

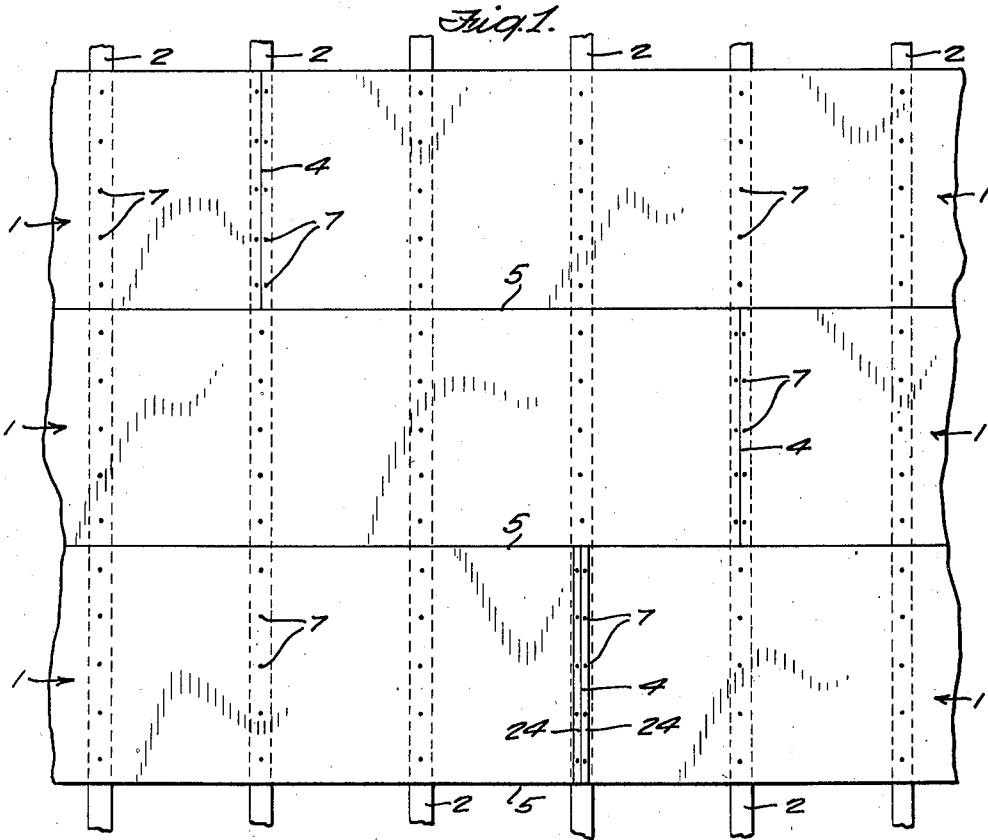
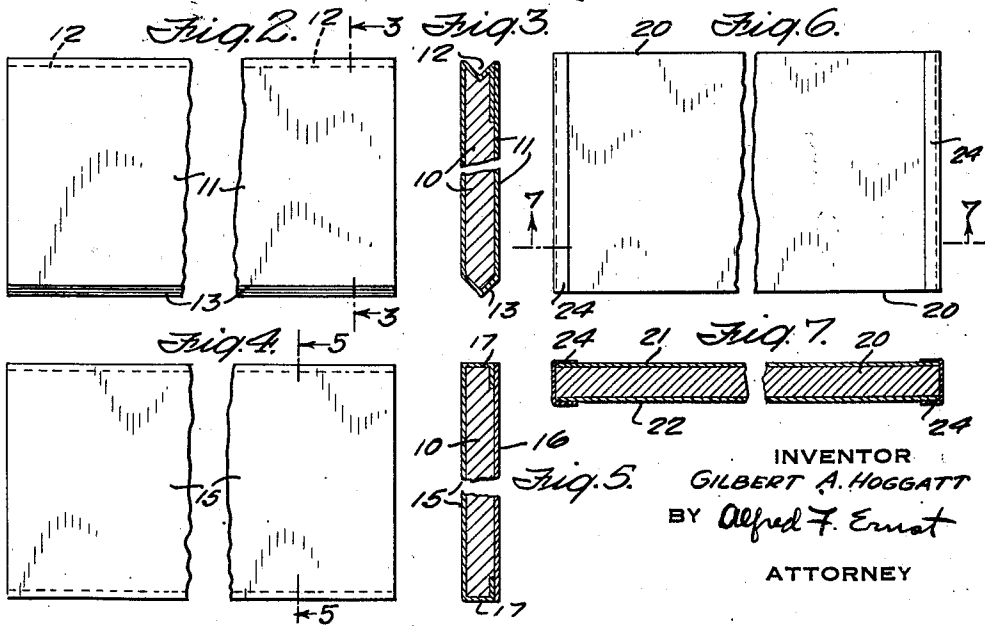
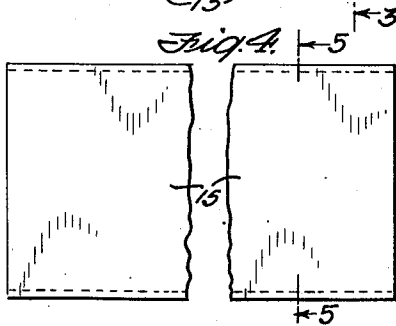
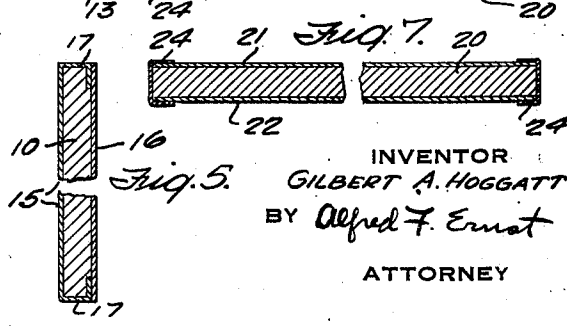
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WALL CONSTRUCTION

