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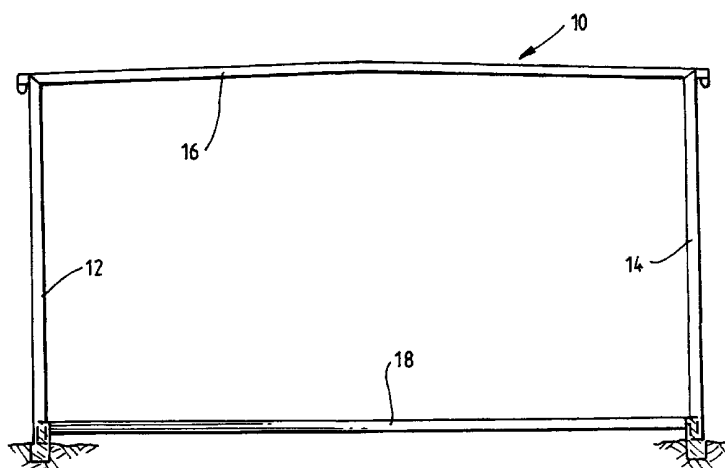
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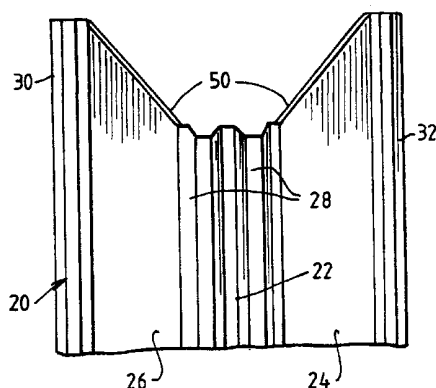
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(54) Title: A MODULAR WALL, ROOF, FLOOR OR COMBINATION BUILDING SYSTEM



(57) Abstract: A modular building (10) comprising an opposing pair of modular walls (12, 14), a modular roof (16) and floor (18). The walls (12, 14), roof (16) and floor (18) are constructed from a plurality of elongate panels (20) connected together in a side-by-side relationship and of substantially identical channel-shaped cross-section. The wall panel (20) comprises a web (22) formed continuous with an opposing pair of flanges (24, 26) which diverge outwardly at an obtuse angle relative to the web (22). The web and flanges may also include a series of longitudinally extending stiffening ribs (28). Opposing free edge portions of the flanges (24, 26) include C-shaped locking ribs (30, 32) respectively, permitting clipping or interlocking of adjacent panels (20).



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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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A BUILDING SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to a modular
5 building system and relates particularly, though not
exclusively, to a wall, roof or floor panel. The
invention further relates to a method of constructing a
modular building and in particular a modular wall, roof,
floor or combination thereof.

10

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided
an elongate wall panel of a generally channel shaped
cross-section including a web and an opposing pair of
15 flanges, the wall panel at or adjacent one end having hold
down means being adapted to anchor the wall panel in a
substantially vertical orientation to concrete footings.

Preferably the hold down means is in the form of one or
20 more hold down bolts mounted to one or both of the
flanges. More preferably the hold down bolts are adapted
to at least partly embed within a concrete hob formed at
said one end in a recess defined by adjacent of the wall
panels.

25

Typically the concrete hob is anchored to the concrete
footings via one or more starter bars set therein.

Preferably the wall panel is one of a plurality of
30 elongate wall panels having adjacent flanges connected to
one another to form a wall.

According to another aspect of the invention there is
provided a method of constructing a modular wall from a
35 plurality of elongate wall panels being channel shaped in
cross-section and including a web and an opposing pair of
flanges, said method comprising the steps of:

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connecting adjacent flanges of adjacent wall panels to one another to form the modular wall;

erecting the modular wall in a substantially vertical orientation; and

- 5 anchoring the modular wall at a lower end to concrete footings via hold down means connected to each of the wall panels.

10 Preferably anchoring of the modular wall to the concrete footings is effected via one or more concrete hobs formed at the lower end of the modular wall in a recess defined by the channel of the wall panel. More preferably said hold down means is at least partly embedded within one of the concrete hobs.

15 Generally the hold down means is in the form of one or more hold down bolts mounted to the flanges of one of the wall panels and embedded in one of the concrete hobs.

20 Typically said method also comprises the step of temporarily connecting formwork to the lower end of the modular wall, said formwork being effective in enclosing the recess in which each of the concrete hobs is thereafter formed.

25 Preferably the method further comprises the step of setting the concrete hobs within one or more starter bars which protrude from the concrete footings.

30 According to a further aspect of the invention there is provided a modular floor including a plurality of elongate floor panels connected together in a side to side relationship, the floor panels each being channel shaped in cross-section and including a web and an opposing pair
35 of flanges.

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Generally the modular floor also includes floor cladding being fixed to the web of adjacent of the floor panels.

According to yet another aspect of the invention there is
5 provided a modular roof and wall combination constructed from a plurality of respective elongate roof and wall panels connected in a side to side relationship and each being of a generally channel shaped cross-section and including a web and a pair of opposing flanges, an upper
10 end of one of the wall panels being shaped complementary to a cross-sectional shape of a corresponding one of the roof panels which nests and is fixed to said wall panel.

