COMPOSITE WOODEN PANEL

FIG. 1

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Feb. 8, 1966

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3,234,074

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Filed Jan. 14, 1963

2 Sheets-Sheet 1

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This invention relates to a new and useful concept in a prefabricated structural wooden building panel and the method for its making, and more particularly to a prefabricated structural building panel which can utilize lower grade wood products than have hitherto been employed in the prefabricated wooden panel industry.

In recent years, the building and construction industry has moved increasingly toward the broad scale use of prefabricated building components. This trend has been stimulated by the high cost of raw materials together with the ever increasing high cost of the labor required to manufacture, erect and finish the various building products.

One of the newest classes of prefabricated building components are those which combine plywood and lumber in such a way as to take fullest advantage of the structural characteristics of each. The resulting products have the labor-saving advantages of other prefabricated components of wood with the added advantage of minimum weight for the strength characteristics needed. Stress-skin panels, which are sandwiches that may be made with plywood surfaces and spaced lumber cores, are typical examples of such prefabricated components. They are used as roof panels and wall panels for homes, industrial, and farm buildings, small apartment buildings, schools and stores.

For most uses, insulation must be incorporated in the hollow portion of the sandwich unless the core itself possesses insulating characteristics, such as would be the case where a non-flammable material was used in the sandwich, as, for instance, plastic foam material or asbestos.

Perhaps the single greatest limitation of the stress-skin panel is its inherent lack of fire resistance. When in place in a building, as, for example, in a roof panel, the stresses caused by the roof loads which tend to bend it are concentrated in the outer plywood skins. In the event of fire, if the outer 1/4 inch of veneer is seriously damaged the structural integrity of the entire panel is lost. While it is possible to pressure treat the plywood with fire retardant compositions so that combustion will not be supported, nevertheless the exposed thin surface of the panel is still vulnerable to damage by fire through charring.

Another problem encountered is that in providing fire resistance to a stress-skin panel, as by the application of light-weight plaster to the ceiling side thereof, the builder incurs a considerable added expense. In fact, such treatment of a panel amounts to more than half the cost of the panel itself.

Another limitation of prefabricated roof panels that are presently known is the fact that the roofing material must still be applied on the erected roof and at the same cost as on the more conventional construction of sheathing applied to roofing structures. Currently, this amounts to about 15 to 18 cents per square foot for a three-ply roof built up of tar and roofing felt with no gravel surfacing.

Finishing the inside surface of prefabricated panels with paint also presents a problem in that it adds to the final costs of the installed panel.

This invention comprises a wooden composite structural building panel made up of a lumber center and wood veneer or lumber crossbands and may include hardboard or wood surface facing layers. The invention also includes the process of producing said composite structural panel.

The center is made up of longitudinal lumber strips of varying widths. The lumber strips are cross-banded with veneer or lumber bonded to each flat surface of the strips. Hardboard or veneer surfaces may in turn be bonded to the crossband.

The edges of the lumber strips are routed to provide a concave surface. In this way the strips are edge butted to the extent that contact between strips is made only in the area immediately proximate to the flat, generally parallel top and bottom surfaces. A void is left between any two abutting strips along the entire length thereof. In this way expanding or swelling of the wood strips by virtue of moisture absorption enables the wood to expand with a minimum of stressing either of the crossband or the surface layers. The edge butting of the lumber strips provides a continuous, flat surface under the crossbanding and thus minimizes surface concavities and telegraphing defects when veneer crossbanding is used. Such defects are frequently encountered in conventional, spaced, lumber-core panels due to non-continuous support beneath the surface layers. Thus there is inherent in the design of this composite wooden panel a dimension stabilizing feature, the advantage of which will become apparent in subsequent discussion.

Accordingly, it is an object of this invention to provide a composite wooden panel which is extremely simple in design, rugged and strong in construction, and economical to produce.

Another object of this invention is to furnish a prefabricated structural panel which inherently possesses a high degree of fire endurance because the primary structural component, the core, which is preferably lumber, is protected from charring by one or more face components.

Another object of this invention is to furnish a prefabricated structural panel which may be made fire retardant in portions of its construction or in the entire panel itself.

Another object of this invention is to supply a prefabricated structural panel which permits the use of low grade lumber for the center without any impairment of its structural characteristics.

A further object of the invention is to provide a prefabricated panel having a minimum of surface defects caused by spaced core members.

