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**Pre-Cast Panel and a Method of Constructing
A Wall Structure using Pre-Cast Panels**



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Field of the Invention

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This invention relates to a pre-cast panel for a wall structure, a method of constructing a wall structure using such pre-cast panels, and to walls constructed by that method.

Background to the Invention

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Certain categories of walls, particularly internal walls, are presently made of brick to provide noise and thermal insulation, and to also provide walls that have a solid feel. It has been proposed to construct such walls using pre-cast panels.

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However, pre-cast panels create additional complexities due to their inherent nature. One of these is that there is a certain amount of movement of walls. This movement may be due to any one or more of many known factors. As pre-cast panels are each, in effect, a separate "wall" they can move relative to each other. This causes cracking of the mortar and thus unsightly cracks can appear in the wall. An alternative is to produce a full-length pre-cast panel wall and install it in one operation. However, this means that such a wall becomes an item in the critical path of the construction process and thus will slow down the construction process and the overall erection of the building. Also, such a wall would be very heavy thus requiring high capacity cranes. This would increase the overall cost of construction of the building.

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Furthermore, they are normally solid and therefore have no ability to hide conduits containing electrical cables, telecommunication cables, air conditioning piping, water pipes, and so forth. Therefore, and for noise and thermal insulation, they are often made as a cavity wall structure with there is being two, parallel walls, each wall being made of pre-cast panels.

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This takes up more space, and can add to the weight and thus the floor load-factor. As the panels are all of the same size, the joins between them align and this can cause problems in the event of cracking taking place. Such cracks are also quite unsightly.

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With such hollow wall structures, in the event of there being a problem with a service within the wall cavity, it is very difficult for the tradesman attempting to resolve the problem to be able to locate the service. For example, a frayed telecommunications cable. Therefore, one face of the entire wall must often be removed to enable the cable to be located for repair or replacement. This is excessive work for a simple problem.

It is therefore the principal object of the present invention to provide a pre-cast panel that can be combined with other pre-cast panel to create a unitary wall structure of high strength and rigidity.

- 5 Another object of the present invention to provide a pre-cast panel that can be combined with other pre-cast panel to create a cavity wall of high strength and rigidity.

A further object of the present invention is to provide a pre-cast panel having embedded conduits with junction boxes able to be relatively easily located.

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Summary of the Invention

- With the above and other objects in mind the present invention provides a pre-cast panel for a wall structure, the pre-cast panel having a front face with at least one first void therein adjacent a first side edge and intermediate the height of the first side edge, there being a first passage from the first void to the first side edge to enable a first fastener to pass through the first passage from the first side edge and into the first void, the first fastener also being for passing through an adjacent second passage and into an adjacent second void of an adjacent pre-cast panel, so as to secure the pre-cast panel to the adjacent pre-cast panel.

- 20 The pre-cast panel may have a second side edge remote from the first side edge, the second side edge having a second void therein adjacent the second side edge, there being a second passage from the second void to the second side edge to enable a second fastener to pass through the second passage for the second side edge and into the second void, the second fastener also being for passing through an adjacent first passage and into an adjacent first void of a further adjacent pre-cast panel, so as to secure the pre-cast panel to the further adjacent pre-cast panel.

- All the voids may pass through the respective pre-cast panels, or may be a concave recess into the respective pre-cast panels that do not pass through the respective pre-cast panels.

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- Spaced along the first side edge there may be a plurality of spaced-apart first voids each having the first passage. At least one of the first passages may have a first vertical axis that is elongated to provide a tolerance in vertical alignment. Spaced along the second side edge there may be a plurality of spaced-apart second voids each having the second passage. At least one of the second passages may have a second vertical axis that is elongated to provide a tolerance in vertical alignment.

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The first side edge may be convex and the second side edge may be concave. The first and second fasteners may each comprise a bolt threaded at each end, and a nut and washer for use on each end.

- 5 The first void may extend for substantially the pre-cast panel's full height, and may have a first narrow neck adjacent a top edge or bottom edge of the pre-cast panel. Additionally, the second void may extend for substantially the pre-cast panel's full height, and may also have a second narrow neck adjacent the top or bottom edge of the pre-cast panel.
- 10 There may be a first rib extending for the full height of the pre-cast panel immediately adjacent the first side edge and extending laterally to the first void, and a second rib extending for the full height of the pre-cast panel immediately adjacent the second side edge and extending laterally to the second void. The first void and second void may form a centre rib between them, the centre rib extending for the full height of the pre-cast panel and
- 15 substantially centrally of the first side edge and the second side edge.

