

PATENT SPECIFICATION

(11)

1 416 832

(21) Application No. 25677/73 (22) Filed 30 May 1973

(44) Complete Specification published 10 Dec. 1975

(51) INT. CL.² E04H 1/02

(52) Index at acceptance

E1A 33X 38X 391 407 411 435 45X

E1W 4B17 4B18 4B2 4B33 4B45 4B47 4B4 4B54 4B64
4B69 4B9



(54) BUILDING CONSTRUCTION

(71) I, DONALD LOUIS STELP, a citizen of the United States of America, of 33-G, Block D, Kim Sia Court, Singapore 9, Republic of Singapore, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to the construction of buildings using interconnected modular prefabricated panel units.

Prefabricated buildings using preformed wall, floor, and roof panel units are well known. Early developments used panels of wood and pressed fibre board having interlocking tongue and groove edge configurations. Later, concrete slabs were utilised for such purposes, the slabs being precast and provided with appropriate bolt apertures and nut accommodating cavities. Inwardly extending reinforcing ribs with captive wooden blocks cast in them were incorporated in these concrete panels for ease of joining the panels and for insulating purposes. It was found, however, that such panel constructions were very heavy and difficult to use and to transport and did not provide the thermal insulation qualities which were desired when structures constructed of such materials were to be used for working and living quarters and shelters.

Insulating core panels were then developed which greatly increased the desirability of this type of construction but these proved to be very costly to manufacture and time consuming and difficult to assemble, dismantle and relocate. Rigid polyurethane foam cores sandwiched between skins of aluminium sheeting have been proposed but they suffer largely from the use of this relatively expensive metal. In order to join a series of such panels, elaborate connecting arrangements have been devised which have the disadvantage

of being expensive to fabricate, difficult to join and seal, and fragile in that the cross-sectional areas of these panels along their joined edges is generally reduced by either single or double tongue and groove configurations and thus highly subject to damage in use and transit and further they are difficult to repair on site.

A further disadvantage of using a metal-skinned structure is the effect of the atmosphere and weather on such materials and the cost of applying protective coatings to overcome the deleterious effects and decorative coatings to present a more pleasant looking finished structure.

According to this invention, a building of modular construction having a floor, side walls and a roof has each of these parts formed by a series of prefabricated channel-shaped panel units arranged side by side, each unit comprising a web portion and a pair of flange portions with parallel outer faces extending substantially at right angles to, and one along each of two opposite edges of, the web portion, the flange portions of adjacent units in the floor, each side wall and the roof being fixed to each other face to face and the units in the side walls being fixed to those in the floor and roof by panel joiner members which are sandwiched in the joints between adjacent flange portions of the side wall units and project from the ends of these joints into joints between adjacent flange portions of the floor and roof units.

Preferably the panel units each comprise a core of rigid foamed plastics material with a skin of glass fibre reinforced plastics material.

The interconnection of the various parts of the building by the panel joiner members sandwiched in the joints between adjacent units gives rise to considerable ease and consequently speed of erection. Further, the formation of the units with foamed

[Price 33p]

plastics cores and glass fibre reinforced plastics skins ensures that units are light to handle which again facilitates and expedites erection and it also makes subsequent protection or decoration unnecessary.

The building also preferably includes panel spacer members disposed in the joints between adjacent units in the floor and roof where these joints are not occupied by the panel joiner members projecting into them from the side walls.

An example of a building constructed in accordance with the invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view of the building;

Figure 2 is an exploded perspective view of various side wall, floor and roof components of the building;

Figure 3 is an exploded perspective view of various end wall and roof components of the building;

Figure 4 is a cross-section through a connection between an end wall panel and a roof panel of the building;

Figure 5 is a cross-section through a connection between an end wall panel and a floor panel of the building; and,

Figure 6 is a perspective view of a part of a compressible foamed plastics tape which is inserted between abutting surfaces of components of the building.

Referring to Figure 1 of the drawings, a building 11 has a door 13 and windows 15 in a side wall 17, an end wall 19, a floor 21 and a roof 23, all supported by an adjustable support structure having legs 25, associated saddle portions 27 and base plates (not shown) on the ground 29.

