DIMENSION PANELS IN A MODULAR SYSTEM OF SMALL HOUSE CONSTRUCTION

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The Forest Products Laboratory has been exploring the possibilities of a shop-made building panel producible from low grade and waste timber. Experiments have been made with a system of employing such a panel in house construction so as to realize low cost with good serviceability and attractive appearance. The system is especially directed toward the employment of men and types of timber that in some areas cannot be fully utilized by present methods. The results to date are indicated in the accompanying photographs. No complete house has been built by this method and no manufacturing tests have been made to determine its practicability or cost. Ways and means of making such tests on a semi-commercial basis are sought, but have not yet been worked out. The basic idea is extremely simple, but this may be a liability instead of an asset if it is assumed that details of construction and workmanship can be disregarded. Successful application is largely dependent upon intelligent regard for important details, especially those relating to moisture and shrinkage control. Hasty trials that do not take advantage of the information and experience that the Laboratory has already accumulated are to be strongly discouraged. Assistance will be given by the Laboratory as freely and fully as possible to those who wish to investigate further.

Emphasis here on important details does not mean that there is but one way to handle the features incorporated in this type of construction. As a matter of fact there are several alternatives and variations and considerable flexibility within the main pattern of the basic system so that what is shown here is really only suggestive rather than a description of the one and only way.

Gradual development of the possibilities rather than general promotion has been looked upon as a wise procedure. A self-contained plant to produce the panels from local material not suitable for standard grades of lumber, especially in connection with the utilization of hardwoods, has seemed a logical application. However, other applications may be as good or better through the manufacture of the individual pieces of the panels as standard sawmill items, especially in the case of softwoods, and shipment to

panel-assembly shops near the centers of consumption. Any application to emergency housing projects would probably follow this pattern. Although not intended for temporary or demountable construction, the fact that all parts of the house except the framing and roof are of uniform sized panels which are fastened to the framing with little nailing and no face-nailing means that a building could be disassembled without much damage to the re-use value of the material.

To the individual who might be interested in this method of construction for his own home there is no application at the present time because the panels are not available on the market and the component pieces from which the panels might be made are not standard mill patterns and sizes.

The general aim is to reduce the present high handling costs of using short lengths individually by assembling them into convenient-sized panels under conditions where machinery, conveyors, and jigs can take the place of excessive hand labor. Extending the acceptability of hardwood species in house construction depends largely on substituting mechanical and shop work for manual work on the building site. It is the aim of this development also to avoid the rough, cheap, and out-moded appearance ordinarily associated with the use of short lengths in building and to suggest forms for wood products from low grade that are in line with trends in present day architecture.

Technically, the aim of the development is to provide inexpensive and rapid assembly of solid wood cuttings into shop-made panels, and of panels into wall and floor structures for both exterior and interior coverage primarily without gluing; to provide methods of compensating for the deleterious effects of swelling and shrinking that take place in solid wood, especially in panel form; to provide proper protection to the increased amount of end grain wood that is exposed to the elements when short lengths are used on exteriors; to provide an insulated, moisture-resistant panel and wall assembly with surfaces suitable for exterior and interior use; by means of as complete fabrication as possible at centralized plants to facilitate the technical control of the finer points of construction detail and carry out operations not feasible with the use of stock items of lumber, viz., where desirable the application of preservative treatments, aluminum priming, end grain and joint coatings, predrilling, prefinishing, etc.

In essence the system illustrated in this report involves the use of shop-finished building panels of uniform size for all parts of a house except the framing and roof.

The individual panel is two stud spaces in length and the width of one, or typically 16" x 32". A certain proportion of half panels, 16" x 16", would be used. The panels are made of relatively narrow cuttings nominally 1 inch in thickness. They are of nonglued construction (except as an alternate for painted walls where, under certain conditions, edge-glued assembly may be used) with special treatment of joints to provide weather tightness for exterior walls and decorative appearance for interior surfaces. The fact that relatively small cuttings are used in the panels means that a wide variety of low-grade and lesser-used species as well as standard species can be brought into utilization in this form of construction, either in natural or painted finish.

The panels are for use in so-called curtain wall construction where conventional framing erected on the site is braced sufficiently to carry the full load without reliance on the coverage material. They are further intended for use in a modular system of building layout in which spacing of framing members, dimensions of rooms, location and size of openings conform to the standard module of 16 inches.

Pertinent features of the structural system may be outlined as follows:

(a) The use of shop-made panel units for exterior and interior walls, ceiling, and floor, typically 16" x 32"* (plus certain proportions ofhalf-panel units, 16" x 16").

(b) The exterior panel asshown is made up of 3-inch strips tongued and grooved to special water-resisting joint at edges and ends; assembled by two cleats on the back near the top and bottom edge. The panel reaching across two stud spaces is locked to the framing by the horizontal mullion bars. Although additional fastening is probably not necessary, if desired the panels would be face-nailed to the studs at six points.

(c) The horizontal mullion bars of random lengths lock the panels together at the top and bottom edge and pitch the water away from the top and bottom of the panels.