- There may be a lateral passage extending through the first rib, second rib and centre rib, the lateral passage being a concave recess into the respective ribs and having a depth substantially the same as that of the first and second voids. The second void may be a mirror
- 20 image of the first void.

- At least one of the first rib, the second rib, and the centre rib may have embedded therein and extending substantially perpendicularly outwardly therefrom, a plurality of fasteners to enable the pre-cast panel to be securely attached to a parallel pre-cast panel.
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- The first void, second void and lateral passage may be able to accommodate service cables and conduits, and the pre-cast panel may have a substantially planar rear face.

- Mounted within the pre-cast panel may be at least one vertical conduit and at least one
- 30 horizontal conduit, the at least one vertical conduit and the at least one horizontal conduit intersecting at least one junction box, there being at least one indicia on the front face to indicate a location of the at least one junction box. There may be a single vertical conduit located centrally of the pre-cast panel, and a plurality of horizontal conduits, there being a junction box for each intersection of the plurality of horizontal conduits with the at least one
- 35 vertical conduit, and there being an indicia for each junction box.

Each of the at least one horizontal conduits may pass through the first and second voids but do not extend outwardly beyond the first and second side edges, and the vertical conduit may not extend upwardly beyond the top edge.

In another form the present invention provides a pre-cast panel for a wall structure, the pre-cast panel having a substantially planar rear face, a substantially vertically extending first side edge and a substantially vertically extending second side edge; the pre-cast panel
 5 having a first rib extending for substantially the pre-cast panel's full height and being immediately adjacent the first side edge, and a second rib extending for substantially the pre-cast panel's full height and being immediately adjacent the second side edge; there being at least one void between the first rib and the second rib, the at least one void extending for the full height of the pre-cast panel, the void being in the form of a concave recess into the pre-cast panel but not extending through the pre-cast panel.
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A centre rib may be provided intermediate the first rib and the second rib and extending substantially parallel to them both, the centre rib dividing the void into a first void and a second void. The second void may be a mirror image of the first void.
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A lateral passage may be provided extending through the first rib, second rib and centre rib, the lateral passage being a concave recess into the respective ribs and having a depth substantially the same as that of the first and second voids.

20 At least one of the first rib, the second rib, and the centre rib may have embedded therein and extending substantially perpendicularly outwardly therefrom, a plurality of fasteners to enable the pre-cast panel to be securely attached to a parallel pre-cast panel.

The first void, second void and lateral passage may be able to accommodate service cables and conduits.
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In a further form, the present invention provides a pre-cast panel having a front face, there being mounted within the pre-cast panel at least one vertical conduit and at least one horizontal conduit, the at least one vertical conduit and the at least one horizontal conduit intersecting at least one junction box, there being at least one indicia on the front face to indicate a location of the at least one junction box.
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There may be a single vertical conduit located centrally of the pre-cast panel, and a plurality of horizontal conduits, there being a junction box for each intersection of the plurality of horizontal conduits with the vertical conduit, and there being indicia for each junction box.
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The pre-cast panel may have a plurality of voids in the front face adjacent first and second side edges each of the horizontal conduits pass through the voids but preferably does not extend outwardly beyond the first and second side edges.

The pre-cast panel has a top edge and the vertical conduit preferably does not extend upwardly beyond the top edge.

5 In all forms, the securing may be releasable.

The invention also provides a method of making a wall structure using a plurality of pre-cast panels as described above, the method including the steps of:

- (a) placing a first panel into position;
- 10 (b) inserting a first fastener into a first passage of a first side edge of the first panel until a first end of the first fastener enters a first void in the first panel;
- (c) placing a second panel into position adjacent the first panel;
- (d) moving the first fastener axially along the first passage until a second end of the first fastener enters a second passage of the second panel and passes
- 15 into a second void in the second panel;
- (e) securing the first fastener using a nut and a bolt in both of the first and second voids; and
- (f) filling the first and second voids with a filling material.

20 In a final form the present invention provides a method of constructing a cavity wall structure using pre-cast panels, the method including the steps of constructing a first face of the cavity wall using a plurality of first panels each having a plurality of vertically extending first voids and a plurality of vertically-extending, spaced-apart first ribs, there being a first join at the join of each of the first panels with an adjacent first panel, the plurality of first voids and first ribs

25 facing inwardly towards the intended wall cavity; and constructing a second face of the cavity wall using a plurality of second panels each having a plurality of vertically extending second voids and a plurality of vertically-extending, spaced-apart second ribs, there being a second join at the join of each of the second panels with an adjacent second panel, the plurality of second voids and second ribs facing inwardly towards the intended wall cavity; the second

30 voids aligning with the first voids to form the wall cavity, and the second ribs locating on and being secured to the first ribs such that the first joins are not aligned with the second joins and are offset from each other.