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WALL CONSTRUCTION

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This invention relates to wall constructions especially to such constructions as utilize panels or wallboards mounted on a supporting structure. The invention particularly relates to wall constructions in which gypsum wallboards are mounted on and to span across a space between spaced supports in a building construction.

Wallboards and similar sheets and panels of various kinds are commonly erected upon a supporting structure with their edges adjacent or in abutting relation to provide a covering for said structure. Such wallboards or panels usually are made of standard dimensions such that they will span across the spaces between supports which form the supporting structure spaced at standard distances. Such spaced supports may be studs, beams or joists, set, for example, on 16" centers, the wallboards being fastened so that the edges thereof meet upon a stud, beam or joist. These wallboards are of such length or width as to span across two or more spaces between such spaced supports. Especially when such wallboards or panels are erected on frames utilizing wood supporting members, in the form of studs, beams or joists, they are commonly fastened by driving nails through the panel from the face thereof and into a supporting member to fasten the boards to the structure. These fastenings usually are spaced apart along the edges of the panels, that is, along the studs, beams or joists into which they are fastened and as well at intervals along the intermediate supporting members. The wall structure thereby obtained has a certain degree of rigidity and resistance to racking or other movement, principally in a direction which is in the plane of the wall, which may be caused by loading, settlement, drying out of the supporting members and other causes. Particularly where such walls constitute the supporting walls which carry the main or a substantial load in a building it is desirable that the rigidity and resistance referred to as well as the strength of the wall for support of the load may be sufficient to carry said load and, as well, to prevent undesirable movement of the wall which is likely to result in damage thereto or to distortion thereof which would produce defects, such as cracks in the finish layers or in the decoration applied to the structure, whether at the inside of the building or at the outside thereof.

