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(54) Building structures.

(57) An assembly of a wall panel (2) of a building and a support structure (1) therefor comprises angle members (11) each secured at one face to the support structure (1) and each with its other face extending towards the panel (2) to define a support channel therefor. The panel end (2) is spaced from the support structure (2) to define a gap to accommodate differential expansion between the panel (2) and support structure (1). In a preferred embodiment, the wall panel (2) comprises a composite structure comprising a layer of expanded foam material sandwich between sheets of board or metal.

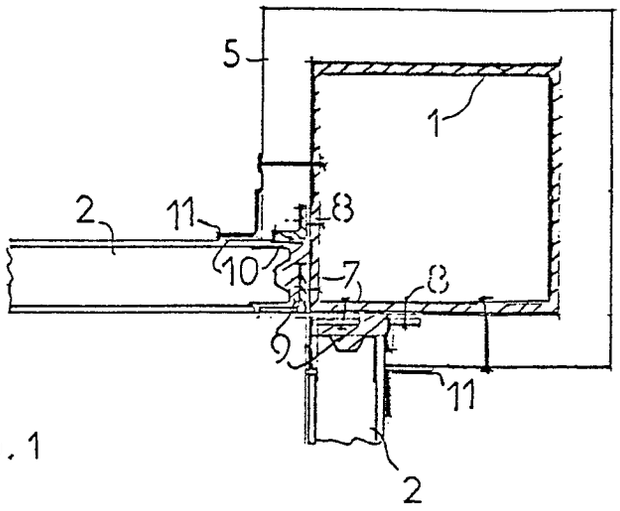

FIG. 1

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Building Structures

This invention relates to building structures and more especially to modular building structures such as mobile Hospital units in which pre-engineered steel frames and external and internal composite wall units comprising expanded foam filled panels of standard sizes and shapes are employed for ease of assembly. The invention also relates to methods of assembling such structures.

Modular building systems are known in which standard-sized components such as wall panels, support columns, roof trusses etc are employed. Advantages of such systems include the ability quickly to install buildings on site on prepared foundations with a minimal need for skilled labour. Hitherto, items such as wall panels have been of limited size to alleviate problems which may occur due, for example, to differential thermal expansion between the individual panels and the supporting structure. These problems are accentuated by known techniques of assembly and when employing metallic or metal coated panels.

Furthermore, panels previously employed have not enjoyed the heat insulation characteristics necessary for buildings, e.g. hospitals in countries where extremes of temperature can occur.

GB 1039684 and GB 1350942 disclose building structures in which pre-formed structural members are secured to rectangular-section colums by means of spring-loaded or tensioned clamps. The use of such clamps would impose high compressive stresses on the structural members therefore making them unsuitable for supporting composite wall panels where the imposition of even low compressive stresses would be sufficient to cause severe damage to the panels upon relative movement occuring between the panels and the column caused, for example, by thermal expansion of the column relative to the panels.

GB 1139954 discloses a building construction in which composite internal wall panels are supported from a hollow cross beam by clamping strips. For the reasons given in the preceeding paragraph, the use of such clamping strips would impose compressive stresses on the wall panels sufficient to inhibit or restrain relative movement engendered by differential thermal expansion so leading to severe damage to the composite panels.

GB 1250638 also discloses a building construction in which an internal wall panel is supported within retaining members, these retaining members being releasably carried by a box section steel column. Such an arrangement would be insufficient to support an external wall panel if subjected to loads caused, for example, by high winds and storms.

The present invention sets to provide a building structure and method of assembly which alleviates problems associated with these and other conventional building structures.

According to the present invention in one aspect, there is provided a building structure including a wall panel comprising a layer of expanded foam sandwiched between sheets of timber board or metal, supported from a hollow-section steel column, the building structure being characterised in that internal and external "L" section angle plates are mechanically secured to the steel column each with one web in close abutting contact with the column and the other web extending in a direction away from and normal to the column, each angle plate extending vertically of the column to a height at least commensurate with the height of the panel to be supported by the column, the said other webs of the angle plates together defining a channel of a width sufficient to enable one side edge section of the panel to be supported therein with the panel end spaced from the column and without the imposition of compressive stress on the panel end by the angle plates.