The offset of the first and second voids may be by half of a width of each of the first panels,

35 and the plurality of first and second panels may be as described above.

The present invention also extends to a wall constructed using these methods and the panels.

Description of the Drawings

In order that the invention may be readily understood and put into practical effect, there shall now be described by way of non-limitative example only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative drawings in which:

Figure 1 is a partially exploded isometric view of a wall constructed using a first embodiment of the present invention;

Figure 2 is an isometric view of two of the panels of the wall of Figure 1;

Figures 3 to 5 are partial cross-sectional views schematically illustrating the joining of the two panels of Figure 2;

Figure 6 is a front perspective view of a first pre-cast panel of a second embodiment of the present invention;

Figure 7 is a view similar to Figure 6 of a second version of the second embodiment;

Figure 8 is a front perspective view of a third pre-cast panel of the second embodiment;

Figure 9 is a front perspective view of a fourth pre-cast panel of the second embodiment;

Figure 10 is a front perspective view of a fifth pre-cast panel of the second embodiment;

Figure 11 is a front perspective view of a sixth pre-cast panel of the second embodiment;

Figure 12 is a front elevation of the panel of Figure 9 after installation;

Figure 13 is a front elevation in partial section of the panel of Figure 7 after installation;

Figure 14 is a cross-sectional view along the lines and in the direction of arrows A-A on Figure 12;

Figure 15 is a cross-sectional view along the lines and in the direction of arrows A-A on Figure 13;

Figure 16 is a horizontal cross-sectional view of a cavity wall constructed using the panels of Figures 6 to 11;

Figure 17 is a front isometric view of a panel according to a third embodiment of the present invention;

Figure 18 is a vertical cross-section along the lines and in the direction of arrows 2-2 on Figure 17;

Figure 19 is an isometric view of a plurality of panels of Figure 18 arranged side-by-side; and

Figure 20 is a detailed view of one part of the junction of two panels of Figure 19.

Description of Preferred Embodiment

To first refer to Figures 1 to 5, there is shown a wall 10 constructed using a number of like panels 12. The number and width of panels 12 used will depend on the length of the wall 10. The wall 10 extends between a floor 14 and a ceiling 16. A metal angle member 18 may be used as to secure the top of panels 12 during construction of wall 10.

Each panel 12 has a first side edge 20, a second side edge 22, a top edge 24, a bottom edge 26, front face 28 and rear face 30. One of the side edges 20, 22 may be convex, and the other concave. This may be in the form of a tongue 32 and groove 34, as illustrated.

- 5 Adjacent first side edge 20 is a number of first voids 36 in front face 28. Although there are two first voids 36 as shown there may be any whole number, depending on the nature of wall 10, panels 12, and their physical requirements. Preferably there are two or three voids 36. Voids 36 may be in the form of a concave recess into front face 28, or may pass completely through panel 12. Again this will depend on the requirements of wall 10 and panels 12. The
10 voids 36 should be of a sufficient size to be able to achieve the desired function, as will be understood from the following description, but preferably their size is kept to a minimum.

- Extending from first side edge 20 to each first void 36 is a first passage 38. First passages 38 are preferably central of the depth of first side edge 20, and are preferably round in cross
15 section. However, one or more of first passages 38 may be have an elongated vertical axis to allow for tolerance and correct alignment of panel 12 with an adjacent panel 40. For example, one of the first passages 38 may be elliptical or rectangular.

- Adjacent second side edge 22 is a number of second voids 42. Although there are two
20 second voids 42 as shown there may be any whole number, depending on the nature of wall 10, panels 12, and their physical requirements. The number, and horizontal alignment (height above bottom edge 26), of second voids 42 should be the same as the number of first voids 36, and their horizontal alignment (height above bottom edge 26). Preferably there are two or three second voids 42. Voids 42 may be in the form of a concave recess
25 into front face 28, or may pass completely through panel 12. Again this will depend on the requirements of wall 10 and panels 12. The voids 42 should be of a sufficient size to be able to achieve the desired function, as will be understood from the following description, but preferably their size is kept to a minimum.

- 30 Extending from second side edge 22 to each second void 42 is a second passage 44. Second passages 44 are preferably central of the depth of second side edge 22, and are preferably round in cross section. However, one or more of second passages 44 may be have an elongated vertical axis to allow for tolerance and correct alignment of panel 12 with an adjacent panel 46. For example, one of the second passages 44 may be elliptical or
35 rectangular. Second passages 44 should be horizontally aligned with first passages 38.