Still another object of this invention is to provide a prefabricated structural panel which because of its low cost and design permits factory finishing of those surfaces of the panel which will be exposed on the inside of the building.

Yet another object of this invention is to furnish a prefabricated structural building panel which has inherent dimensional stability even in the face of considerable moisture absorption.

A further object of this invention is to provide a prefabricated structural building panel which even though it is made up of a number of edge butt center strips forces the individual center strips to work structurally as a unit.

These, together with other objects and advantages which will become subsequently apparent from the details of construction and operation and method of making as more fully hereinafter described and claimed, reference being had to the accompanying drawings, forming a part thereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a partial view in perspective of the structure of this panel; FIGURE 2 is a partial view in perspective showing that the facing or outside layers may be a wood veneer.
as well as the hardboard facing or outside layers as shown in FIGURE 1;

FIGURE 3 is a partial view in perspective showing that the crossbanding may consist of random width lumber pieces arranged with their grain at an angle to the center lumber strips;

FIGURE 4 is a partial perspective view showing an alternative form of void space between pairs of center strips; and

FIGURE 5 is a partial view in perspective showing an alternative embodiment of the structure of this invention.

Referring now to FIGURE 1 it will be seen that the panel of FIGURE 1, is comprised of three or more laminates. The strips 12 make up the panel center. Such strips 12 are preferably about two inches deep and ideally slightly less than two inches wide. The strips are provided with recessed surfaces 14 on the opposing side faces, thus rendering the cross section of said strips essentially double concave. An alternative configuration is shown in FIGURE 4, illustrating that the configuration of the recessed side faces which define the void need not take any specific form.

When the strips 12 are edge butted, an air space or void is created along the entire length of the abutting strips. The function of the edge butted lumber strips 12 is to provide strength and stiffness to the panel as well as insulation qualities and fire endurance. The mass of the lumber itself would enable the panel to qualify as "heavy mill construction" under conventional building codes.

It is preferable that the lumber strips be cut so that their longitudinal dimensions coincide with their wood grain direction. The desired grain direction of the lumber strips is shown in the drawings by arrow 16. It is also preferred, but not essential, that the grain of the lumber strips be oriented as nearly as possible in a direction normal to the crossband surfaces 20. Such preferred direction of the grain is shown by the arrow 18. Such orienting of the wood grain is preferred because when wood becomes moist it expands primarily in a direction normal to the grain pattern. Thus, referring again to the arrow 18, expansion of strips 12 would tend to narrow the space between the surfaces 14.

The structural center strips 12 may be made of low grade, light weight wood species such as lodgepole pine, western red cedar, spruce, fir and others with which those skilled in the art will be familiar. The precise dimensions of the lumber strips 12 will depend upon the distances which the panels may be required to span and the spacing loads on the panel. A center section approximately 2 inches thick, made up of strips 12, is desirable. Such a panel, made of west coast Douglas fir, will carry design loads of forty pounds per square foot with a deflection of approximately 0.4 inch.

Preferably the strips are kept narrow (i.e., less than 60° wide) to produce the optimum quality panel having the desirable qualifications mentioned previously. The thickness required in the panel is a function of the inherent stiffness of the particular lumber center pieces being used. Since the stiffness of the lumber is essentially independent of grade, the center of the panel could be made most economically of strips of lumber of very low grade and value, with attendant cost savings.

A crossband is bonded to the opposed flat surfaces of the lumber strips 12 with the strips arranged in side-by-side or edge butted relationship. Such crossbands may be made of sliced or rotary cut lumber. FIGURES 1, 2 and 4, or may be made of random width sawn lumber as shown in FIGURE 3. The crossbands 20 or 20a are placed so that the grain thereof, as indicated by arrow 22, runs at an angle, normally a right angle, to the grain of strips 12. The crossbands act as a load transferring or bridging the individual strips to work structurally as a unit. The crossbands 20 are in the preferred embodiment approximately % inch thick but can vary from this value depending on the type of crossbanding and strength which must be designed into the panel. The crossbands also serve the very important functions of stabilizing the panel against dimensional change and affording surface continuity for the lumber strips. Since wood does not appreciably shrink or swell along the grain the crossbands are placed with their grain running at an angle, and in the preferred embodiment such angle would be substantially a right angle to the grain of the lumber strips. The crossbands thus restrain the tendency of the center or strips 12 to shrink and swell across their grain.