It has been the practice in some cases to fasten to the outside framework, for example, the studding of the outside walls, in the manner

described panels, including those made of fibre board or of insulating board as well as those made of gypsum or plaster board, to act as sheathing boards not only to enclose the building but to provide the requisite strength and rigidity in these outside wall structures. While certain panels, for example, those made of insulating board, heretofore have shown considerable rigidity and resistance to stress placed thereon this result in part may be ascribed to the fact that panels of this type may be made and handled in relatively wide sheets, for example, about 4' by 8', as a single unit which spans over a number of studs and for a considerable length therealong. Thus a rather large size area is covered by a single integral covering of fibrous material which inherently has a great strength of structure capable of resisting the stress brought thereon compared to materials of crystalline structure such as gypsum. Such insulating board panels, moreover, ordinarily are made with a thickness of $\frac{1}{2}$ " to 1", which is greater than that of other types of wallboard panels, for example, gypsum wallboard and gypsum sheathing which is made not greater than $\frac{1}{2}$ ". In part these differences in dimension and thickness are prescribed because of the difference in weight of the materials, the fibre boards being of lighter weight than the gypsum wallboard which has a relatively heavy core of gypsum between its cover papers. While, therefore, the invention is applicable to all types of wallboards, it has particular significance in connection with wallboards of the type of gypsum wallboards or gypsum sheathing in which a frangible core, such as the calcined gypsum in set condition, lies between cover papers or other envelope which provides the necessary tension carrying element in such wallboards.

One object of the invention is to improve the strength and rigidity of walls of the type referred to by securing the cooperation of the several panels or wallboards which are fastened to the supporting structure or framework with each other in such a way that the stresses brought upon a portion of the wall and received by one such panel board may be resisted not merely by said panel alone or with the aid of the supports to which it is attached but with the aid also of the adjacent panel boards, including those which are more remote in the wall from said stress receiving panel board.

This result is accomplished according to the invention in several ways each of which accomplishes the binding together of said panels or

wallboards at their adjacent or abutting edges in stress-transferring and strain-resisting relation. To accomplish this purpose an adhesive material is placed between said adjacent edges, that is, between those edge surfaces of the wallboards or panels which are transverse to the main or face surfaces thereof. The adhesive may be applied to the edges of the boards as they are erected or in other ways and when set affords a strong bond between said transverse edge surfaces. Particularly in the case of wallboards with a frangible core between cover papers such as gypsum wallboard or gypsum sheathing this bond is effected principally between the cover papers which usually in such wallboards extend upon the faces of the boards but also around two opposite edges thereof. As these cover papers are strongly bonded to the core at these transverse edge surfaces the bond provided by the adhesive is effective to cause each panel to act with the panel adjacent thereto as if said two panels substantially were one. In other words, any stress brought upon the one panel particularly in the direction of the plane of the panels will be transmitted to the adjacent panel through the set adhesive material and together with the fasteners and supporting structure carrying said second panel will assist the first panel and its supports in resisting the strain.

Modifications of the invention thus broadly described will be understood from the drawing, description of which is to follow. Within the scope of the invention the adhesive bond may be provided only on the edges of the panels or wallboards which extend crosswise of the length of the supporting members, such as studs, beams or joists. This bond, however, may be provided between the edges of such panels or wallboards which extend along and meet upon said supporting members. In some cases the adhesive may be placed between all adjacent edges of adjacent panels. Moreover, in those certain constructions in which the panels or wallboards are erected with the adjacent edges meeting between supporting members the adhesive may be placed between said edges and serve to bind the adjacent panels together and cooperate with holding devices such as clips sometimes provided engaging the edges of the panels in the manner commonly understood in the art.

In Fig. 1 is illustrated a typical wall construction utilizing wallboards in which the invention is applied.

Fig. 2 is a face view and Fig. 3 a section on enlarged scale on line 3—3 of Fig. 2 showing a sheathing wallboard with a frangible core.

Fig. 4 is a face view and Fig. 5 a section on enlarged scale on line 5—5 of Fig. 4 illustrating a modified form of wallboard with frangible core for use in the invention.

Fig. 6 is a face view and Fig. 7 a section on enlarged scale on line 7—7 of Fig. 6 showing a wallboard with reinforced edges for use in the invention.

