A pre-cast concrete building panel, adapted for use in even a load-bearing wall without additional framing, comprising a continuous peripheral metal channel frame, a concrete mass poured in situ in the frame, with the frame serving as the form, a slab of insulation embedded in the concrete but spaced at its edges from the metal frame, relatively heavy upper and lower shear bars welded to the frame and extending across the panel through the upper and lower edge portions of the concrete, and a lighter wire fabric reinforcement embedded in at least one face of the concrete mass. A plurality of short cantilever re-bars, welded to and projecting inwardly of the vertical sides of the frame, reinforce the vertical edges of the concrete mass.

11 Claims, 10 Drawing Figures
PRE-CAST CONCRETE BUILDING PANELS

BACKGROUND OF THE INVENTION

Concrete panels are in increasing use for building walls. One known technique provides for pouring of the individual panels on a suitable bed; after curing, the panels are hoisted into vertical alignment and secured to each other to form a wall. Ordinarily, concrete, steel, or other columns are used between the panels to support part or all of the roof of the building or other parts of the building above the wall. This kind of construction is described in Sackett U.S. Pat. No. 3,394,523. In some instances, the panels are joined with concrete columns or pilasters to afford a monolithic structure, which may be subject to cracking or other damage due to thermal expansion and other environmental factors.

In the fabrication of most concrete panel structures, the concrete is cast separately from the framing or other support members, as in the Sackett patent and in McCown U.S. Pat. No. 3,228,161. This entails substantial labor in the construction of forms prior to casting of the concrete and in the subsequent stripping of the forms from the concrete panels after they have been cast and cured. In a few instances, provision has been made for using a part of the composite panel structure as a form for the concrete; see Hunsbrugh U.S. Pat. No. 1,031,926. But these panel structures have ordinarily required external mounting hardware for securing the panels to supporting columns or related structures.

The use of pre-cast panels has presented a continuing difficulty due to the relative ease with which the panels are damaged, particularly around the panel edges and at any decorative face. Thus, substantial care and expense are frequently necessary in protecting the panels, especially when the panels are cast at a location remote from the building site.

The concrete panels of the known art that have used metal framing along the vertical edges of the panels, including White et al. U.S. Pat. No. 2,907,148, Cochrane U.S. Pat. No. 2,664,740 and the French Brevet D'Invention No. 1,171,513, have usually employed flat-faced angle or channel frame members. Such frames present considerable difficulty in achieving a weather-tight seal between panels, since it is virtually impossible to assure truly flat, square surfaces throughout the lengths of the frame members. Moreover, frame members of this configuration are difficult to seal by caulking, gaskets, or like means; the sealing means tends to fall away from the frame surface after only a brief exposure to the elements.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a new and improved insulated pre-cast concrete building panel that effectively and inherently reduces the possibility of inadvertent damage to the panel when transported from one location to another.

Another important object of the invention is to provide a new and improved pre-cast concrete building panel that requires no separate form and that entails no stripping of the panel from a form after the panel has been cast and cured.

Another object of the invention is to provide a new and improved basic pre-cast concrete building panel structure that effectively and inherently provides for the use of a wide variety of surface finishes on panels that may be fabricated in advance of need.

An additional object of the invention is to provide a new and improved pre-cast concrete building panel that affords a strong bearing wall suitable for use in either single or multi-story construction without the necessity of employing separate framing and with little or no external hardware required for mounting a plurality of the panels in place in a load bearing wall.

A specific object of the invention is to provide a new and improved metal-framed pre-cast concrete building panel structure that protects both the panel edges and a decorative panel surface, and that also affords a firm base for seating a gasket or caulkling along the joint between adjacent panels.

Accordingly, the invention relates to a pre-cast concrete building panel adapted for use in an external load bearing wall consisting essentially of a plurality of such panels assembled in edge-to-edge relation and joined together to afford a continuous wall structure. A panel constructed in accordance with the invention comprises a continuous peripheral metal channel outer frame encompassing all sides of the panel and the marginal edges of both the front and rear surface of the panel, the channel being of generally C-shaped cross-sectional configuration. A concrete mass, poured in situ in the outer frame with the outer frame affording a peripheral form for the concrete mass, fills the frame.