Preferably the flanges and/or the web of each of the wall
15 panels at their upper end include folded portions arranged in the same plane as the corresponding roof panel. More preferably the roof panel is fixed to the corresponding wall panel via a fastening which engages the roof panel and the adjacent folded portion of the wall panel.

20 Typically the modular roof and wall combination also includes an elongate roof mounting member connected to the modular wall and upon which the web of adjacent of the roof panels is fixed. More typically the mounting member
25 is in cross-section of an angle-shaped profile.

According to yet a further aspect of the invention there is provided a modular wall and floor combination constructed from a plurality of respective elongate roof
30 and floor panels connected in a side to side relationship and each being of a generally channel shaped cross-section and including a web and a pair of opposing flanges, one end of each of the floor panels being mounted to a lower end of a corresponding one of the wall panels.

35 Preferably the modular wall and floor combination also comprises one or more floor mounts connected to an

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interior face of the modular wall and upon which the web and/or a free edge portion of the flanges of the floor panels is fixed. More preferably the floor mounts include one or more members of an angle-shaped profile each
5 disposed in a generally horizontal plane.

Typically the floor panels are oriented so that the web faces upward. More typically said wall and floor combination also includes wall or floor cladding fixed to
10 an interior surface of the modular wall or the webs of the modular floor, respectively.

Preferably the wall, roof and/or floor panels include interlocking elements formed at opposing free longitudinal
15 edge portions of the opposing flanges. More preferably the interlocking elements are in the form of interlocking ribs of a C-shaped cross section and designed to clip or nest within one another. In one embodiment one of the C-shaped ribs has its free edge portion disposed inward of
20 the panel whereas an opposing of the ribs is turned outward of the panel thereby facilitating interlocking of adjacent of the panels.

Typically the web of the panel includes longitudinally
25 extending strengthening ribs. More typically the flanges of the panel includes transversely extending corrugations.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to achieve a better understanding of the nature
30 of the present invention a preferred embodiment of a modular building system will now be described in some detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is an end elevational view of building
35 constructed in accordance with an embodiment of the invention;

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Figures 2a to 2e are cross-sectional views at various stages of constructions of a modular wall and floor together with footings of the modular building of Figure 1;

5 Figure 3 is a cross-sectional view taken through 3-3 of Figure 2c;

Figure 4 is a cross-sectional view taken through 4-4 of Figure 2e;

10 Figure 5 is a side view of an upper end of a wall panel of the modular building of Figure 1;

Figure 6 is a front view of the upper end of the wall panel of Figure 5;

15 Figure 7 is a perspective view of part of a roof panel and an upper end of a wall panel removed from one another;

Figure 8 is a cross-sectional elevational view of a roof panel connected to a wall panel of the modular building of Figure 1; and

20 Figure 9 is a cross-sectional view taken through 9-9 of Figure 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figure 1 there is a modular building 10 comprising an opposing pair of modular walls 12 and 14 between which at upper and lower ends a modular roof 16 and modular floor 18, respectively, is spanned. In this example the modular walls 12 and 14, roof 16 and floor 18 are constructed from a plurality of elongate panels connected together in a side to side relationship and of a substantially identical channel shaped cross-section.

35 Figures 5 to 7 illustrate an upper end of one of a plurality of the wall panels such as 20 taken from the modular wall 12 or 14 of the modular building 10. The wall panel 20 includes a web 22 formed continuous with an opposing pair of flanges 24 and 26 which diverge outwardly at an obtuse angle relative to the web 22. The web 22

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includes a series of longitudinally extending stiffening ribs such as 28. Although not illustrated the flanges 24 and 26 may also include a series of transversely extending corrugations which provide additional rigidity to the wall panel 20. Opposing free edge portions of the flanges 24 and 26 include C-shaped interlocking ribs 30 and 32, respectively. The interlocking ribs 30 and 32 have a free edge portion of one of the ribs 30 turned inward whilst the opposing interlocking rib 32 is turned outward of the panel 20. This facilitates clipping or interlocking of adjacent of the panels such as 20.

Figures 2a to 2e depict the various stages in construction of the modular wall 14 and floor 18. The modular wall 14 is in this embodiment erected over and in line with concrete footings 34 which in a conventional manner include steel reinforcing such as 36. The concrete footings 34 include a plurality of longitudinally spaced apart reinforcing starter bars such as 38. Importantly, each of the wall panels 20 includes a plurality of hold down bolts such as 40 which are each fixed to one of the flanges such as 24 of the wall panel 20. The hold down bolts 40 are each bent at right angles so that they are directed toward the concrete footings 34. The hold down bolts 40 which in this embodiment together constitute the hold down means are embedded within a concrete hob 42 which is cast upon the concrete footings 34 within a recess 44 formed by adjacent of the wall panels 20. The starter bars such as 38 are also set within the corresponding concrete hob 42.

The modular floor 18 is formed from a plurality of interlocked floor panels such as 45 connected together in a side to side relationship and of an identical profile as the wall panels such as 20. As shown in Figures 2e and 4 the modular floor 18 is at opposing ends mounted to the respective wall 12 or 14 via upper and lower floor mounts

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46 and 48. The upper floor mount includes a series of elongate angle-section members fixed to the web 22 of one of the wall panels 20 and located underneath a web of the corresponding floor panel 45. The lower floor mount 48 is
5 in the form of a single length of an elongate angle-section member fixed to the web 22 of the wall panel 20 and located underneath the interlocking ribs of the adjacent floor panels 45. The modular floor 18 is clad with a suitable flooring material laid across and fixed to
10 the webs of the floor panels such as 45. The interlocking ribs of the floor panels 45 permit drainage of water or condensation which may form in the modular floor 18. Advantageously, the modular floor 18 provides an insulation blanket between the floor cladding and the
15 recesses defined between adjacent interlocking floor panels 45.