In Fig. 1 wallboard panels 1 are shown mounted upon vertical studs 2 set in spaced relation in a wall in the usual manner on, for example, 16" centers. The wallboards 1 which are typically shown as gypsum sheathing are commonly of 2' width, that is, 2' high in Fig. 1 and 8' long. This horizontal dimension of 8' will extend, therefore, from the joint 4 in the upper tier illustrated to the sixth stud (not shown) to the right or the left of said joint for the spacing of the studs given, namely, 16". From a similar joint 4 in

the middle tier the gypsum wallboard panels 1 will extend to the right and to the left to the sixth stud (also not shown) for said spacing of 16". Similar arrangement occurs in the lower tier. Staggering of the vertical joints 4 is accomplished as shown. The construction illustrated in Fig. 1, showing the common arrangement of such wallboard panels in the form of gypsum sheathing, illustrates only a portion of such a wall. It will be apparent that the vertical joints 4 fall upon the studs in the particular embodiment illustrated whereas the horizontal joints 5 between the boards extend in line across the series of studs.

The panels of gypsum sheathing are fastened by nails, for example, 11 gage, 1 3/4" galvanized roofing nails, spaced along the studs approximately on 4" centers, thus for each tier and joint 4 bringing the end nails at about 2" from the horizontal edges of the panels. The nails may be spaced about 3/8" from the vertical edge 4 of the panel so that they may enter the studs which ordinarily are about 1 3/4" thick. Similar spacing of the nails along the intermediate studs may be used to fasten the panels 1 to these intermediate studs in the manner usually practiced in the art.

In such a wallboard construction as illustrated in Fig. 1 the panel boards or sheathing may be placed with the horizontal edges 5 thereof in close relation and so that adhesive placed therebetween may bond the edge surface which is transverse to the face of one panel to a like surface on the adjacent panel. Similarly along the vertical joint 4 between panels which meet upon the stud 2 adhesive may be placed between the adjacent transverse edge surfaces of the panels to bind these panels together along the joint 4. Thus any stress brought upon a panel in the upper tier not only will be resisted by this panel and the fastenings or nails 7 by means of which it is fastened to the stud, but also will be transmitted to and be resisted by the intermediate panel 1 which is adhesively bound to said panel in the upper tier. Moreover, the adjacent panels in the upper tier which have edges adjacent along the joint 4 with adhesive therebetween will assist each other in resisting such stress and the resulting strain. This second upper panel also being adhesively bound to the panel in the middle tier along the joint 5, will act therewith to resist the strain caused by stress transferred to it through the adhesive in joint 5 from the first-mentioned panel. Similar action takes place with the panels of the lower tier which are adhesively bonded to the middle tier. The effect is obtained, therefore, of a single slab having the extent of the several tiers of the wallboards or sheathing boards and the extent of a number of lengths of boards. Such a composite slab has very much greater resistance to stress and resulting strain and movement thereunder than the structure which is made up simply of unsupported tiers of panels held to the supporting studs only by nails or other fasteners.

The panels of the type illustrated in Fig. 2 may be used for the invention. These panels illustrate a common type of sheathing which may have the dimensions referred to above, 8' in length and 2' in width, with a thickness of 1/2". Upon the core 10 is wrapped the cover paper 11. The core and cover paper are so formed and wrapped that a V groove 12 is formed along one of the long edges of the board and a V shaped tongue 13 is formed along the other lengthwise

edge of the board. It is common practice to nail such panels in a manner illustrated in Fig. 1 with the V shaped tongue 13 of one panel entered into the V shaped groove 12 of the adjacent panel to form joints 5. For the purposes of the invention it is preferable, though not essential, that these sheathing panels be mounted with the V edge groove 12 upward so that the V shaped tongue 13 will fit down into this groove. The reverse arrangement of these panels may be used but the preferred arrangement has the advantage that the adhesive to be applied between the edge surfaces of the tongue and groove may be placed in the groove of the panels of one tier and the panels of the next tier above may be mounted and rest down in the groove so as to provide a good contact and hold the V tongue in place, the adhesive meanwhile remaining in the groove.