Finally, outside layers may be added to the crossbands to further strengthen the panel structure and to provide coats on both sides that are capable of being appropriately finished. Preferably the faces referred to by number 24 are a hardboard material such as a resin bonded wood fiber material. The faces 24 in the preferred embodiment are approximately % of an inch thick in their finished state.

Hardboard has been found to be particularly suitable as a facing because it is dense, absorptive, of uniform texture, and yet strong. It reinforces the basic center and core structure but by the same token the hardboard facing itself is restrained against dimensional change by both the center and the cores. The hardboard provides an excellent base for factory treatment with roof or floor coatings, paints and other finishes. The density of the facings 24 in hardboard form gives them inherently more resistance to fire, even without fire retardant treatment than lower density veneer faces.

While, as has been mentioned, the structural panel of this invention because of the hardboard facings has excellent resistance to fire, nevertheless if greater fire resistance is desired each or all of the component parts can be separately treated with fire retardant compositions before assembly.

It is not desired to limit this invention to a panel which has only a hardboard facing. As shown in FIGURE 2 the facing could be made of veneer. In this case the facings 26 must be bonded to the outside surfaces of the crossbands 20 with the grain at an angle to the grain of the crossband. Thus, in effect, the grain of the faces 26 would be running in the same direction as the grain in the strips 12.

The panels are preferably fabricated in a single pressing operation. When faced panels are made, the face material (hardboard unconsolidated resin-bearing fibrous mats, or wood veneer) is first placed on a suitable supporting surface. Next, the crossband is coated on both sides with a suitable adhesive and placed on the face sheet. The flat surfaces of the lumber strips 12 are then placed on the adhesive coated surface of the crossbands, oriented as previously described. It is essential that the strips be placed in edge-buttng relationship to one another. A second adhesive coated crossband is then placed on the strips and the second face material placed on the crossband.

The assembly is next placed in a suitable press and consolidated under pressure. During the pressing the adhesive which bonds the members is set to form the composite panel.

If cold setting adhesives are used, the pressing operation must be continued until the adhesive is sufficiently strong to hold the components together. The panels can be removed from the press before the adhesive is fully cured if they are handled carefully in accordance with standard veneer press plywood manufacturing techniques. Alternatively, restraining clamping may be employed to provide continuous pressure until the adhesive is fully set.

If thermosetting adhesives are used, such as those based on synthetic resins, the assembly must be heated while under pressure to a temperature and for a time sufficient to set the adhesive.

The panel may be bonded with a variety of adhesives. Thus, adhesives based on casein, animal blood, soya meal,
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Thus the two outside veneers, as represented by arrows 48, have their grain directions running across, generally at a right angle to the grain direction of strips 32. The plywood center strips are not recessed on any surface but are merely cut to the desired dimensions. The recessed surfaces 34 in the lumber center strips 32 form elongated voids between each pair of center strips. The contact surfaces 40 abutting the plywood center strips result in the core or center of the panel having surface continuity for the crossbands. Obviously it is contemplated that the core design shown in FIGURE 5 could also have other types of crossband material, as for instance those shown in FIGURES 1 to 4. It is also apparent that the outer veneers of the plywood crossbands of FIGURE 5 could be finished or that a facing layer could be added thereto.

The foregoing is considered as illustrative of the principles of this invention. Modifications and changes will occur to those skilled in the art but it is not intended to limit the invention to the exact construction, operation and process shown and described.