Figures 8 and 9 illustrate connection of the modular roof 16 to the modular wall 14. The modular roof 16 is formed
20 from a plurality of roof panels such as 55 of an identical configuration to the wall panels such as 20 connected together in a side to side relationship. The modular roof 16 is "inverted" compared to the modular floor 18 wherein the interlocked free edges of the flanges extend upward.
25 Significantly, the upper edge of each of the wall panels such as 20 is cut or cropped so that it is shaped complementary to a cross-section of the roof panel 55 which nests therein. The opposing flanges 24 and 26 include folded portions in the form of tabs 50 upon which
30 an underlying surface of the corresponding flanges of the roof panel 55 are fixed. The modular roof 16 extends beyond the line of the modular wall such as 14 so as to form eaves. Guttering such as 52 encloses an open end of the roof panels 55 which each include an opening 54 formed
35 in the web so as to permit the drainage of rainwater from the roof 16 into the guttering 52. Importantly, the building 10 includes an elongate roof mounting member 56

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fixed to an exterior face of the modular wall 14. The mounting member 56 is in the form of an angle-shaped steel member which is screwed to the interlocking ribs of adjacent of the wall panels 20. Advantageously, this connection is made without penetrating or piercing the modular wall 14 itself.

In order to further facilitate an understanding of the invention, the general steps involved in construction of the described modular building 10 will now be outlined:

- (i) the concrete footings 34 are prepared in a conventional manner together with the footing reinforcing 36 and the starter bars such as 38 as shown in Figure 2a;
- (ii) the wall panels such as 20 are connected together in a side to side relationship so as to form the wall module such as 14;
- (iii) formwork such as 58 is bolted to adjacent webs 22 of adjacent wall panels 20 on an interior surface thereof;
- (iv) the roof support member 56 is screwed to interlocking ribs of adjacent wall panels 20 at the eaves line;
- (v) the hold down bolts 40 are fixed to the flanges such as 24 and 26 of the wall panels such as 20 through pre-punched holes formed therein;
- (vi) the modular wall 14 is erected into a vertical position over the concrete footings 34 as shown in Figure 2b;
- (vii) concrete is cast or poured into the recess 44 defined between the formwork 58 and the adjacent flanges such as 24 of adjacent wall panels 20 as shown in Figure 2c;
- (viii) the formwork 58 is removed once the concrete has cured and the upper and lower floor mounts 46 and 48 respectively are bolted to the webs 22 of adjacent wall modules 20 through the existing holes to which the formwork 58 was mounted as shown in Figure 2d;

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(ix) the modular floor 18 is constructed from the floor panels 45 and at opposing ends mounted to the floor mounts 46 and 48 of the respective wall modules 12 and 14;

(x) each of the roof panels 55 is spanned between the opposing modular walls 12 and 14 wherein it nests within the corresponding cropped recess formed in the wall panel 20;

(xi) the roof panels 55 are each fixed to the corresponding wall panel 20 via a fastening which passes through the tab 50 of the wall panel into the corresponding flange of the roof panel 55;

(xii) guttering such as 52 is fixed to opposing open ends of the modular roof 16.

It should be appreciated that the sequence and specific steps outlined are for illustrative purposes only and may vary. For example, the concrete hobs 42 and concrete footings 34 may be poured together rather than separately as described in the above procedure. Additionally, the roof module 16 may be erected prior to construction of the floor module 18. The modular building 10 is appropriately clad on the walls with sheet material such as GYPROCK and on the floor with hardwood flooring or similar.

Now that a preferred embodiment of the present invention has been described in some detail it will be apparent to those skilled in the art that the modular building system and its various aspects have at least the following advantages:

- (i) the modular building can be constructed with relative ease requiring minimal trade expertise;
- (ii) the modular building is relatively rigid and robust in construction;
- (iii) the modular building is relatively serviceable wherein components such as a wall panel can be replaced independent of the remainder of the structure;

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(iv) the modular building is inherently thermally efficient insofar as it includes a thermal blanket between the modular wall or modular floor and the respective cladding.

5

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, the building panels described need not be of the same configuration provided, for example, the wall panels include or are adapted to connect to hold down means which anchor the panel to the concrete footings. The invention is also intended to extend to buildings and other structures including only one aspect of the described invention such as the modular wall without the modular floor. For example, the wall panels are appropriate for use in fence construction in which case a series of adjacent wall panels together form the fence. The modular wall or fence may be capped particularly in applications where the fence serves as a noise reducer. Alternatively, in a security application it may be advantageous to have no cap on the fence.