As can be seen in Figures 2 and 3, the side wall is constructed from prefabricated panel units 31, the end wall from similar panel units 33, the floor 21 from panel units 35, and the roof 23 from panel units 37. Basically, all the panels include broad surfaced web portions 39 and relatively narrower, parallel, flange portions 41. Preferably, the web width and the flange width of all the panel units are the same, however, the lengths of units to be used for different purposes may be different. For example, the length of the end wall panel units 33 are shown longer than the side wall panel units 31, and the roof panel units 37 longer than the floor panel units 35 and both may be longer than the end wall panel units 33. In this example, the side wall panel units 31 are 8 or 12 feet in length, 4 feet wide, have 8 inch wide flanges, and the web portions are 2 inches thick. The end wall units have similar dimensions except that their length is longer by double the flange and web thickness dimensions in order to cover the flanges of both the floor and roof units.

Thus, the length of the end wall panels, in the case of 12 feet long side wall panels, is 13 feet 4 inches. As to the roof panel units 37, these may be 24 feet long, for example, leaving a 2 foot portion 43 overhanging each side, as seen in Figures 1 to 3. Thus, a typical building construction in accordance with the present invention may be 20 feet wide and of varying length in 4 foot units. The distance between floor and ceiling may be 8 foot where air conditioning is being used and 12 foot with no air conditioning. In this preferred example, the panel units are constructed having a rigid polyurethane foam core 45 sandwiched between a pair of parallel glass fibre reinforced polyester sheets 47 forming a skin. It has been found that a glass fibre reinforced polyester skin provides for a very long essentially maintenance free life and one which is relatively light in weight and which has a strength comparable to a metal skin. Colour may be provided in the fabrication of the glass fibre reinforced plastics material so that buildings constructed with this material need not often, if ever, be painted. The advantageous weight feature of this type of panel structure is clearly shown by the fact that such panels may weigh approximately 10 pounds per lineal foot of cross-section. Of course, a key factor in the ability to use this sandwiched material as an integral structural frame and surface element is the shallow rectangular channel-shaped cross-section of the panel units coupled with the flat joiner members.

Panel units making up the individual walls 17 and 19, the floor 21 and the roof 23 are connected together, with the flanges 41 of the units side by side, by the use of conventional connectors, for example, bolts 49 with heads 51 and nuts 53. The flanges 41 are provided with holes 55 at uniform predetermined positions through which the bolts 49 are inserted.

It can be seen that joining the adjacent panels forming the individual walls, floor and roof is a relatively simple task. The same is true for joining the floor 21 to the end walls 19 and the end walls 19 to the roof 23. However, rigidly attaching the side walls 17 to the floor 21 and the roof 23 in a load transmitting manner is another matter. The conventional solution would be to use unsightly and protruding L-shaped angle brackets bolted to the wall panel units and to the adjacent floor and roof panel units, or anchor rods traversing vertically through the wall panels and tying to the roof and floor panels.

Instead of this, the present invention utilizes panel joiner members 57 that are relatively thin elongated strips preferably of glass fibre reinforced polyester material,

but which may also be any lightweight material having a relatively high shear strength. These joiner members 57 are of approximately the same width as the panel flanges 41 and about $\frac{1}{4}$ of an inch thick. These members are disposed between the flanges 41 of abutting side wall panel units 31 and project below and above the side wall panels and between abutting flange portions of the floor and roof panel units 35 and 37, as shown in Figures 2 and 3. The joiner members are provided with holes 59 which coincide with the pattern and spacing of the holes 55 in the panel flanges 41 to accommodate the bolts 49. In this manner, the side wall panels 31 are fixed in a rigid and load carrying manner to the floor and roof panels.

In order to fill the gaps left unoccupied between adjacent floor and roof panel flanges because of the use of the members 57, similarly dimensioned panel spacer members 61 are used. These spacer members include holes (not shown) positioned to match the holes 55 in the floor and roof flanges so that the bolts 49 passing through the latter also extend through the holes in the members 61.

