed, hopper, and awning.

HOUSE PLAN
WP — SERIES FIVE

Floor plan for houses of this series built without basements.

FLOOR PLAN

Plan shows stairway to basement.
The open plan in the living and work areas of this house results in strategic placement of the dining area. It can be treated either as an eating space in the kitchen or as an alcove-extension of the living room, whichever the family desires now or later. Since only one place is given to eating, the space that might have been assigned to a second dining area can be more purposefully used. Furthermore, there is need for only one dining set.

The passageway through the house from the front door to the back makes all areas easily accessible and eliminates much cross-traffic through the living and work areas. Only a small segment of the living room is exposed to traffic. The door near the kitchen can be used as either the front or back entrance.

The house has two bathrooms—an unusual feature for a house of this size. They are placed back-to-back for economy. Since most of the soiled clothes come from the bedrooms, the laundry is included in the half-bath. This bath is not only near the bedrooms but is also convenient to the other parts of the house.

Over-all floor area of the house is 1,056 square feet. Outside dimensions are 24'-8" x 44'-8".

Roof types recommended are the 4/12 "W" truss, the 3/12 truss, the 2/12 sloped roof-ceiling, and flat.

WP5-3. The 3/12 roof of this house is extended to form a flat roof for the garage and over the breezeway. There are privacy enclosures near the dining area at the street side, and near the front entrance.

WP5-2. The carport at the service side of this house is formed by an extension of the 2/12 roof. The house is shown with clerestory fixed-glass and vertical siding. Windows are fixed, awning, and hopper types.

WP5-4. The fence screens the outdoor-living area of this house which has horizontal siding and casement windows. The roof of the house has a 4/12 slope. The flat-roofed garage is connected to the house by a covered breezeway.
ERECITION OF HOUSES FROM PANELS

In building a house with wall panels, the builder has a choice of two methods of wall erection: 1) panel-by-panel erection, or 2) the assembly of panels into walls which are then tipped into place.

Panel-by-Panel Erection

If a small crew is employed, the walls should be erected panel by panel. Two carpenters can accomplish this in a relatively short time. The procedure is:

1. Set a corner panel into place. Plumb and true it from both directions and steady it with a brace.
2. Nail the panel to the floor. (In slab construction, nail the panel to the sill.)
3. Place each individual panel in the same way, fastening it to the preceding panel.
4. Assemble a 2" x 6" double header in short lengths. Lap the joints so that no two joints occur at the same stud.
5. After an entire wall has been erected, install the sections of the header on top of the panels and fasten with ¾" x 7" lag screws placed 4 feet on center and approximately 12 inches from one edge of each panel.
6. Nail the sections of the header together after they are in place on the wall.
7. Erect walls in sequence and close the corners with corner posts and sheathing.

With the panel-by-panel method, horizontal and vertical siding should be applied after the walls have been erected. Sheet siding (plywood, hardboard, asbestos cement) and some forms of board-and-batten siding can be applied to the panels in the shop.

Wall Tip-Up

Assembly of the panels into walls which can be tipped into place is suggested only for a builder with a large crew. The assembly can be made on the floor of the house. The procedure is:

1. Place panels tightly together.
2. Fasten double 2" x 6" spaced headers to the panels by means of ¾" x 7" lag screws placed 4 feet on center and approximately 12 inches from one edge of each panel.
3. Toe-nail the panels together at the bottom.
4. Apply siding over the sheathing. (The siding may also be applied after the wall is erected.)
5. Tip the wall into place.
6. Secure the panels by means of 16d nails at the bottom, the top, and two intermediate places. Nails should be driven from both sides.
7. After two opposing walls have been assembled and tipped into place, the end-walls should be assembled and placed.
8. Close the corner with corner posts, sheathing, and siding to match the rest of the house.

Completing the Structure

After the exterior walls are in place, install the roof.

If trusses are to be used, they can be hung in an inverted position on the exterior walls and rotated into place. Gable ends can be handled in the same way. Apply roof sheathing and roof covering next.

If roof rafters are to be used, the bearing partition can be assembled on the floor inside the house and tipped into position. Ceiling joists and rafters are then installed, and roof sheathing and covering applied.

After the basic shell of the house is erected, the interior ceiling, wall and floor (only if wood) surfaces should be finished. This should be done before interior partitions are assembled (on the floor) and tipped into place.
FOR ADDITIONAL INFORMATION, SEE SMALL HOMES COUNCIL PUBLICATIONS

Circulars (10 cents each)
C5.1 — Household Storage Units
C5.11 — Storage Partitions
C5.31 — Cabinet Space for the Kitchen
C5.32 — Kitchen Planning Standards
F2.0 — Basements
G3.1 — Heating the Home

Instruction Sheets (25 cents each)
“W” Roof Truss (4/12 Slope)
3/12-Slope Truss for 20'-8" to 30'-8" Spans
Construction of Storage Partitions