Fig. 4 shows a face view and Fig. 5 a section in enlarged scale of a panel of common type having square edges which also may be used for a construction of the invention. In this panel the core material 10 has a cover paper 15 extending upon one face thereof and around opposite edges and upon the opposite face of the core. Upon said opposite face is applied a so-called back cover paper 16. It will be apparent that the panels of the type illustrated in Fig. 4 of suitable length and width may be mounted in the manner illustrated in Fig. 1 with their edges 17 in abutting or adjacent relation. The adhesive may be placed between these edges by application to the edge of the panel previously erected or may be applied to both said edges before erection, one panel being pressed into edge contacting relation with the adjacent panel. The nailing may be carried out as illustrated in Fig. 1 or in any other suitable manner for securing the panels to the supports.

Fig. 6 shows a face view and Fig. 7 a section in enlarged scale on line 7-7 of Fig. 6 of a modified form of panel which may be utilized in the wall construction of the invention. The lengthwise edges 20 of the panel of Fig. 6 may be formed either in the manner illustrated in Figs. 2 and 3 or in that illustrated in Figs. 4 and 5. The end edges of the panel, however, may be those which in the wallboard machine are made by cutting a continuous length of wallboard into panel lengths with the core exposed between the cover papers 21 and 22. In order to provide a good surface for receiving the adhesive material and as well to provide a reinforcement for this otherwise uncovered edge and to secure similar strength and protection from damage as is the case with edges 12 and 13 of the board of Fig. 2 and, edges 17 of the board of Figs. 4 and 5 and edges 20 of Fig. 2, strips 24 are applied at these otherwise exposed edges of the board of Figs. 6 and 7 and lapped upon the cover papers 21 and 22 to which the strips 24 may be adhesively secured. The strips 24 may be made of fibrous material such as paper or of other fabric or material capable of taking stress as well as providing the desired surface to which the adhesive will stick and afford the necessary bond between the abutting edge surfaces.

It will be apparent that in the drawing illustrated in Fig. 1 the joint 4 between two panels may also be glued to cause these two panels to act together in stress-transferring and strain-resisting contact. In Fig. 1 the joint 4 in the lowest tier is illustrated as formed between two panels 1 of the character shown in Figs. 6 and 7.

It will be noted that the nails 7 may be driven through the portions of the reinforcing strip 24 which are lapped upon the faces of and extend along the edges of two abutting panels. This strip 24, therefore, provides a greater strength of the panel and better engagement and holding power for the nail than with panels which have open ends with the core uncovered by the cover sheets.

It has been shown by tests of the constructions which have been described above that the strength of the composite structure is very much greater than the usual construction in which the panel or sheathing boards are fastened to the studs without the means for securing cooperation of one panel or sheathing with the other which is accomplished by the use of the adhesive between abutting edges according to the invention. As an illustration of the gain to be made both in strength to resist destruction under load and in reduction of deflection indicating increased stiffness of the structure, the following table is given:

Table

Load on panel in lbs.	Horizontal deflection in 8'		
	Test 1	Test 2	Test 3
1600.....inches.....	.67	.57	.08
2000.....do.....		2.01	.10
3200.....do.....			.28
Failed at.....pounds.....	1625	2075	3200

The above tests were made on $\frac{1}{2}$ " thick tongue and groove gypsum sheathing of the type illustrated in Figs. 2 and 3. The length of the panel tiers was 8' and the width thereof 24". These panels were erected on 2" x 4" studs in four tiers to a total height of 8'. The studs were placed on 16" centers. The panels were nailed to the studs with 11 gage 1 $\frac{3}{4}$ " galvanized roofing nails spaced 4" on centers on all supports and $\frac{3}{8}$ " from the vertical edges meeting at the joints 4 of Fig. 1. Vertical joints were staggered.