All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

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CLAIMS:

1. An elongate wall panel of a generally channel shaped cross-section including a web and an opposing pair of
5 flanges, the wall panel at or adjacent one end having hold down means being adapted to anchor the wall panel in a substantially vertical orientation to concrete footings.
2. A wall panel as defined in claim 1 wherein the hold
10 down means is in the form of one or more hold down bolts mounted to one or both of the flanges.
3. A wall panel as defined in claim 2 wherein the hold
down bolts are adapted to at least partly embed within a
15 concrete hob formed at said one end in a recess defined by adjacent of the wall panels.
4. A wall panel as defined in claim 3 wherein the
concrete hob is anchored to the concrete footings via one
20 or more starter bars set therein.
5. A wall panel as defined in any one of the preceding
claims wherein the wall panel is one of a plurality of
elongate wall panels having adjacent flanges connected to
25 one another to form a wall.
6. A method of constructing a modular wall from a
plurality of elongate wall panels being channel shaped in
cross-section and including a web and an opposing pair of
30 flanges, said method comprising the steps of:
 connecting adjacent flanges of adjacent wall panels
 to one another to form the modular wall;
 erecting the modular wall in a substantially vertical
orientation; and
35 anchoring the modular wall at a lower end to concrete
footings via hold down means connected to each of the wall
panels.

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7. A method of constructing a modular wall as defined in claim 6 wherein anchoring of the modular wall to the concrete footings is effected via one or more concrete
5 hobs formed at the lower end of the modular wall in a recess defined by the channel of the wall panel.

8. A method of constructing a modular wall as defined in claim 7 wherein said hold down means is at least partly
10 embedded within one of the concrete hobs.

9. A method of constructing a modular wall as defined in claim 8 wherein the hold down means is in the form of one or more hold down bolts mounted to the flanges of one of
15 the wall panels and embedded in one of the concrete hobs.

10. A method of constructing a modular wall as defined in any one of claims 7 to 9 also comprising the step of temporarily connecting formwork to the lower end of the
20 modular wall, said formwork being effective in enclosing the recess in which each of the concrete hobs is thereafter formed.

11. A method of constructing a modular wall as defined in
25 any one of claims 7 to 10 further comprising the step of setting the concrete hobs within one or more starter bars which protrude from the concrete footings.

12. A modular floor including a plurality of elongate
30 floor panels connected together in a side to side relationship, the floor panels each being channel shaped in cross-section and including a web and an opposing pair of flanges.

35 13. A modular floor as defined in claim 12 also including floor cladding being fixed to the web of adjacent of the floor panels.

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14. A modular roof and wall combination constructed from a plurality of respective elongate roof and wall panels connected in a side to side relationship and each being of a generally channel shaped cross-section and including a web and a pair of opposing flanges, an upper end of one of the wall panels being shaped complementary to a cross-sectional shape of a corresponding one of the roof panels which nests and is fixed to said wall panel.
15. A modular roof and wall combination as defined in claim 14 wherein the flanges and/or the web of each of the wall panels at their upper end include folded portions arranged in the same plane as the corresponding roof panel.
16. A modular roof and wall combination as defined in claim 15 wherein the roof panel is fixed to the corresponding wall panel via a fastening which engages the roof panel and the adjacent folded portion of the wall panel.
17. A modular roof and wall combination as defined in any one of claims 14 to 16 also including an elongate roof mounting member connected to the modular wall and upon which the web of adjacent of the roof panels is fixed.
18. A modular roof and wall combination as defined in claim 17 wherein the mounting member is in cross-section of an angle-shaped profile.
19. A modular wall and floor combination constructed from a plurality of respective elongate roof and floor panels connected in a side to side relationship and each being of a generally channel shaped cross-section and including a web and a pair of opposing flanges, one end of each of the floor panels being mounted to a lower end of a corresponding one of the wall panels.

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20. A modular wall and floor combination as defined in claim 19 also comprising one or more floor mounts connected to an interior face of the modular wall and upon
5 which the web and/or a free edge portion of the flanges of the floor panels is fixed.

21. A modular wall and floor combination as defined in claim 20 wherein the floor mounts include one or more
10 members of an angle-shaped profile each disposed in a generally horizontal plane.

22. A modular wall and floor combination as defined in any one of claims 19 to 21 wherein the floor panels are
15 oriented so that the web faces upward.

23. A modular wall and floor combination as defined in any one of claims 19 to 22 also including wall or floor cladding fixed to an interior surface of the modular wall
20 or the webs of the modular floor, respectively.