A layer of insulation material is embedded in and fills the central portion of the concrete mass, the insulation terminating short of the steel outer frame so that a part of the concrete mass affords a complete peripheral inner frame interposed between the edges of the insulation and the outer frame. Upper and lower shear bars of relatively heavy steel are included in the panel; the shear bars are joined to the sides of the metal frame and extended across the upper and lower edges, respectively, of the panel, within the aforesaid concrete inner frame. A wide fabric reinforcement, formed of much lighter elements than the shear bars, is embedded in one face of the concrete mass between the insulation and the external surface of the panel. A plurality of short reinforcing bars are joined to and project horizontally inwardly of the vertical sides of the metal frame, into the vertical portions of the concrete inner frame, at spaced intervals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a rear elevation view of a pre-cast concrete building panel constructed in accordance with the present invention, together with the edge portion of an adjacent panel joined thereto in a wall structure;

FIG. 2 is a sectional elevation view, drawn to an enlarged scale, taken approximately along line 2—2 in FIG. 1;

FIG. 3 is a transverse sectional view taken approximately as indicated by line 3—3 in FIG. 1;

FIG. 4 is a detail view of a part of the panel structure;

FIG. 5 is a detail view of one corner of the metal outer frame for the panel;

FIG. 6 is an elevation view showing a plurality of panels assembled in a wall structure and employed to illustrate the variety of decorative effects readily achievable with panels constructed in accordance with the invention; and
FIGS. 7, 8, 9 and 10 are transverse sectional views, similar to FIG. 3, showing the joint between adjacent panels, with different frame configurations.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1-5 illustrate a pre-cast concrete building panel 10 constructed in accordance with one embodiment of the present invention. Panel 10 comprises a continuous peripheral steel channel outer frame 11 including upper and lower channel members 12 and 13 and side channel members 14. As shown in the drawings, the steel channel outer frame 11 encompasses all four sides of the panel 10, including the marginal edges of both the front and rear surfaces 15 and 16 of the panel. The channel that forms the outer frame 11 is of generally C-shaped cross-sectional configuration as clearly shown in FIGS. 2, 3 and 5. It is welded together at the corners (see FIG. 5) to afford a continuous peripheral shell encompassing all edges of the completed panel structure. Typically, the thickness T of the channel (FIG. 2) is four inches, though wider channels can be used. The flange height F should be 1½ inches or more.

Panel 10 further comprises a concrete mass 17 that is poured in situ in the outer frame 11 with the outer frame affording a peripheral form for the concrete mass. Thus, in fabricating panel 10, frame 11 is clamped or otherwise secured to a horizontal surface, closing off the rear area of the frame corresponding to surface 16. The concrete that is to form mass 17 is then poured into the frame, the edge portions of the concrete mass being confined by the form. Usually, the filling of the concrete mass into the metal outer frame is limited to a level approximately even with or lower than the inner edges 18 of the channel members adjacent which is to be the front surface 15 of the panel so that the main body of the concrete mass terminates approximately along the line 19 (FIGS. 2 and 3).

In addition to the concrete mass 17, a number of other structural elements are permanently mounted within metal frame 11. Near the top edge of the metal frame, a pair of relatively heavy steel upper shear bars 21 and 22 (FIGS. 1, 2) are mounted to the frame, the ends of these bars being welded to the side walls of the frame. At the bottom of the steel frame, two lower steel shear bars 23 and 24 are similarly welded to the metal frame, extending across the lower edge of the panel within the confines of the steel frame. It is not always essential that two shear bars be provided both at the top and bottom of the panel; frequently, a single shear bar can be employed at the top or at the bottom of the panel. In a typical construction, shear bars 21-24 may constitute standard No. 4 reinforcing bars, having a nominal diameter of one-half inch.