To construct wall 10, a panel 12 is placed into position. A fastener 48 is passed through each passage 38, 44 until it is completely through voids 36, 42. When in this position, the fasteners 48 may extend beyond edges 20, 22. Fasteners 48 may be bolts, preferably

double ended bolts – threaded at each end 50 and having no head. The length of fasteners 48 will depend on the panels 12, 40, 46; but their diameter is preferably only slightly smaller than the diameter of passages 38, 44.

- 5 Once fasteners 48 are in position, the adjacent panels 40, 46 can be moved into position and their passages 38, 44 aligned with fasteners 48. Once tongue 32 engages in groove 34, fasteners 48 are moved axially until a threaded end 50 is visible in each void 36, 42. Nuts 52 and washers 54 are then placed over ends 50 and loosely tightened. Panels 12, 40, 46 are then correctly aligned, and all nuts 52 tightened. Fasteners 48 can be used without extra
10 components such as, for example, sleeves or the like. A simple structure and methodology therefore results. Normal tools are all that is required.

- As is normal, bolts (not shown) are used to secure panels 12, 40, 46 at top edge 24. Jointing compounds may be used for vertical joints (edges 20, 22) and non-shrink grouts
15 may be used, in the normal manner. Voids 36, 42 may be filled with non-shrink grout when wall 10 is complete. Ends 50 of fasteners 48 may be provided with a cover that preferably extends to the nut 52 so as to protect the thread on the ends 50 from any filling material or other damage. The cover may be a tape, plastic cap, or the like.

- 20 In this way wall 10 becomes, in effect, a unitary wall with relative movement of panels 12, 40, 46 generally not being possible. This should reduce the incidence of cracks appearing, and may aid wall strength.

- 25 In Figures 6 to 16, like components have like reference numerals with a prefix number 2.

- Figures 6 to 11 show six different panels, indicated as 260, 262, 264, 268, 266 and 270 respectively. To consider Figures 10 and 11, and thus panels 266, 270, each panel 266, 270 has a first side edge 220, second side edge 222, top edge 224, bottom edge 226, front face
30 228 and rear face 230. A void 272 extends centrally of the panels 266, 270 and is generally centrally located in face 228. The void 272 extends for substantially the full height of panels 266, 270 but does not extend to top edge 224. Adjacent bottom edge 226, void 272 has a narrow neck 274. Void 272 forms parallel ribs 276, 278 with first rib 276 being immediately adjacent first side edge 220 and extending for the full height of panels 266, 270. Second rib
35 278 is immediately adjacent second side edge 222 and extends for the full height of panels 266, 270. A transverse passage 280 extends through ribs 276, 278 to enable service cables, conduits and pipes to pass therealong.

Void 272 is preferably a different depth into front face 228 to the depth of voids 36, 42 into front face 28. The difference may be that void 272 is of less depth. This may be due to different pre-cast panel thickness. Transverse passage 280 is preferably as deep as void 272. Bolt holes 282 are provided for purposes to be understood from the following description. On rear face 230 recesses 284 are provided that align with boltholes 282. Bolt holes 282 pass from front face 228 to recesses 284. As can be seen panels 266 and 270 are mirror images of each other.

Panel 268 of Figure 9 is similar to the panels 266, 270 but is of greater width. Thus, a centre rib 286 is provided, extending for the full height of panel 268. Transverse passage 280 passes through centre rib 286. Centre rib 286 divides void 272 into a first void 236 and a second void 242. Voids 236, 242 extend for the full height of panel 268. Again, bolt holes 282 and recesses 284 are provided.

Panel 268 of Figure 9 is, in effect, a centre panel and panels 266, 270 of Figures 10 and 11 are "end" panels, as will be understood from the following description. Preferably, panels 266, 270 are half the width of panel 268.

Panels 260, 262 and 264 of Figures 6 to 8 are somewhat similar to panel 268. Each has a first side edge 220, second side edge 222, top edge 224 bottom edge 226, front face 228, rear face 230, first rib 276, second rib 278, centre rib 286, first void 236, second void 242, and transverse passage 280. Here, voids 236, 242 extend for the full height of panels 260, 262 and 264 from bottom edge 226 to top edge 224. At top edge 224 is narrow neck 274, with voids 236, 242 being of full width adjacent bottom edge 226. Panel 264 of Figure 8 is a mirror image of panel 260 of Figure 6. Again panel 262 of Figure 7 is, in effect, a centre panel and panels 260, 264 of Figures 6 and 8, respectively, are end panels. This will be understood from the following description. Preferably, all panels 260, 262, 264 are of the same width.