What is claimed is:
1. A composite wooden structural panel comprising: a plurality of elongated wooden center strips of uniform thickness in side-by-side, edge-abutting relationship, said center strips in cross-section having opposed recessed side edges and also having opposed substantially parallel and flat top and bottom surfaces so that an elongated air space is defined between any pair of abutting center strips and so that said top surfaces and said bottom surfaces, respectively, are in common planes, said elongated air space in cross-section having its dimension normal to said top and bottom surfaces greater than its dimension parallel to said top and bottom surfaces, said center strips being formed so that the grain thereof extends longitudinally, a wood crossband bonded by adhesives to each of said top and bottom surfaces, the grain of said crossband extending generally across the grain of said center strips, and the top and bottom portions of said center strips being in contacting relationship with each other for continuous support of said crossbanding material.
2. A composite wooden structural panel, comprising: a plurality of elongated wooden center strips of uniform thickness in side-by-side, edge-abutting relationship, said center strips in cross-section having opposed recessed side edges and also having opposed substantially flat and parallel top and bottom surfaces so that an elongated air space is defined between any pair of abutting center strips and so that said top surfaces and said bottom surfaces, respectively, are in common planes, said elongated air space in cross-section having its dimension normal to said top and bottom surfaces greater than its dimension parallel to said top and bottom surfaces, said abutting center strips contacting each other only in areas in close proximity to each of said top and bottom surfaces to form continuous support for a wood crossband bonded by adhesives to each of said top and bottom surfaces, the grain of said crossband extending generally across the grain of said center strips, and a hardboard facing bonded by adhesives to said crossband to form a unitary structural panel assembly.
3. A composite wooden structural panel, comprising: a plurality of elongated wooden center strips of uniform thickness in side-by-side, edge-abutting relationship,
said center strips having opposed substantially parallel top and bottom surfaces and in cross-section having opposed recessed side edges so that an elongated air space is formed between any pair of abutting center strips,
said elongated air space in cross-section having its dimension normal to said top and bottom surfaces greater than its dimension parallel to said top and bottom surfaces,
said top surfaces and said bottom surfaces, respectively, being in common planes, with said center strips being cut so that the grain thereof extends generally longitudinally and said recessed side edges defining contact surfaces at the extreme lower and extreme upper margins of said edges forming continuous support for a wood veneer crossband bonded by adhesives to each of said top and bottom surfaces, the grain of said crossband extending generally across the grain of said center strip.

4. A composite wooden structural panel, comprising:

a plurality of elongated wooden center strips of uniform thickness in side-by-side, edge-abutting relationship, with at least every other one of said strips in cross-section having opposed recessed side edges defining contact surfaces at the extreme lower and extreme upper margins of said edges,

all of said center strips having opposed substantially parallel top and bottom surfaces and said center strips being formed so that the grain thereof extends longitudinally,
said plurality of center strips forming an elongated air space between any pair of said abutting center strips,
said elongated air space in cross-section having its dimension normal to said top and bottom surfaces greater than its dimension parallel to said top and bottom surfaces,

wood crossbands bonded by adhesive to each of said top and bottom surfaces, the grain of said crossbands extending generally across the grain of said center strips, and

said contact surfaces being in contacting relationship with each other for continuous support of said crossbanding material.

5. A composite wooden structural panel, comprising:

a plurality of elongated center strips of uniform thickness in side-by-side, edge-abutting relationship, with every other one of said center strips being made of lumber and being cut so that the grain thereof extends longitudinally,
said plurality of said center strips having opposed substantially parallel top and bottom surfaces and said lumber center strips in cross-section having opposed recessed side edges defining contact surfaces at the extreme lower and the extreme upper margins of said edges so that an elongated space is formed between any pair of abutting center strips,
said elongated air space in cross-section having its dimension normal to said top and bottom surfaces greater than its dimension parallel to said top and bottom surfaces,
said top and bottom surfaces respectively being in common planes, with the center strips disposed between said wood lumber strips being of plywood construction and having the grain of the outside veneer thereof extending generally longitudinally, wood cross bands bonded by adhesives to each of said top and bottom surfaces, the grain of said crossbands extending generally across the grain of said center strips, and

said contact surfaces being in contacting relationship with said plywood construction center strips for continuous support of said crossbanding material.

6. A composite wooden structural panel, comprising:

a plurality of elongated wooden center strips of uniform thickness in side-by-side, edge-abutting relationship,
said center strips in cross-section having opposed recessed side edges defining contact surfaces at the extreme lower and extreme upper margins of said surfaces, and also having opposed substantially flat and parallel top and bottom surfaces so that an elongated air space is defined between any pair of abutting center strips and so that said top surfaces and said bottom surfaces, respectively, are in common planes,
said elongated air space in cross-section having its dimension normal to said top and bottom surfaces greater than its dimension parallel to said top and bottom surfaces,
said center strips being formed so that the grain thereof extends longitudinally,
said abutting center strips being glued to each other only at said contact surfaces forming continuous support for a wood crossband bonded by adhesives to each of said top and bottom surfaces, the grain of said crossband extending generally across the grain of said center strip.

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