A wire fabric reinforcement 26 for the concrete mass 17 is also mounted in frame 11. In panel 10, only one wire fabric reinforcement is employed, and this reinforcement is located near the surface of the frame that is to define the limits of the rear panel surface 16. If desired, a second wire fabric reinforcement can be incorporated in the panel, adjacent the front surface 15. The wire reinforcement is much lighter than the shear bars; by way of example, reinforcement 26 may comprise standard 6x6-6/6 square welded wire fabric.

A layer of insulation material 27 is embedded in and fills the central portion of the concrete mass 17. The insulation 27 preferably constitutes a single slab of foamed polystyrene or other relatively rigid foamed resin, through other insulation materials (e.g., glass fiber) may be employed. The edges of this insulation 27 do not extend out to the steel outer frame 11. Rather, the insulation terminates short of the outer frame (see FIGS. 2, 3) so that a part of the concrete mass 17, after the concrete mass has been poured and cured, affords a complete peripheral inner frame interpose between the edges of the insulation 27 and the steel outer frame 11. In a typical four inch thick panel, insulation 27 may have a thickness of one inch, with about 1¼ inches of concrete on each surface. Around the edges, the spacing of the insulation from the metal frame is preferably of the order of 6 inches.

Within frame 11, a plurality of short steel reinforcing bars 29 are welded to the side frame members 14 and 15. Each of the reinforcing bars 29 projects horizontally inwardly from the steel outer frame toward the central insulation 27. Preferably, the ends of bars 29 are bent to afford a generally L-shaped configuration, the resulting vertically extending end portions of these bars affording a guide for alignment of insulation 27 in the central portion of the pre-cast panel. A tight fit between bars 29 and insulation 27 can be utilized to hold the insulation in accurate alignment at the center of the panel during fabrication. Bars 29 afford substantial strengthening of the panel along its vertical edges, an important factor in maintaining structural integrity of the panel. By way of example, bars 29 may be formed from standard No. 4 stock.

At the top center of panel 10, a steel retainer 31 spans shear bars 21 and 22, being welded to the two upper shear bars (FIGS. 2, 4). Retainer 31 has a threaded central opening 32 that is aligned with a central opening 33 in the upper steel frame member, channel 12. A large eye bolt or other lift member 34 extends through opening 33 in channel 12 and is threaded into opening 32 in retainer 31. For added reinforcement at the top central location of the panel, one or more additional steel reinforcement members 35 are preferably welded to retainer 31. In the illustrated construction, bars 35 extend downwardly into the concrete mass 17 and project laterally for a substantial distance, serving to distribute stresses through the upper portion of concrete mass 17 during erection of panel 10 as described hereinafter.

The outer surface 15 of panel 10 is filled with a relatively thin layer 37 of a decorative material. The decorative layer 37 may comprise a layer of concrete made with a decorative aggregate and subsequently treated to afford an exposed-aggregate finish. On the other hand, the decorative layer 73 may comprise simply an additional layer of concrete that has been scored, sculptured or otherwise modified to afford a desired surface appearance. The thickness of layer 37 is subject to considerable variation depending upon the desired appearance; moreover, it need not be uniform throughout the panel area.

In the manufacture of panel 10, the complete metal frame 11 is assembled by welding appropriate lengths of steel channel to each other. Usually, the panel is of rectangular configuration and the corners are formed as shown in FIG. 5. The height H and width W of the panel are selected to conform with general building requirements. The width may vary from 2 feet to 6 feet, or even wider in some instances. The height H may be
as low as 8 feet, of may exceed 14 feet, depending upon the height of the building (or building story) in which the panel is to be used. With the steel frame 11 assembled, the shear bars 21-24 and the reinforcement bars 29 are welded to the frame. The wire fabric 26 is welded to the frame, or to the shear bars. A compressible gasket 41 (FIGS. 1, 2) may be mounted on the outer surface of the channel member 13 forming the bottom of the metal frame for mounting purposes as described hereinafter.