Panel 262 has first passage 238 in first rib 276 for accommodating fasteners 248 in the manner as described in relation to Figures 1 to 5; and second passages 244 in second rib 278 also for accommodating fasteners 248 in the manner as described in relation to Figures 1 to 5. Therefore, one or more panels 262 can be constructed together to form a unitary wall.

End panel 260 has only second passages 244 in second rib 278 also for accommodating fasteners 248 in the manner as described in relation to Figures 1 to 5. First rib 276 has no first passages 238 as it is an end panel. Similarly end panel 264 has only first passages 238 in first rib 276 also for accommodating fasteners 248 in the manner described in relation to

Figures 1 to 5. Second rib 278 has no second passages 244 as it is an end panel. Panels 260, 264 can be combined with one or more panels 262 to form a unitary wall, as will be understood from the following description. Each panel 260, 262, 264 has a plurality of bolts 288 embedded therein and projecting perpendicularly outwardly from front face 228. Bolts 288 are aligned with and are for engagement through, bolt holes 282 in panels 266, 268 and 270.

To construct a hollow cavity wall 290, it is best to start at one end using, for example, a panel 260. Panel 260 is secured to ceiling 216 and secured in position. It may also be secured to floor 214 using metal rods 293 or the like. Preferably this is completed before another panel is placed in position. Panel 262 is then placed into position and loosely tightened to ceiling 216 using bolts 292. It is then secured to the panel 260 using fasteners 248 (in the manner described in relation to Figures 1 to 5) with fasteners 248 being sequentially tightened to ensure correct alignment and that it is correctly located. It is then secured to ceiling 216 by completing the tightening of bolts 292 (Figure 13). It is also secured to floor 214 using metal rods 293. Once bolts 292 at top edge 224 are tightened to achieve correct alignment with ceiling 216, fasteners 248 can be sequentially tightened so that panel 262 is correctly in place, as are its adjacent panels. Further panels 262 and end panel 264 are added to form one side of the cavity wall 290 (Figures 14 to 16). This creates a wall of unitary construction in a progressive manner, so that at any time during its erection, it is relatively rigid. For panels 260, 262 and 264, front face 228 should face inwardly towards the intended cavity. In this way the voids 236, 242 and the ribs 276, 278, 286 all face inwardly.

All mechanical and electrical services required to be in the wall cavity may then be placed in position in the voids 236, 242.

Upon all services being in place and all panels 260, 262 and 264 being securely in position to create one half of wall 290, panels 266, 268 and 270 are placed in position. Bolt holes 282 are aligned with bolts 288 and panels 266, 268 and 270 slid into position. By starting with a panel 260 or 264 from one end, and with panels 266, 270 each being half the width of panel 268 (panels 260, 262, 264 and 268 preferably all being of the same, uniform width), an offset securing arrangement results, as shown in Figure 16. In this way, first and second ribs 276, 278 of panels 268 are attached to centre rib 286 of panels 260, 262, 264 and thus join lines 292 between panels 260, 262, 264 do not align with join lines 294 of panels 266, 268, 270. This provides a higher likelihood of no cracks appearing in the completed wall.

Upon panels 266, 268, 270 being in position, washers and nuts (not shown) are placed over the ends of bolts 288 and sequentially tightened to form the completed cavity wall 290. The

nuts and washers locate in recesses 284, which can subsequently be filled in the same manner as voids 36, 42.

With panels 266, 268, 270 also having their front face 228 facing towards the intended cavity, voids 272, 236 and 242 align to create cavities 296 and aligned transverse passages 280 through which electrical and mechanical services can pass, in the usual manner.

As with the embodiment of Figures 1 to 5, jointing compounds may be used for all vertical joints and non-shrink grouts may be used in the normal manner. Recesses 284 may also be filled with non-shrink grout when wall 290 is complete. Voids 236, 242 will face inwardly towards cavities 296 so they will not require filling. Ends 250 of fasteners 248 and/or bolts 288 may be provided with a cover that preferably extends to the nut so as to protect the thread on the ends from any filling material or other damage. The cover may be a tape, plastic cap, or the like..

In Figures 17 to 20 a third embodiment is shown. Again, like components use like reference numerals with the addition of a prefix number 3.