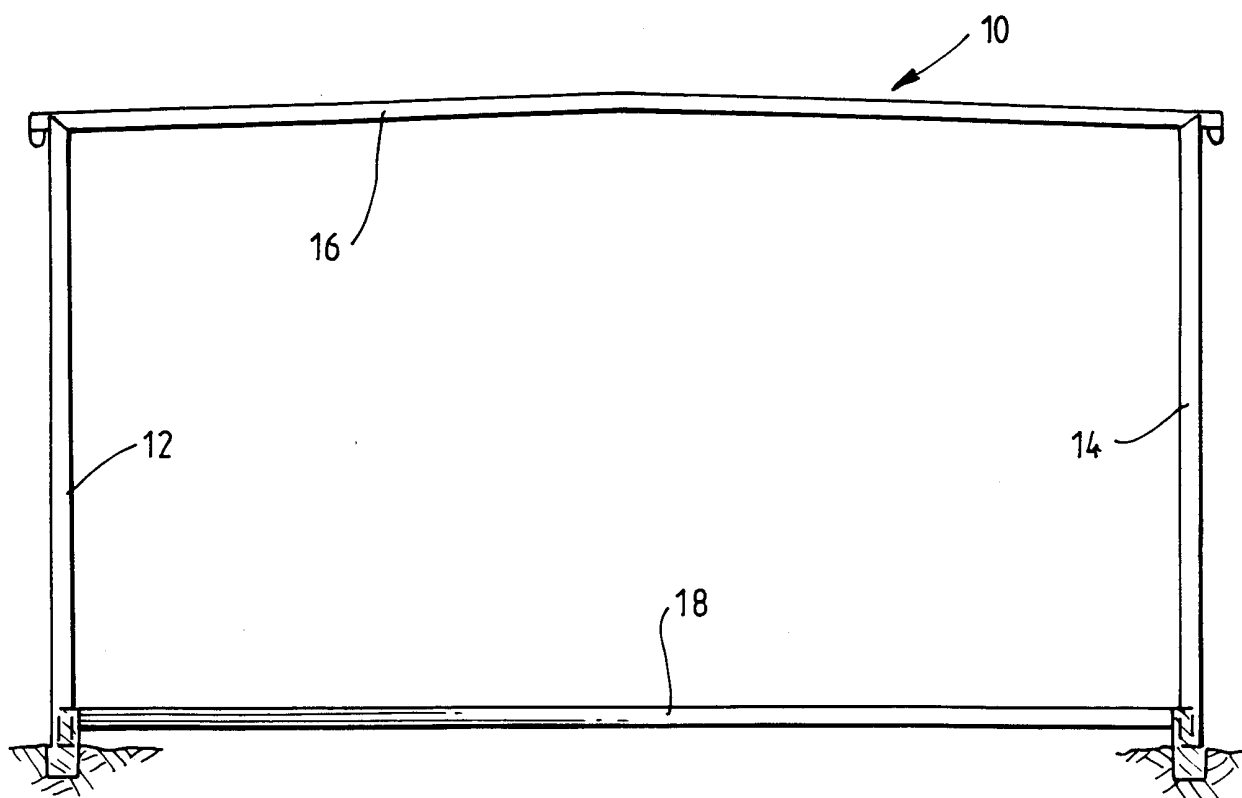


FIG. 1.