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*A wider unit, viz., 24" x 32" or 48", may prove advantageous under some conditions.

(d) Conventional framing is used, except for minor features, with particular attention to the size and location of window and door openings so that the standard spacing of studding and joists (consistently on 16-inch spacing) will be maintained as uniformly as possible to minimize cutting of panels on the job.

(e) For small one-story houses no sheathing or subflooring is used. Diagonal bracing of the framing according to good present practice is contemplated for purposes of stiffness.

(f) The window construction is important in order to adhere to the 16-inch module and avoid necessity of cutting panels. There are various alternatives, but thus far a bank of narrow casement sash has been used, let in between the studs without the usual framing. The stud is used as a part of the window jamb and the balance of the window frame is simple and economical. From several points of view this window treatment appears to be flexible and satisfactory.

(g) For the fullest realization of the economies accruing to this system of house construction the 16-inch module must be adhered to in planning the building. Adherence to such a module brings up both advantage and disadvantage according to the point of view. Although the system is flexible with respect to size and shape of building and permits numerous variations in design it is not adapted to some of the architectural features, such as built-up entrance features, bay windows, complicated dormers, circular windows, and blinds and fancy shutters, that builders oftentimes put into small low-priced houses to give them so-called individuality and dressed-up appearance. To some this will be a disadvantage. Others will consider it an advantage in that it will encourage the elimination of imitative and relatively costly "frills." This type of house will look better without frills than with them, relying for its attractiveness on simple lines and good proportions. However, the pattern lends itself to various treatments in design which architects seem to favor in modern construction. It is believed that one of the advantages of this panel form of product is that it permits designers to create new effects in wood construction and to use wood "set off" with new products that have undoubted appeal, such as glass brick, plastic tiles, chromium strips, etc., that are rather incongruous with traditional wood construction.

(h) In all cases the finish, at least in part, is better and more cheaply applied in the panel-assembly shop than after installation on the walls. Prefinishing is especially advantageous in solid wood panels because it permits the use of special and coatings where necessary and the tongue and groove can be finished the same as the face, hence the opening of joints does not expose raw wood and is not so disfiguring as in the present conventional methods of handling lumber for paneling.

PLANT REQUIREMENTS AND COSTS

In general the most favorable conditions for the application of the method would appear to be those of a small strictly modern plant designed particularly for the purpose of building-panel manufacture, equipped to handle low grade lumber, logs, or bolts efficiently, and located within or close to the consuming territory which it is to serve so that there can be a close association between supplier and builder. It appears to be an undertaking for numerous, scattered plants. If it proves successful advantages should accrue to the buyer of a house, to the employment of labor, and to utilization of low quality timber.

Without having made any close analysis or study of this phase of the subject it seems reasonable to assume that a plant adapted to production of the panels on an efficient basis would have the following equipment:

Dry kiln	Moulder
Cut-off saw	Drum sander
Ripsaw	End matcher
Jointer	Variety bench saw
Shaper	Painting and finishing room facilities

This is in addition, of course, to the ordinary sawmill equipment.

A nailing machine might or might not prove more efficient on a moderate production basis than simple table templates and jigs for hand nailing. A glue spreader and clamp carrier would be necessary, of course, if any panel stock were to be produced by edge gluing.

All new equipment of the above items, including building and power, would probably cost in the neighborhood of $40,000 for a plant capacity of approximately 15,000 square feet of finished panels per day or sufficient to build three five-room houses. Roughly a five-room house will require 5,000 square feet of panels for inside and outside walls, ceiling, and floor, not including framing and roof structure. A made-over plant or one with good used equipment would represent a substantially smaller investment, perhaps as low as $15,000.

Along with the panel plant a sawmill would be required for a self-contained unit unless the plan were to operate on low grade lumber from mills already in the vicinity. A new small sawmill with the equipment required for the efficient handling of bolts and short logs along with the building and power unit would perhaps cost $6,000.

If the component pieces of the panels were purchased worked to pattern from a sawmill-planing mill and shipped in bundles to a panel-assembly shop, the equipment requirements at the fabricating end would be substantially less than above.

It is virtually impossible for us in the present status of knowledge of the panel construction project to venture any close estimates of production costs and savings in building costs.

As rough indication of what the manufacturing costs may be, the following figures are used:

Rough lumber per M	$15
Seasoning	5
One-third waste on the above	7
Cutting and ripping	5
Dressing and moulding	3
Assembly into panels	7
Prefinishing	8
For exterior, mullion bar per M feet of panels	7
For interior panels, sanding	3
For interior panels, insulation and building paper	10

The interior panels, insulated, will cost somewhat more than the exterior panels plus the mullion bars. Not all the interior panels will require insulation, but for rough calculation let us assume that, including the mullion bars, all panels will average $60 per M prefinished.

The exterior panel at $60 per M board feet would be somewhat more than the cost of the sheathing material, outside the lumber-producing territories, that would be used in a small conventionally-built house. Within a lumber-producing territory it might be $30 more than the cost of sheathing for those who can buy direct from a small mill. Under most conditions the $60 would be perhaps half