One panel 312 is shown in Figure 17. This panel 312 is the same as panel 12 of Figures 1 to 5. In addition, panel 312 has embedded therein at least one horizontal conduit 356. In this instance three conduits 356 are shown. The number may be any whole number multiple of 1 although strength requirements may limit the possible number of conduits 356. Conduits 356 are preferably located at standard height for electrical and telecommunications connections. For example, a lowest conduit 356(a) may be located in the range 300 to 400mm above the floor as this is a relatively standard height for television signal connections, electrical power outlets, telephone and computer connections, and so forth. An intermediate conduit 356(b) may be in the range 1.0 to 1.3m above the floor as this is a relatively standard height for such things as electric light switches, telephone and computer connections electric power outlets above benches and desks, air conditioning controls, and the like. A third conduit 356(c) may be 2.0 to 2.2m above the floor as this is a relatively standard height for such devices as wall-mounted electric lights, air conditioning outlets, and so forth.

There may be at least one vertical conduit 358 (Figure 18). Although only one is shown, two, three or four may be provided. Where vertical conduit 358 intersects a horizontal conduit 356, a junction box 398 is provided. On or in front face 328 are permanent indicia 300 and which are substantially aligned with the centre of each junction box 398. The indicia may be, for example, an indent, a mark, an embedded metal or magnetic device easily detected through paint by a magnetic locator, or otherwise as desired. In this way if repairs to a cable

are required, an extra device (e.g. switch) installed, or if additional cables are to be installed, the worker can easily locate the required junction box 398 by the indicia 300. The worker can then make a relatively small hole in front face 328, remove the cover of the relevant junction box 398, locate the cable, and proceed. Upon completing the required task, the
5 cover of the junction box 398 is replaced, the hole in face 328 filled, and indicia 300 replaced or recreated.

Panel 312 can be in the form of any one or more of panels 12, 40, 46, 260, 262, 264, 266, 268 and 270. It may be used in the manner described in relation to Figures 1 to 5 and/or
10 Figures 6 to 16.

When constructing a wall 310 using panels 312, horizontal conduits 356 of adjacent panels may be joined using a connector sleeve 302 that engages in a recess 301 around each end of horizontal conduit 356 (Figure 20). It is preferred for conduits 356 to not extend beyond
15 side edges 320, 322; and for conduits 358 to not extend above top edge 324. Also, it is preferable for conduits 356 to pass through voids 336, 342 to assist workers. Conduits 356, 358 and junction boxes 398 may be of any suitable form to perform their required function. They may be for electrical and/or telecommunications cables as shown, water, refrigerant for air-conditioning, or otherwise as required.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology that many variations or modifications in details of design or construction may be made without departing from the present invention.

For example, the pre-cast panels shown are all planar/rectangular – They may be of any suitable shape such as, for example, "L" or "T" shape, "U" or "V" shape, and so forth. A panel may also be of reduced height to allow for a door opening or window beneath and/or
above the panel.

The present invention also extends to all features disclosed both individually and in all possible combinations and permutations. For example, an indicia such as indicia 300 may be place in or on any filling of voids 36, 42, and recesses 284, so as to make them more easily located by a workman. By way of example, such an indicia could be a magnet or
35 other magnetic material inserted into any cover placed over ends 50, as is described above. Also, a structure according to Figures 1 to 5 may be combined with the cavity wall of Figures 6 to 16. This may require the panel 12 to have voids 36, 42 on both front face 28 and rear face 30.

The Claims

1. A pre-cast panel for a wall structure, the pre-cast panel having a front face with at least one first void therein adjacent a first side edge intermediate the height of the first side edge, there being a first passage from the first void to the first side edge to enable a first fastener to pass through the first passage from the first side edge and into the first void, the first fastener also being for passing through an adjacent second passage and into an adjacent second void of an adjacent pre-cast panel, so as to secure the pre-cast panel to the adjacent pre-cast panel.
2. A pre-cast panel as claimed in claim 1, wherein the pre-cast panel has a second side edge remote from the first side edge, the second side edge having a second void therein adjacent the second side edge, there being a second passage from the second void to the second side edge to enable a second fastener to pass through the second passage for the second side edge and into the second void, the second fastener also being for passing through an adjacent first passage and into an adjacent first void of a further adjacent pre-cast panel, so as to secure the pre-cast panel to the further adjacent pre-cast panel.
3. A pre-cast panel as claimed in claim 1 or claim 2, wherein all the voids pass through the respective pre-cast panels.
4. A pre-cast panel as claimed in claim 1 or claim 2, wherein all the voids are a concave recess into the front face of respective pre-cast panels and do not pass through the respective pre-cast panels.
5. A pre-cast panel as claimed in any one of claims 1 to 4, wherein spaced along the first side edge there are a plurality of spaced-apart first voids each having the first passage.
6. A pre-cast panel as claimed in claim 5, wherein at least one of the first passages has a first vertical axis that is elongated to provide a tolerance in vertical alignment.
7. A pre-cast panel as claimed in any one of claims 2 to 5, wherein spaced along the second side edge there are a plurality of spaced-apart second voids each having the second passage, there being the same number of second voids as first voids and the second voids and first voids being horizontally aligned.