Figures 4 and 5 illustrate a preferred manner in which the end wall panel units 33 are connected to roof panel units 37 (Figure 4) and to floor panel units 35 (Figure 5). Here it can be seen that a roof cap 63 of a suitable material such as glass fibre reinforced plastics material moulded in a rectangular channel-shaped form is positioned over the upstanding flanges 41 of the roof panel units 37 (also seen in Figure 3). The caps also include appropriate holes 65 to allow the passage of the bolts 49, and also notches 67 are cut or moulded in the outer flanges 69 of those caps 63 which are positioned at the end walls 19, to clear the flanges 41 of the panel units 33.

As an alternative to the placing of a spacer member between the outer face of a floor panel flange and the web portion of an adjacent end wall panel (or interior panel partition), a base moulding 71 of any suitable material and comprising an elongated flat strip portion 73 and a transversely extending flange portion 75 may be used as shown in Figure 5. The moulding 71, of course, includes holes 77 to accommodate the bolts 49.

In addition to the panel joiner members and spacer members and mouldings being positioned between the abutting panel units, sealing materials are preferably also used between all abutting surfaces to provide a weather tight enclosure. Conventional sealants may be used, but preferably, a compressible polyurethane foam tape 79 having adhesive covered outer surfaces 81, on one or both sides, such as illustrated in Figure

6, is utilized. Prior to use, the tape 79 may be $\frac{1}{4}$ inch thick, but it will resiliently compress to about $\frac{1}{32}$ of an inch in thickness.

From the foregoing it can be seen that there has been described a very advantageous, lightweight but strong building construction method which utilizes panels having a geometry and construction designed for ease of fabrication, erection, dismantling, handling transport and storage. It should be understood, however, that although certain materials have been specifically identified, other materials having similar characteristics may be substituted therefor.

WHAT I CLAIM IS:—

1. A building of modular construction having a floor, side walls and a roof each formed by a series of prefabricated channel-shaped panel units arranged side by side, each unit comprising a web portion and a pair of flange-portions with parallel outer faces extending substantially at right angles to, and one along each of two opposite edges of, the web portion, the flange portions of adjacent units in the floor, each side wall and the roof being fixed to each other face to face and the units in the side walls being fixed to those in the floor and roof by panel joiner members which are sandwiched in the joints between adjacent flange portions of the side wall units and project from the ends of these joints into joints between adjacent flange portions of the floor and roof units.

2. A building according to claim 1, in which the panel units each comprise a core of rigid foamed plastics material with a skin of glass fibre reinforced plastics material.

3. A building according to claim 1 or claim 2, including panel spacer members disposed in the joints between adjacent units in the floor and roof where these joints are not occupied by the panel joiner members projecting into them from the side walls.

4. A building according to any one of the preceding claims, in which the lower and upper ends of the side wall panel units abut the web portions of the panel units in the floor and roof respectively.

5. A building according to claim 4, in which the web portions of the panel units in the side walls project outwards from the building.

6. A building according to claim 1, in which the flange portions of the floor panel units extend downwardly and the flange portions of the roof panel units extend upwardly.

7. A building according to claim 6, in which rectangular channel-shaped roof cap members with downwardly extending flange portions are fitted over abutting pairs of the upwardly extending roof flange portions.

8. A building according to claim 7, in which rectangular channel-shaped end wall

but which may also be any lightweight material having a relatively high shear strength. These joiner members 57 are of approximately the same width as the panel flanges 41 and about $\frac{1}{4}$ of an inch thick. These members are disposed between the flanges 41 of abutting side wall panel units 31 and project below and above the side wall panels and between abutting flange portions of the floor and roof panel units 35 and 37, as shown in Figures 2 and 3. The joiner members are provided with holes 59 which coincide with the pattern and spacing of the holes 55 in the panel flanges 41 to accommodate the bolts 49. In this manner, the side wall panels 31 are fixed in a rigid and load carrying manner to the floor and roof panels.

In order to fill the gaps left unoccupied between adjacent floor and roof panel flanges because of the use of the members 57, similarly dimensioned panel spacer members 61 are used. These spacer members include holes (not shown) positioned to match the holes 55 in the floor and roof flanges so that the bolts 49 passing through the latter also extend through the holes in the members 61.