According to the present invention in another aspect there is provided a method of assembling a building structure in which a wall panel comprising a layer of expanded foam sandwiched between sheets of timber board or metal is supported from a hollow section steel column, the method being characterised by the steps of mechanically securing a first "L" section angle plate to one vertical face of the steel column, the angle plate extending vertically of the column to a height at least equal to the height of the panel to be supported from the column, positioning the panel with one vertically extending end section in contact with the adjoining web face of the angle plate, mechanically securing a second "L" section angle plate of similar length to that of the first angle plate to said one vertical face of the steel column with the respective web face of the second angle plate in contact with said panel end section whereby the panel is supported between the opposed web faces of the two angle sections without the imposition of compressive stress.

The invention permits clear internal wall surfaces for ease of internal planning and layouts, and thermal bridging at the columns may be overcome by cladding the external face of the column with a pre-engineered lagging unit.

Structural beams are contained within the assembly of columns and walls panels. Insulation materials within wall panels in accordance with the invention and column lagging units preferably con-

sist, inter alia, of expanded foam such as styrofoam, phenolyc, polysocyanurate or polythene. Angle plates fixed to columns and panels may be located at pre-determined positions by welding, rivetting or drill-screwing to permit dismantling at a later stage.

The invention is designed to permit a pre-engineered building to be rapidly erected on site and, if required, to be later dismantled and re-erected elsewhere with minimal damage to the fabric of the building.

The invention coupled with the external column lagging and internal sealant strips to the angle plates, ensures a water-tight and draught free structure.

The invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:-

Figure 1 is section taken through a building structure in accordance with the invention;

Figure 2 is a section taken through an alternative building structure in accordance with the invention;

Figures 3 and 4 are respectively lengthwise and vertical cross-sections taken through a composite building panel in accordance with the invention; and

Figure 5 is a section of a sheet of a pre-engineered lagging unit.

Figure 1 illustrates a hollow section steel column 1 forming part of a pre-engineered steel frame of a building, which supports inter alia a pair of composite wall panels 2. As illustrated more particularly in Figure 3, each panel 2 comprises a layer 3 of expanded foam insulation material such as styrofoam, phenolyc or polythene sandwiched between and adhered to external panels 4 of timber board or metallic sheets. Each panel therefore comprises a skeletal frame of timber or metal into which expanded foam material has been injected or located in block form.

The external surfaces of the column 1 are lagged with a pre-engineered cladding unit 5 of expanded foam insulation material such as styropore or styrofoam and are retained in position by rivets or bolts 6 which pass through the cladding unit 5 and into the column 1. The pre-engineered units may be supplied to site in the manner illustrated in Figure 5 for ease of assembly. The foam material is carried by a thin metallic or glass reinforced plastics backing sheet.

Internal and external "L" section angle plates 7, 8 are mechanically fixed to the steel column 1 such that the angle plates form integral parts of the column 1. The angle plates 7, 8 are preferably of steel and are each mechanically anchored to the column with one web face in abutting contact with the adjoining vertical face of the column. The plates 7, 8 may be fixed to the column 1 by welding, rivetting, screw-drilling or the like. The angle plates 7, 8 extend over the entire height of the panels 2 and the panel end closest to the column is supported between the webs of the plates 7, 8 which lie normal to the column face. The panels 2 are, therefore, supported over their entire heights by the sideways extending webs of the angle plates 7, 8. The spacing of the angle plates 7, 8 is such that no compressive stress is imposed on either of the two supported panel faces by the plates 7,8. The space defined between each panel end and the respective surface of the column 1 is filled with a polyurathene foam material 9 for insulation purposes. The foam may be injected into each space in liquid form, the liquid expanding on solidification to provide good insulation characteristics.

Additionally, pre-compressed sheets of resin filled foam material 10 are positioned between the side faces of each external angle plate 8 and the adjoining vertical face of the respective panel 2 for insulation purposes. The sheets 10 expand to a controlled extent with time to provide good insulation characteristics. Additional sheets 10 may also be positioned between the panel 2 and the cladding unit 5.

It will be seen from Figure 1 that the angle plates 8 are positioned between the column 1 and the pre-engineered units 5. Additional "L" section plates 11 may be secured to the panels to help retain the units 5 in place.

As mentioned previously the panel ends adjacent the column 1 are spaced from the opposed column faces to accommodate any thermal expansion of the steel column which may arise during use of the building without imposing stresses on the panels 2. The presence of the foam material 9 does not inhibit such thermal expansion of the steel column. The angle members 7, 8, therefore, define expansion joints within which any relative movement between the panels and the respective support columns can readily be accommodated without causing damage to the composite panels.