8. A pre-cast panel as claimed in claim 7, wherein at least one of the second passages has a second vertical axis that is elongated to provide a tolerance in vertical alignment, there being the same number of second passages as first passages, the first passages and second passages being horizontally aligned.
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9. A pre-cast panel as claimed in any one of claims 2 to 8, wherein the first side edge is convex and the second side edge is concave.
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10. A pre-cast panel as claimed in any one of claims 2 to 9, wherein the first and second fasteners each comprise a bolt threaded at each end, and a nut and washer for use on each threaded end.
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11. A pre-cast panel as claimed in any one of claims 4 to 10, wherein the first void extends for substantially the pre-cast panel's full height.
12. A pre-cast panel as claimed in claim 11, wherein the first void has a first narrow neck adjacent a top or bottom edge of the pre-cast panel.
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13. A pre-cast panel as claimed in claim 4 when appended to claim 2, or claim 11 or claim 12, wherein the second void extends for substantially the pre-cast panel's full height.
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14. A pre-cast panel as claimed in claim 13, wherein the second void has a second narrow neck adjacent the top or bottom edge of the pre-cast panel.
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15. A pre-cast panel as claimed in claim 11, claim 12, or claim 13, when appended to claim 11 or claim 12, wherein there is a first rib extending for the full height of the pre-cast panel immediately adjacent the first side edge and extending laterally to the first void.
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16. A pre-cast panel as claimed in claim 13 or claim 15 when appended to claim 13, wherein there is a second rib extending for the full height of the pre-cast panel immediately adjacent the second side edge and extending laterally to the second void.
17. A pre-cast panel as claimed in any one of claims 13 to 16, wherein the first void and second void thereby form a centre rib between them, the centre rib extending for the full height of the pre-cast panel and being substantially centrally of the first side edge and the second side edge.

18. A pre-cast panel as claimed in claims 17 when appended to claim 16, wherein there is a lateral passage extending through the first rib, second rib and centre rib, the lateral passage being a concave recess into the respective ribs and having a depth substantially the same as that of the first and second voids.
19. A pre-cast panel as claimed in any one of claims 13 to 18 when appended to claim 11 or claim 12, wherein the second void is a mirror image of the first void.
20. A pre-cast panel as claimed in claim 18, wherein at least one of the first rib, the second rib, and the centre rib have embedded therein and extending substantially perpendicularly outwardly therefrom, a plurality of bolts to enable the pre-cast panel to be securely attached to a parallel pre-cast panel, the parallel pre-cast panel having a plurality of bolt holes for receiving therein the plurality of bolts.
21. A pre-cast panel as claimed in any one of claims 18 to 20, wherein the first void, second void and lateral passage are able to accommodate service cables and conduits.
22. A pre-cast panel as claimed in claim 20 or claim 21, wherein the pre-cast panel has a substantially planar rear face, there being concave recesses into the rear face at a location of each of the bolt holes.
23. A pre-cast panel as claimed in any one of claims 1 to 10, wherein there is mounted within the pre-cast panel at least one vertical conduit and at least one horizontal conduit, the at least one vertical conduit and the at least one horizontal conduit intersecting at least one junction box, there being at least one indicia on the front face to indicate a location of the at least one junction box.
24. A pre-cast panel as claimed in claim 23, wherein there is a single vertical conduit located centrally of the pre-cast panel.
25. A pre-cast panel as claimed in claim 23 or claim 24, wherein there are a plurality of horizontal conduits, there being a junction box for each intersection of the plurality of horizontal conduits with the at least one vertical conduit, and there being an indicia for each junction box.