It should be noted that the metal structure of the panel is completed prior to pouring of the concrete and that the entire frame and reinforcement structure is welded together as a unit. The external welds, particularly at the corners of the frame, should be ground off to permit a smooth finish for the rim of the panel.

The frame is clamped or otherwise positioned on a smooth horizontal floor or other suitable base that closes off the rear face 16 of the frame. A plastic film may be laid out on the floor in advance to prevent adherence of the concrete to the floor. If a decorative surface is desired on the interior of the panel, a sheet of finished plywood or other decorative material may be positioned across the bottom of the frame to be incorporated in the panel structure as a permanent part thereof.

Concrete is then poured into the frame to a level appropriate for positioning of insulation 27 in the panel. In a typical four inch thick panel structure, the initial concrete pour fills the frame to a depth of about 1½ inches. The foamed polystyrene slab or other insulation 27 is then positioned within the frame and additional concrete is poured to fill the frame to the level generally indicated by line 19 in FIGS. 2 and 3.

As soon as the concrete has set up sufficiently to permit movement of the panel, it can be shifted to a new location and another panel can be poured in the same space. At this point, the panel is not completed; the surface layer 37 is still missing. It is frequently desirable to fabricate the panel structures to this intermediate state and withhold pouring or other formation of the surface layer 37 until a final decision is reached as to the exterior surface desired on a given job, due to the wide variety of surface finishes that can be used as discussed more fully in conjunction with FIG. 6. That is, the panels are readily adaptable to fabrication to a near-finished state, with the final finish depending upon the esthetic requirements of a given building.

When the finish has been specified, a surface layer 37 is applied to the panel and processed to give the desired appearance. This can be done at the point of original manufacture or on the job site. The eye-bolt 34 is utilized to hoist the panels for transportation and erection purposes, having been installed prior to pouring of the concrete.

At the job site, the panels are erected in side-by-side relation, as generally shown in FIG. 6, and are welded to each other to form a completed wall structure. Preferably, a plurality of spot welds are used along each edge of the abutting panels as shown particularly in FIG. 3. The joints between adjacent panels, as between panels 10 and 50 in FIG. 3, are caulked to afford a smooth surface and to provide a weather-tight wall. Adjacent panels need not have the same decorative finish. Thus, the panel segment 50 in FIG. 3 is shown with a sculptured concrete finish surface 137 whereas the surface layer 37 of the adjacent panel 10 has an exposed-aggregate finish.

FIG. 6 affords a general illustration of the wide variety of finishes that can be obtained with the panel structure of the invention. As shown therein, the panel 10 has an exposed aggregate surface 37 and the adjacent panel 50 has a sculptured concrete surface 137. To the right of panel 50, the adjacent panel 51 is a concrete surface with a plurality of elongated striations 52. To the left of panel 10 in FIG. 6, there is a narrower panel 53 having a window 54 mounted in the panel, with an exposed aggregate finish 55 at the top of the panel and a sculptured concrete finish 56 at the bottom of the panel. To the left of panel 53 is an even narrower panel 57 decorated with a series of horizontal sculptured lines 58. To the left of panel 57 is another panel 59 with a smooth surface finish. It will be apparent that many other varied surfaces can be employed, depending solely upon the inclinations and ingenuity of the architect or other designer.

When the panels are erected, the gaskets on the bottom surfaces of the panels are compressed by the weight that they support. Typically, the gasket 41 for a given panel may be formed from foamed polyurethane resin having a nominal thickness of one-half inch which is compressed to a thickness of one-eighth inch when the panel is in erected position. This prevents any capillary action and affords a good seal between the panel and the foundation upon which it rests. When the panels have all been erected and welded to each other, the welds should be ground off smooth and the joints between the panels caulked. A finish coat of paint can then be applied to the metal channel members. It is usually desirable to apply a waterproof coating, which may be transparent or may comprise a decorative paint, to the external surface 15 of each of the panels. The internal surface of each panel, such as the surface 16, may be painted or otherwise decorated.