Figures 4 and 5 illustrate a preferred manner in which the end wall panel units 33 are connected to roof panel units 37 (Figure 4) and to floor panel units 35 (Figure 5). Here it can be seen that a roof cap 63 of a suitable material such as glass fibre reinforced plastics material moulded in a rectangular channel-shaped form is positioned over the upstanding flanges 41 of the roof panel units 37 (also seen in Figure 3). The caps also include appropriate holes 65 to allow the passage of the bolts 49, and also notches 67 are cut or moulded in the outer flanges 69 of those caps 63 which are positioned at the end walls 19, to clear the flanges 41 of the panel units 33.

As an alternative to the placing of a spacer member between the outer face of a floor panel flange and the web portion of an adjacent end wall panel (or interior panel partition), a base moulding 71 of any suitable material and comprising an elongated flat strip portion 73 and a transversely extending flange portion 75 may be used as shown in Figure 5. The moulding 71, of course, includes holes 77 to accommodate the bolts 49.

In addition to the panel joiner members and spacer members and mouldings being positioned between the abutting panel units, sealing materials are preferably also used between all abutting surfaces to provide a weather tight enclosure. Conventional sealants may be used, but preferably, a compressible polyurethane foam tape 79 having adhesive covered outer surfaces 81, on one or both sides, such as illustrated in Figure

6, is utilized. Prior to use, the tape 79 may be $\frac{1}{4}$ inch thick, but it will resiliently compress to about $\frac{1}{32}$ of an inch in thickness.

From the foregoing it can be seen that there has been described a very advantageous, lightweight but strong building construction method which utilizes panels having a geometry and construction designed for ease of fabrication, erection, dismantling, handling transport and storage. It should be understood, however, that although certain materials have been specifically identified, other materials having similar characteristics may be substituted therefor.

WHAT I CLAIM IS:—

1. A building of modular construction having a floor, side walls and a roof each formed by a series of prefabricated channel-shaped panel units arranged side by side, each unit comprising a web portion and a pair of flange-portions with parallel outer faces extending substantially at right angles to, and one along each of two opposite edges of, the web portion, the flange portions of adjacent units in the floor, each side wall and the roof being fixed to each other face to face and the units in the side walls being fixed to those in the floor and roof by panel joiner members which are sandwiched in the joints between adjacent flange portions of the side wall units and project from the ends of these joints into joints between adjacent flange portions of the floor and roof units.

2. A building according to claim 1, in which the panel units each comprise a core of rigid foamed plastics material with a skin of glass fibre reinforced plastics material.

3. A building according to claim 1 or claim 2, including panel spacer members disposed in the joints between adjacent units in the floor and roof where these joints are not occupied by the panel joiner members projecting into them from the side walls.

4. A building according to any one of the preceding claims, in which the lower and upper ends of the side wall panel units about the web portions of the panel units in the floor and roof respectively.

5. A building according to claim 4, in which the web portions of the panel units in the side walls project outwards from the building.

6. A building according to claim 1, in which the flange portions of the floor panel units extend downwardly and the flange portions of the roof panel units extend upwardly.

7. A building according to claim 6, in which rectangular channel-shaped roof cap members with downwardly extending flange portions are fitted over abutting pairs of the upwardly extending roof flange portions.

8. A building according to claim 7, in which rectangular channel-shaped end wall



cap members with downwardly extending flange portions are fitted over the upwardly extending roof panel flange portions and the upper ends of the web portions of the end wall panel units where these abut each other, the end wall cap members including notches in their outer flange portions to accommodate the outwardly extending abutting flange portions of the end wall panel units.

9. A building according to claim 3, including a compressible foam sealing tape disposed between the abutting flange portions on each side of the panel joiner members and the panel spacer members.

10. A building according to any one of

the preceding claims, in which the length of the end wall panel units is greater than that of the side wall panel units by substantially the sum of the height of the flange portions of the floor panel units and the height of the flange portions of the roof panel units.

11. A building according to claim 1, constructed substantially as described and as illustrated in the accompanying drawings.

For the Applicant:—

GILL, JENNINGS & EVERY
Chartered Patent Agents,
51/52 Chancery Lane,
London, WC2A 1HN.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1975.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.



* C L M S *