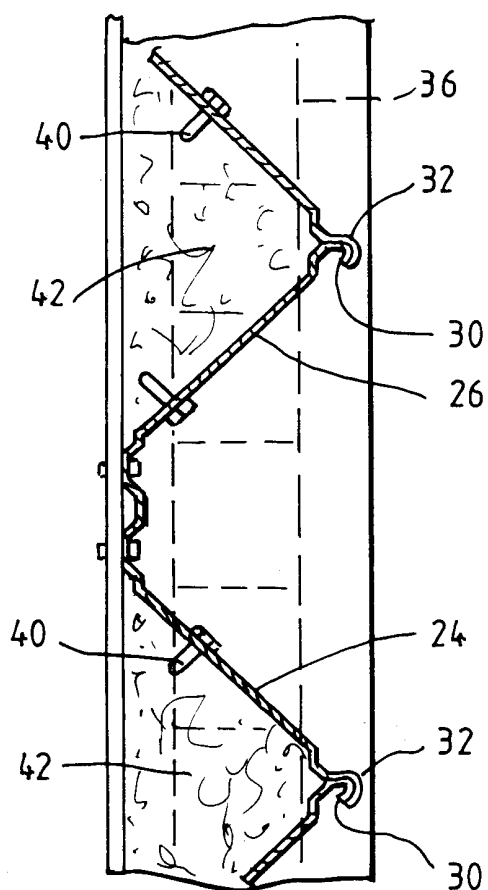
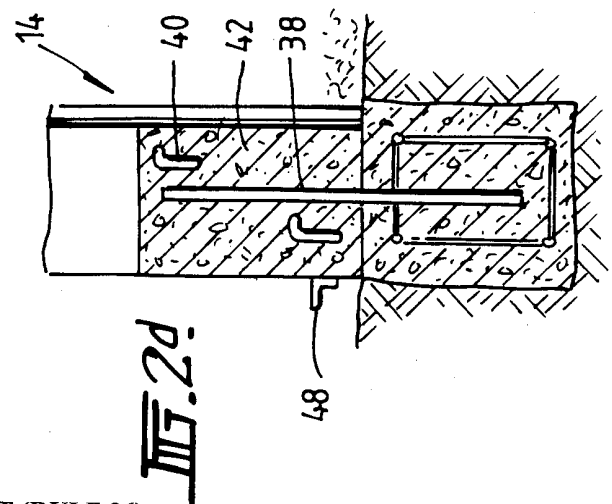
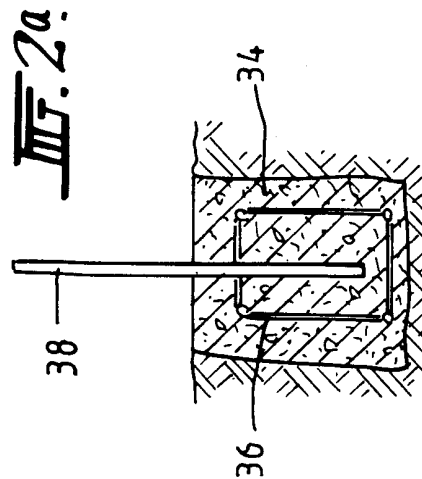
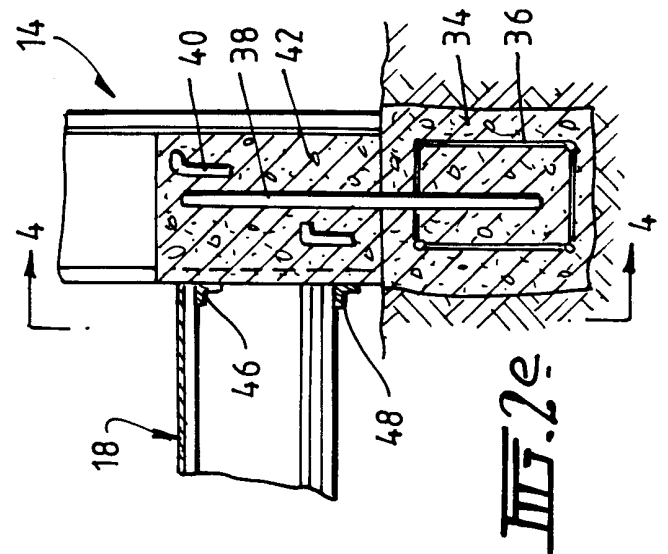
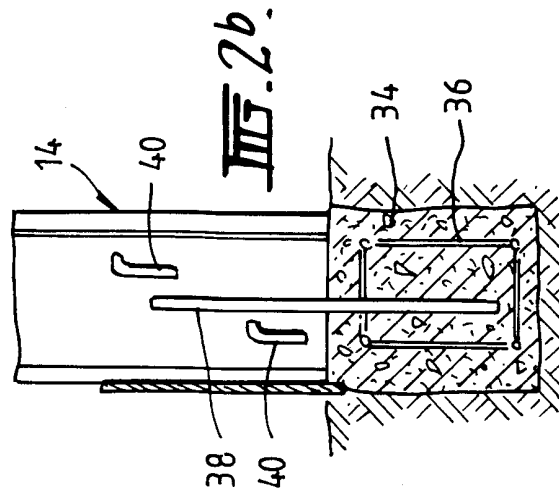
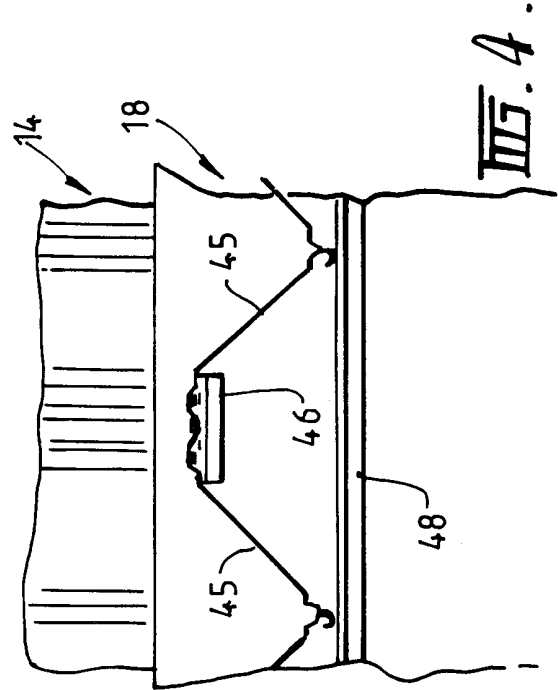
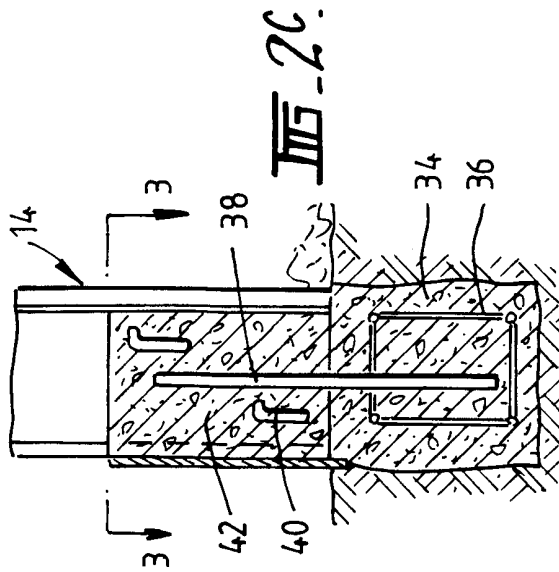
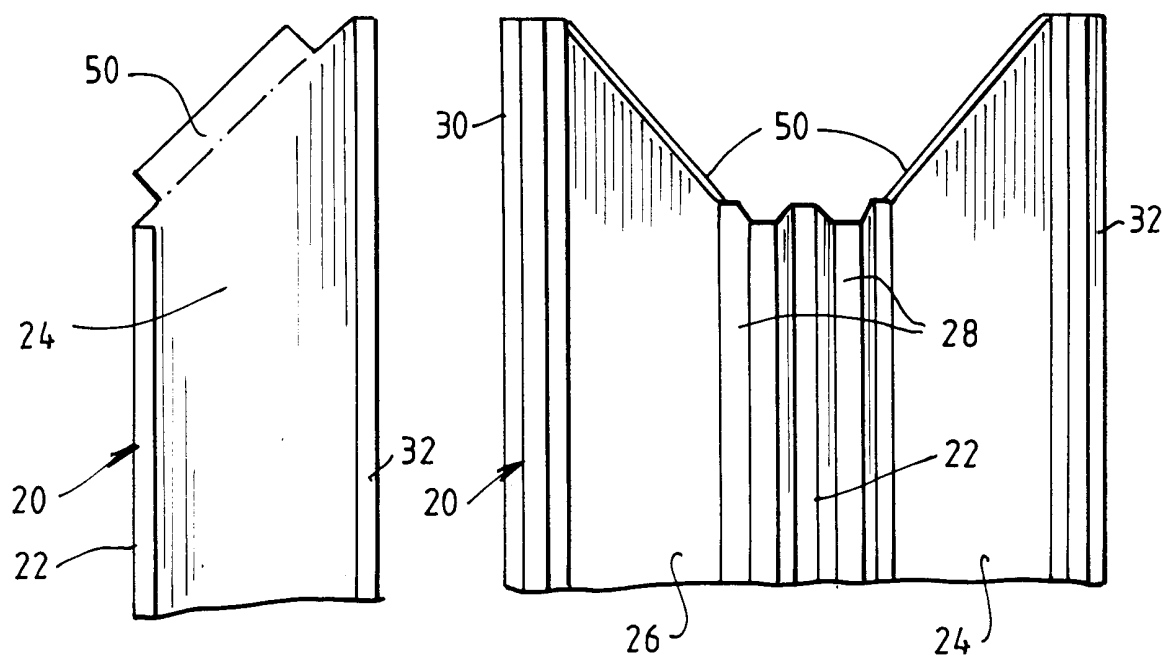
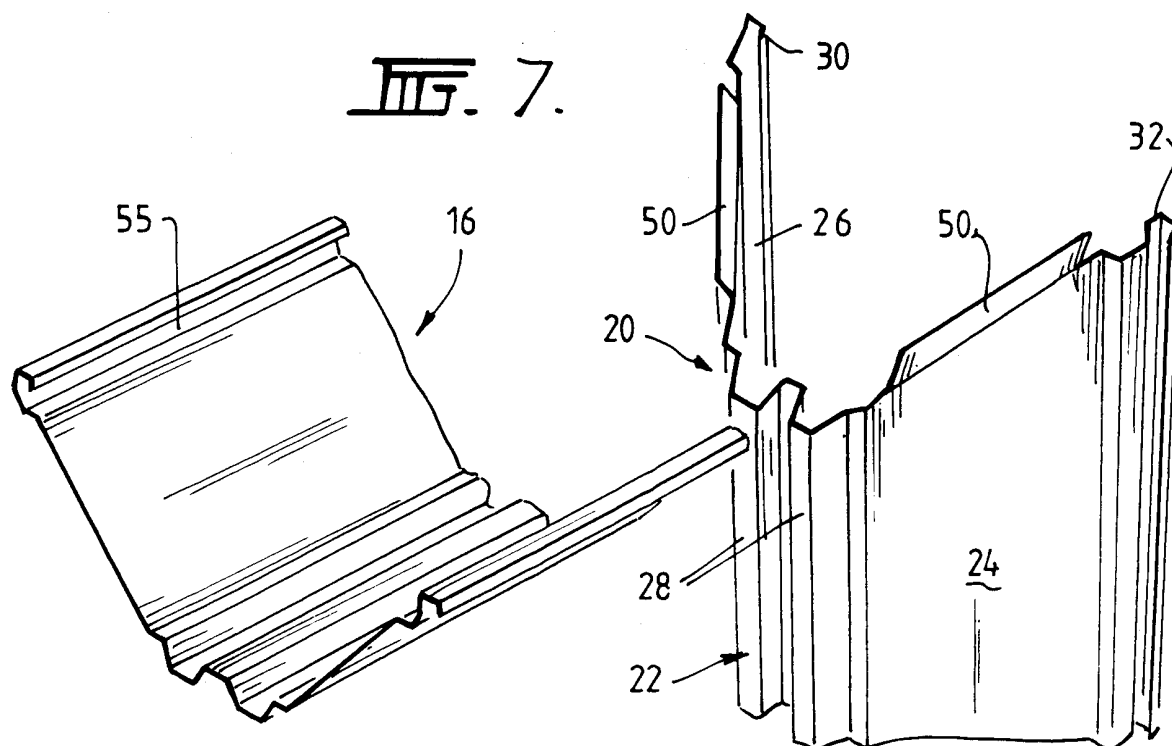
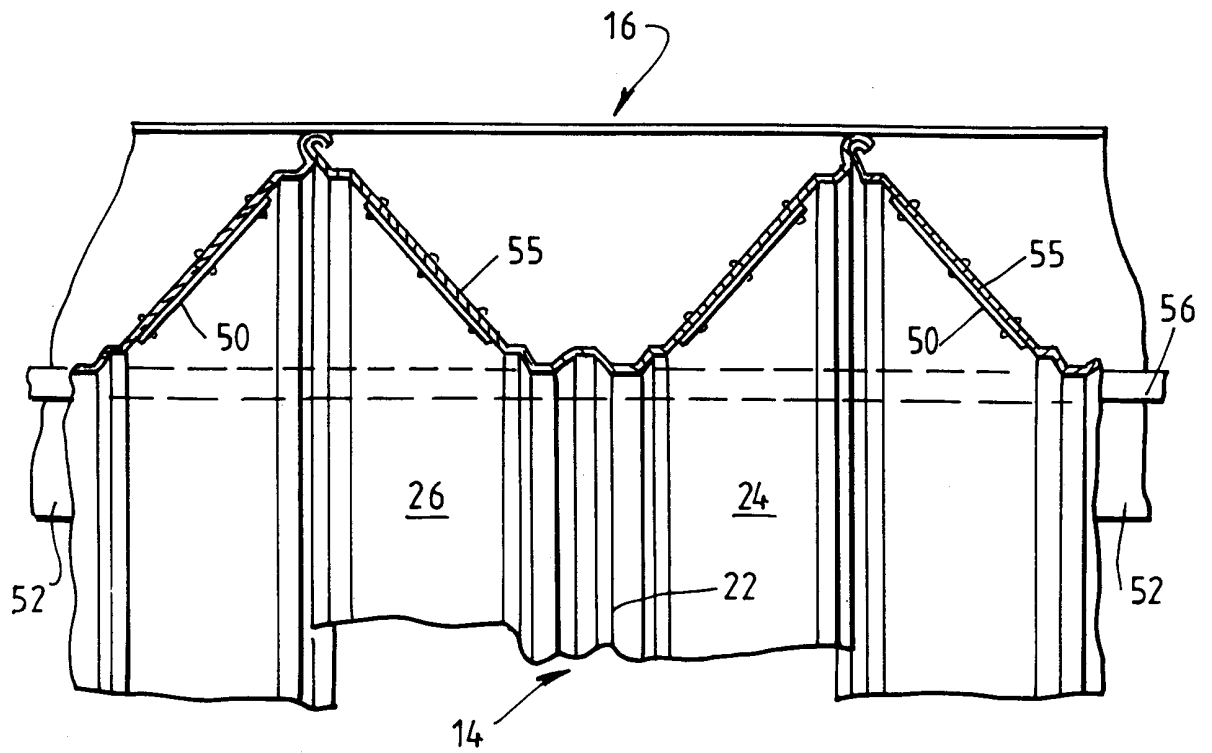
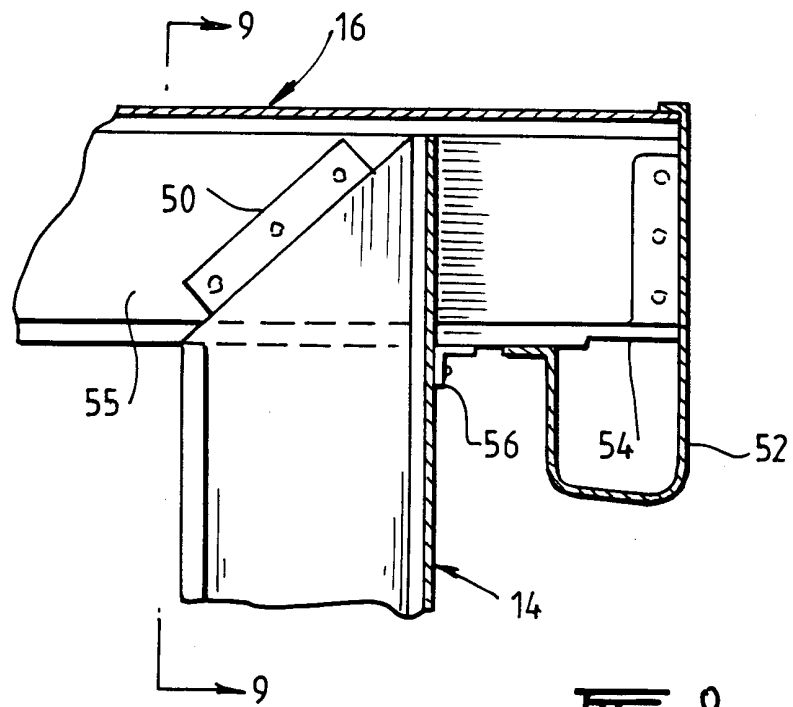


FIG. 3.



FIG. 5.FIG. 6.FIG. 7.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/01381

A. CLASSIFICATION OF SUBJECT MATTER																						
Int. Cl. ⁷ : E04B 1/18, 1/24																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols) E04B, E04C, E04D																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DWPI panel, sheet, board, deck, web, flange, corrugat:, channel, U, V, obtuse, undulat:																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X	WO 93/23629 A (MAUPIN) 25 November 1993 Whole document	1 to 23																				
X	US 3568388 A (FLACHBARTH et al) 9 March 1971 Whole document	1 to 11																				
X	AU 29442/84 (WILSON et al) 20 December 1984 Page 7, line 22 to Page 13, line 5 and figures	1 to 11																				
☐ Further documents are listed in the continuation of Box C ☒ See patent family annex																						
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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search 15 January 2001		Date of mailing of the international search report 16 January 2001																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer COLIN FITZGIBBON Telephone No : (02) 6283 2226																				

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU00/01381

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
WO	93/23629	WO	92/20336	AU	19082/92	EP	512865
		US	5256689	MX	9202156	US	5506262
US	3568388	NONE					
AU	29442/84	NONE					
							END OF ANNEX