Referring now to Figure 2, in which like integers to those illustrated in Figure 1 have been given the same reference numerals, a box section steel column 1 of a building is positioned intermediate one wall length of the building and supports two adjacent composite panels in the manner illustrated. In this embodiment, the angle members 7, 8, 11 are provided on the opposite column surfaces, the expansion joints in all other respects being similar to those illustrated in Figure 1.

Referring now to Figure 3 and 4, the wall panel illustrated comprises a layer of expanded foam material such as styrofoam, phenolyc or polythene, sandwiched between external timber or metallic

panels. Where appropriate, a layer of lead may be positioned between the foam layer and one or both panels to prevent or inhibit the flow of radio activity.

Frame rail members 14 which define the edges of the panels are so shaped as to define along the panel side edges re-entrant sections for enhanced water sealant and structural strength purposes. Along the top edge, the rail section 14 provides a seating for the ensuing panel and a water bar, and along the lower panel edge a reciprocal seating for the panel located above and a water bar.

As mentioned above, for vertical assembly of panels, the edge members 14 co-operate to define a seating surface for accurate location purposes and to facilitate some lateral movement between abutting panels.

A cill rail 15 is rivetted to the bottom rail of an upper panel to mask the joint between adjacent panels and for stiffening and buttressing purposes.

The floors, ceilings, internal and external walls of an assembled building may all be constructed as composite prefabricated units of expanded foam material sandwiched between timber or metallic panels.

The building structure described has particular application in the construction of such buildings as field Hospitals where the ability to assemble relative light weight wall panels, floors, ceilings etc within a prefabricated steel frame work both quickly and relatively cheaply has obvious advantages.

On assembly of the structure illustrated is Figure 1 of the drawings, the prefabricated steel frame including the steel column 1 is erected on site and the internal "L" section angle plates 7 are secured firmly by welding, rivetting or drill-screwing to the column 1 with their sideways extending webs generally in line with the inner face of the column. The wall panels 2 are then positioned with their respective end faces in contact with the plates 7 and the liquid foam material 9 is injected into the space defined between the panel ends and the column faces. The external angle plates 8 are then secured by welding, rivetting or drill-screwing to the respective vertical column faces to provide additional support to the panel ends. The sheets of pre-compressed resin filled foam 10 are located between the adjoining faces of the panel ends and the external angle plates 8 and the external cladding 5 is then located about the external face of the column and retained in position by the bolts or rivets 6.

In the structure described, it is essential firstly, that the angle plates 7, 8 are securely and mechanically fixed to the column 1 such that they form part of the frame structure; and secondly that no compressive stress is applied by the angle plates to the panel ends which is likely to inhibit or restrain movement of the panels relative to the column. If such stress is applied, then relative movement caused by differential expansion will cause damage to the composite panels.

The invention allows structural (live and dead) loading, together with imposed loadings (such as wind and suction loadings) to be carried on an independent structural frame whilst permitting the wall panels a pre-determined movement within the structural frame. This pre-determined movement is set within the permitted tolerances for deflection of the structure.

Wall panels, in accordance with the invention, are partially load bearing in that they support their own weight and one or more successive panels. Each panel is permitted limited slip along head and foot joints of the structure.

It is to be understood that the foregoing is merely exemplary of specific embodiments of structures in accordance with the invention and that modifications can be made thereto without departing from the true scope of the invention.

Claims

1. A building structure including a wall panel comprising a layer of expanded foam sandwiched between sheets of timber board or metal, supported from a hollow-section steel column, the building structure being characterised in that internal and external "L" section angle pieces are mechanically secured to the steel column each with one web in close abutting contact with the column and the other web extending in a direction away from and normal to the column, each angle plate extending vertically of the column to a height at least commensurate with the height of the panel to be supported by the column, the said other webs of the angle plates together defining a channel of a width sufficient to enable one side edge section of the panel.

2. A building structure as claimed in Claim 1 characterised in that the a layer of polyurethane foam is present within the space between the panel end and the adjacent column face.

3. A building structure as claimed in Claim 1 or Claim 2 characterised in that a pre-fabricated cladding unit of an expanded foam material is secured to the external face of the column.