26. A pre-cast panel as claimed in any one of claims 23 to 25, wherein each of the at least one horizontal conduits pass through the first and second voids and do not extend outwardly beyond the first and second side edges.
- 5 27. A pre-cast panel as claimed in anyone of claims 23 to 26, wherein the at least one vertical conduit does not extend upwardly beyond the top edge.
28. A pre-cast panel for a wall structure, the pre-cast panel having a substantially planar rear face, a substantially vertically extending first side edge and a substantially vertically extending second side edge; the pre-cast panel having a front face with a first rib extending for substantially the pre-cast panel's full height and being immediately adjacent the first side edge, and a second rib extending for substantially the pre-cast panel's full height and being immediately adjacent the second side edge; there being at least one void in the front face between the first rib and the second rib, the at least one void extending for substantially the full height of the pre-cast panel, the void being in the form of a concave recess into the front face but not extending through the pre-cast panel.
- 10 29. A pre-cast panel as claimed in claim 28, wherein there is a centre rib intermediate the first rib and the second rib and extending substantially parallel to them both, the centre rib dividing the void into a first void and a second void.
- 20 30. A pre-cast panel as claimed in claim 29, wherein there is a lateral passage extending through the first rib, second rib and centre rib, the lateral passage being a concave recess into the respective ribs and having a depth substantially the same as that of the first and second voids.
- 25 31. A pre-cast panel as claimed in claim 29, wherein the second void is a mirror image of the first void.
- 30 32. A pre-cast panel as claimed in any one of claims 29 to 31, wherein at least one of the first rib, the second rib, and the centre rib have embedded therein and extending substantially perpendicularly outwardly therefrom, a plurality of bolts to enable the pre-cast panel to be securely attached to a parallel pre-cast panel, the parallel pre-cast panel having a plurality of bolt holes for receiving therein the plurality of bolts.
- 35 33. A pre-cast panel as claimed in claim 32, wherein the pre-cast panel has a substantially planar rear face, there being concave recesses into the rear face at a location of each of the bolt holes.

34. A pre-cast panel as claimed in any one of claims 30 to 33, wherein the first void, second void and lateral passage are able to accommodate service cables and conduits.
- 5
35. A pre-cast panel having a front face with a first side edge and a second side edge remote from the first side edge, wherein there is mounted within the pre-cast panel at least one vertical conduit and at least one horizontal conduit, the at least one vertical conduit and the at least one horizontal conduit intersecting at least one junction box, there being at least one indicia on the front face to indicate a location of the at least one junction box.
- 10
36. A pre-cast panel as claimed in claim 35, wherein there is a single vertical conduit located centrally of the pre-cast panel.
- 15
37. A pre-cast panel as claimed in claim 35 or claim 36, wherein there are a plurality of horizontal conduits, there being a junction box for each intersection of the plurality of horizontal conduits with the at least one vertical conduit, and there being an indicia for each junction box.
- 20
38. A pre-cast panel as claimed in any one of claims 35 to 37, wherein the front face has a plurality of voids adjacent each of the first and second side edges, each of the at least one horizontal conduits passing through the first and second voids and does not extend outwardly beyond the first and second side edges.
- 25
39. A pre-cast panel as claimed in anyone of claims 35 to 38, wherein pre-cast panel has a top edge, the at least one vertical conduit not extending upwardly beyond the top edge.
- 30
40. A pre-cast panel as claimed in any one of claims 2 to 39, wherein the securing is releasable.
41. A method of constructing a cavity wall structure using pre-cast panels, the method including the steps of:
- 35
- (a) constructing a first face of the cavity wall using a plurality of first panels each having a plurality of vertically extending first voids and a plurality of vertically-extending, spaced-apart first ribs, there being a first join at the join of each of the first panels with an adjacent first panel, the plurality of

first voids and first ribs facing inwardly towards the intended wall cavity;
and

5 (b) constructing a second face of the cavity wall using a plurality of second panels each having a plurality of vertically extending second voids and a plurality of vertically-extending, spaced-apart second ribs, there being a second join at the join of each of the second panels with an adjacent second panel, the plurality of second voids and second ribs facing inwardly towards the intended wall cavity;

10 (c) the second voids aligning with the first voids to form the wall cavity, and the second ribs locating on and being secured to the first ribs such that the first joins are not aligned with the second joins and are offset from each other.

15 42. A method as claimed in claim 41, wherein the offset of the first and second voids is by half of a width of each of the first panels.

43. A method as claimed in claim 41 or claim 42, wherein the plurality of first and second panels is as claimed in any one of claims 1 to 40

20 44. A method of making a wall structure using a plurality of pre-cast panels as claimed in any one of claims 1 to 40, the method including the steps of:

(g) placing a first panel into position;
(h) inserting a first fastener into a first passage of a first side edge of the first panel until a first end of the first fastener enters a first void in the first panel;
25 (i) placing a second panel into position adjacent the first panel;
(j) moving the first fastener axially along the first passage until a second end of the first fastener enters a second passage of the second panel and passes into a second void in the second panel,
(k) securing the first fastener using a nut and a bolt in both of the first and
30 second voids; and
(l) filling the first and second voids with a filling material.

35 45. A wall when made by the method of any one of claims 41 to 45.

46. A wall made using a plurality of panels as claimed in any one of claims 1 to 40.