Test 1 was made with the gypsum sheathing erected in the usual manner without adhesive between the V edges. In test 2 gypsum sheathing panels of the same type were erected in the same manner as for test 1 except that the otherwise uncovered edges of the panels or sheathing boards were bound with strips of 50# kraft paper tape 3" wide pasted on with casein glue in the manner illustrated in Figs. 6 and 7 above described. Test 3 was made with the horizontal joints 5, that is, those formed with groove and tongue as illustrated in Figs. 2 and 3, cemented together.

A cement, such as a casein glue which may have a certain amount of inert fillers incorporated therein to give proper working qualities, may be used to secure results such as are shown in test 3. The invention, however, is not limited to a particular type of cement or adhesive and glues, pastes or adhesives of various types may be found suitable. It is preferable, however, that the adhesive be made of such consistency and of such adhesive capacity with respect to the cover papers upon the edges of the panels or the gypsum sheathing that the strength of the adhesive when set will be in excess of the shearing strength of the cover paper itself. When such a cement or glue is applied to the edge surfaces of the panel with reasonable care so as to cover these edge surfaces, and each panel, as it is erected, is

pressed with its edge surface in firm contact with the cement applied to the edge surface of the panel previously erected, a strength of the bond between the panels may be developed which will be in excess of the strength of the paper so that upon failure of the structure the cover paper itself will be sheared, that is, the outer or facing ply or plies thereof will be torn away from the underlying plies instead of the cement or glue giving way. In such case a strength for the composite wall in excess of that of panels erected on a frame structure with fasteners alone is insured by virtue of the stress-transferring bond between the panels.

It will be noted that the reinforcing of the otherwise uncovered ends of the boards or panels as in test 2 increased the strength by about 27% and decreased the deflection under the same load as compared with test 1 by about 16%. Correspondingly the failure of the panel structure in test 3 occurred at a load which was substantially double that of the failure load in test 1. Moreover, the deflection in test 3 at 1600#, that is, substantially at the failure load of test 1, was reduced by about 88%. In test 3 the deflection at 2000#, substantially the failure load of test 2, was reduced in relation to test 2 by about 95%. The deflection at failure of the panel structure of test 3 was less than half of the deflection at failure of the panel structure of test 1.

It is apparent from these comparisons that the structure as shown and described above is much more rigid and capable of resisting much greater stress and strain causing distortion and failure than conventional constructions. These characteristics are important in connection with wall structures of this type because long before deflections of the degree shown in the table with their corresponding loads are reached cracks will appear in plaster coatings applied upon such paneled structures as a base. These cracks are immediately conspicuous and unsightly in the plastered wall. Moreover, when such plaster coating are applied as protection on the outside of buildings, cracks developed therein afford passages for entrance of water and the elements which cause deterioration. The resistance to deflection secured by the stiff structure of the invention secures the desired result of limiting and preventing such undesirable conditions in walls and particularly those having a frangible core base, such as gypsum sheathing. When such panels are so used in place of ordinary wood sheathing on frame structures a much stronger and stiffer building is obtained.

The increased strength and rigidity secured by means of the reinforcement 24 of the otherwise exposed edges of the panels which is illustrated in the table may, of course, be added to that secured by the cementing of the lengthwise joints 5 as shown in test 3. When, further, the vertical joints 4 which have the reinforcement of the strip 24 also are cemented together with adhesive a still stronger structure and one having still greater resistance to deflection is obtained. Within the scope of the invention various combinations of the cementing of joints and of the reinforcing of the exposed edges may be made.

It is a principal feature of the invention that the lengthwise edges forming the joints 5, which in the conventional construction are unsupported between the studs or supports 2, are bonded to the adjacent edges of the abutting panels. By virtue of this bond these panels are mutually supported not only against forces applied transversely of the face of the wall but against forces acting in

the plane of the panels either transversely of or generally parallel to the lengthwise edges 5.

For the purposes of the invention the edge surfaces of the panels which are transverse to the faces of the panels preferably are formed so as to receive normal to said edge surfaces a substantial part of the load or stress which is exerted parallel to the plane of the face of the panel. In the case of the V edged panels this "normal" line of exertion becomes split into components acting against the V surfaces. Moreover, the edges of the panels are formed so as to be mutually cooperative or complementary so that the stress-transferring and strain-resisting condition is provided.