4. A method of assembling a building structure in which a wall panel comprising a layer of expanded foam sandwiched between sheets of timber board or metal is supported from a hollow section steel column, the method being characterised by the steps of mechanically securing a first "L" section angle plate to one vertical face of the steel column, the angle plate extending vertically of the

column to a height at least equal to the height of the panel to be supported from the column, positioning the panel with one vertically extending end section in contact with the adjoining web face of the angle plate, mechanically securing a second "L" section angle plate of similar length to that of the first angle plate to said one vertical face of the steel column with the respective web face of the second angle plate in contact with said panel end section whereby the panel is supported between the opposed web faces of the two angle sections with its end spaced from the column and without the imposition of compressive stress.

5. A method as claimed in Claim 4 characterised in that polyurathane foam is introduced into the space defined between the panel end and the column to fill the same for insulation purposes.

6. A method as claimed in Claim 4 or Claim 5 characterised in that pre-compressed resin filled foam sheets are located between the web face of the second angle plate and the adjacent face of the wall panel.

7. A method as claimed in any one of Claims 4 to 6 characterised in that a cladding of an expanded foam material is secured to the external face of the column.

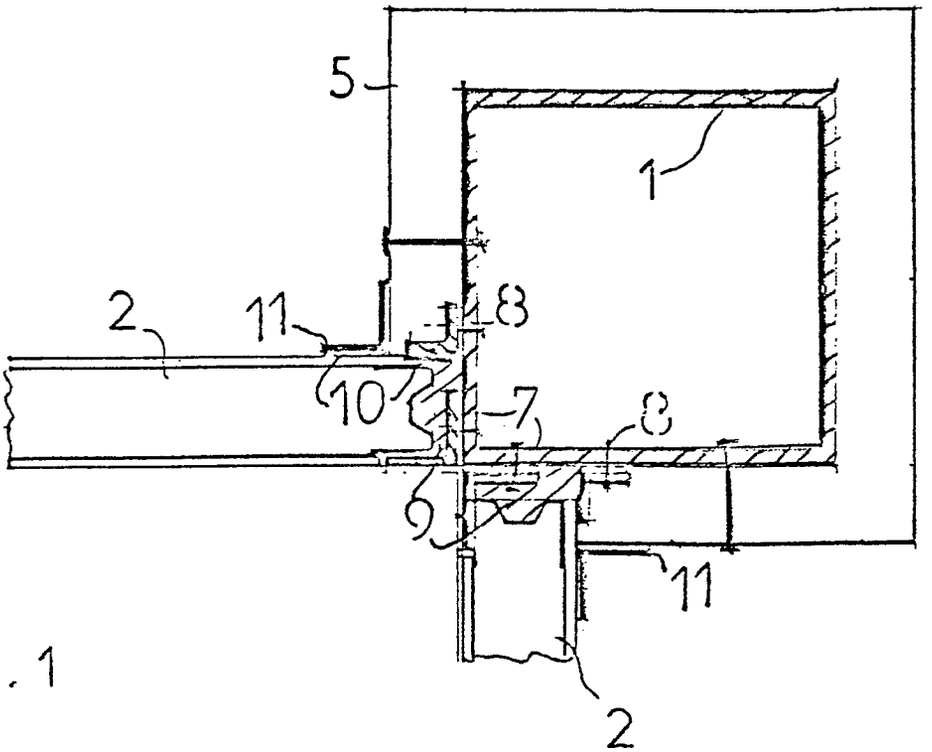

FIG. 1

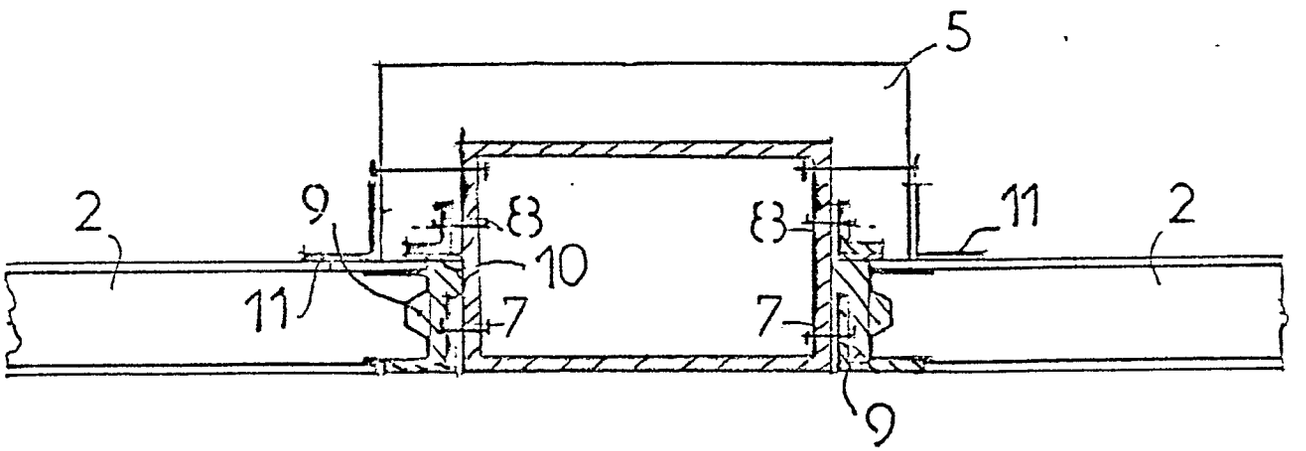

FIG. 2

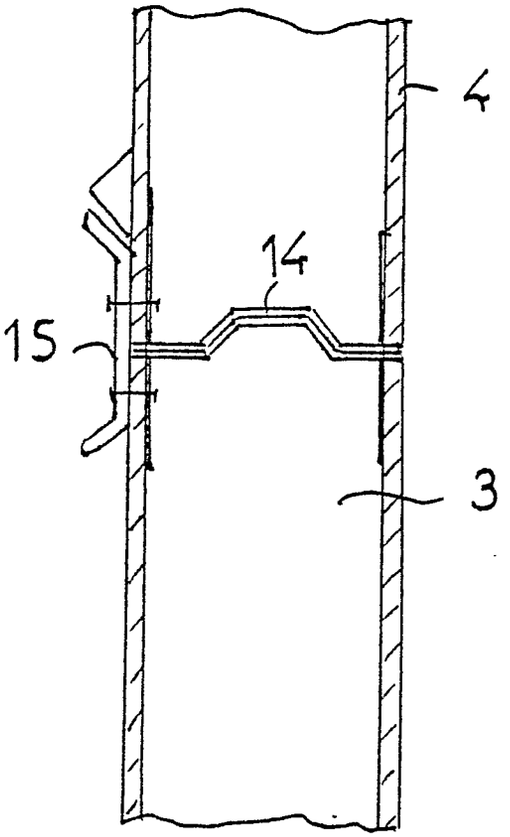

FIG 4

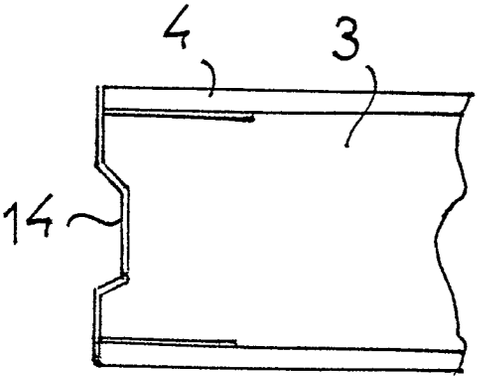

FIG 3

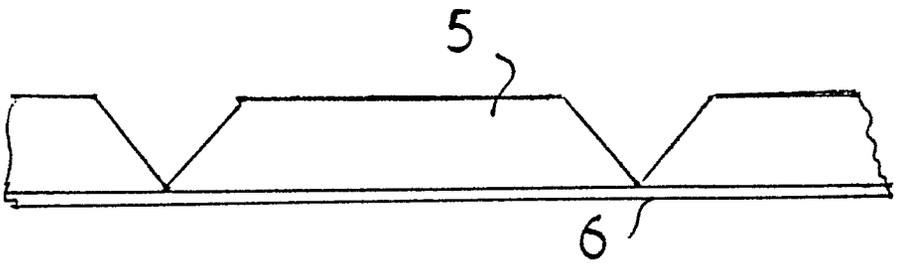

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number

EP 88 30 7653

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	NL-A-6 415 086 (SHELL) * Page 1, line 3 - page 2, line 7; page 4, line 23 - page 5, line 13; figures *	1-2,4-5	E 04 B 2/58
A		3,7	
Y	FR-A-2 225 591 (PENNECOT) * Page 6, lines 15-26; page 7, lines 9-25; figure 16 *	1-2,4-5	
A	FR-A-2 332 401 (RIVA) * Page 3, line 22 - page 6, line 7; figures *	1,2,5	
A	EP-A-0 071 700 (WESPANWERK WENGER AG) * Whole document *	3,7	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 04 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-02-1989	LAUE F.M.

CATEGORY OF CITED DOCUMENTS

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