Having thus described my invention I now claim:

1. A wall construction comprising a plurality of supports of relatively great length with respect to their cross-section extending in the same general direction and spaced apart in the direction transversely of their lengths, panel boards mounted on said supports to span the spaces therebetween with two opposite edges of said panel boards extending in said direction transversely of the length of said supports and unsupported therebetween, means fastening said panel boards to said supports, said panel boards being formed with a frangible core between fibrous cover sheets adhering to the faces of the core and extending upon and adhering to the edge surfaces of said core which are transverse to the faces thereof along said opposite edges, said opposite fibrous sheet covered edge surfaces being formed mutually to conform when in abutting relation to each other, said panel boards being mounted on said supports with said mutually conforming edges on two adjacent boards pressed into firmly abutting contact with each other but with a gluelike adhesive material therebetween in set condition binding said panel boards together along said mutually conforming and abutting unsupported edges with a bond capable of transferring the stress applied to one board and sustained by its cover sheet cooperating with its core to the other board to be sustained by its cover sheet and core.

2. A wall construction according to claim 1 in which said gluelike adhesive material binds said panel boards together at said fibrous sheet covered edges with a bond in excess of the strength of the cover sheets themselves.

3. A wall construction according to claim 1 in which the core material is of gypsum in set condition and said fibrous sheets are cover papers adhering to the face surfaces of said core and to the two opposite edge surfaces thereof.

4. A wall construction comprising a plurality of supports in the form of studs, beams, or rafters of wood extending generally parallel and in spaced relation transversely of their length, a plurality of wallboards having a core of gypsum in set condition with cover papers adhering thereto upon the face surfaces thereof and extending upon and adhering to opposite edge surfaces thereof which are transverse to said face surfaces of the core, said wallboards being mounted on said supports to span the spaces therebetween with said opposite edges thereof extending in said direction transversely of the length of said supports and unsupported therebetween, nails driven through said wallboards into said supports to fasten said wallboards thereto, said opposite paper covered edge surfaces of said wallboards being formed mutually

to conform when in abutting relation to each other, said wallboards being mounted on said supports with said mutually conforming unsupported edges on two adjacent boards pressed in to firmly abutting contact with each other but with a gluelike adhesive material therebetween in set condition binding said wallboards together along said unsupported edges with a bond capable of transferring the stress applied to one board and sustained by its cover paper cooperating with its core to the other board to be sustained by its cover paper and core.

5. A wall construction according to claim 4 in which the edges of said wallboards which extend generally parallel to said supports are positioned upon certain of said supports and have their edge surfaces uncovered by said cover papers, reinforcing strips bonded to and covering said otherwise uncovered edge surfaces and lapped upon a face of said wallboards, and nails driven through said reinforcing strips and said wallboards into said supports to fasten said reinforced edges to said supports.

6. A wall construction according to claim 4 in which the edges of said wallboards which extend generally parallel to said supports are positioned upon certain of said supports and have their edge surfaces uncovered by said cover papers, reinforcing strips bonded to and covering

said otherwise uncovered edge surfaces and lapped upon a face of said wallboards, nails driven through said reinforcing strips and said wallboards into said supports to fasten said reinforced edges to said supports, and a gluelike adhesive in set condition between the adjacent reinforced edge surfaces of two wallboards meeting upon a support and binding said wallboards together along said reinforced edges with a bond capable of transferring stress applied to one wallboard to the abutting board.

7. A wall construction according to claim 4 in which opposite paper covered edges of each wallboard are respectively of tongue and groove form and the wallboards are erected with the tongue edge of one wallboard entering the groove of the adjacent wallboard, said adhesive being placed between said tongue and groove edges.

8. A wall construction according to claim 4 in which opposite paper covered edges of each wallboard are respectively formed as a V edge and a V groove and the wallboards are erected with the V edge of one wallboard entering the V groove of the adjacent wallboard, said adhesive being between said V edge and V groove of the adjacent boards.

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