Although the panels of the invention could be poured on the job site, if desired, it is usually preferable to fabricate the basic panel structures in advance in a shop under control conditions. The decorative layer on the external face 15 of each panel may be omitted until the appearance requirements for a given job are established. As indicated by panel 53 in FIG. 6, doors or windows can be constructed as an integral part of any panel. When the panels are erected in a complete wall structure, the eye bolts 34 are removed and the panels can be secured to a top plate or other structural member by bolts extending down into the panels and threaded into the retainers 31 therein. It will be recognized that the external appearance of individual panels is virtually unlimited, a result made possible by the face-up casting of the panels.

The panel wall, assembled as described above, is not only self-supporting but can serve as a load bearing wall without additional framing of any kind. At each joint between adjacent panels, the welding together of the edge channels of the panels affords an L-beam column. The resulting structure can support additional stories and a substantial roof load. The wall structure affords good insulation qualities without sacrifice of structural integrity.

In the fabrication of the panels, it is important to note that no separate form is required. The labor and difficulty of fabricating forms and subsequently stripping the completed panels from the forms is entirely elimi-
nated. The relatively wide metal rim around each panel does not detract from the panel appearance, but does protect the panel against damage from rough handling, especially during transportation. Aluminum can be used in the fabrication of the outer frame 11, instead of steel, affording some advantages in corrosion resistance; if aluminum is used, frame 11 need not be painted.

There is no concrete exposed at or near the corners or edges of the panels. Transportation of semi-finished panels is simplified because the external finished surfaces are protected. The side and top members of the frame for each panel form a continuous welding surface that eliminates the need for weld plates cast in concrete; virtually no external hardward is required. Of course, electrical conduits and other similar in-fill structures can be cast into the panels if desired. The internal shear bars afford the strength necessary for transportation and also reinforce the erected panels. They may be utilized for convenient mounting of the wire fabric reinforcing. Moreover, they afford an effective support for eye bolt 34, distributing the lifting load through the concrete and preventing deformation of the outer frame 11 during lifting of the panels.

The construction shown in FIGS. 1-5 is eminently practical and highly satisfactory in many applications, particularly in buildings in which the surface finishes for the panels are applied at the job site or in which the panels are transported only a short distance from a manufacturing location to the point of erection. However, transportation of the panels may present some difficulties, if the decorative finish surface 37 is applied at a remote location and the panels are subsequently shipped to the building site, particularly if substantial distances are involved and several panels are shipped simultaneously. The difficulty arises principally from the tendency toward damage of the decorative surface 37; it may be necessary to block the panels in spaced relation to each other.

Another difficulty that sometimes occurs in connection with the panels shown in FIGS. 1-5 pertains to the joints between adjacent panels as shown in FIG. 3. If the panels are actually disposed in abutting relation, when erected, it is difficult to obtain good adherence for the caulking material or gaskets used to seal the joints. The side plates of the channels are seldom exactly planar; consequently, a truly weather-tight joint may be difficult to achieve.

The construction illustrated in FIG. 7, comprising portions of two adjacent panels 70 and 80, is effective to overcome the aforementioned difficulties. As shown in FIG. 7, the metal channel 71 forming the frame for panel 70 is of generally C-shaped configuration, including a rear flange 72 extending normal to a side edge plate 73, and a front flange 74. The front flange 74, however, is flared outwardly at an acute angle from the normal to the side edge plate 73 instead of being disposed at a right angle relative to the side edge plate. The internal construction of the panel is the same as described above, including the reinforcing bars 29, the wire mesh reinforcement 26, and the internal concrete mass 17. The panel also includes a central insulation core 27 and shear bars 29 (FIGS. 1-3) but these are not shown in FIG. 7.

The adjacent panel 80 is of similar configuration. The channel frame member 81 includes a rear flange 82 disposed at a right angle relative to a side edge plate 83, with a front flange 84 flared outwardly of the side edge plate 83. Again, the concrete mass 17, the reinforcing bar 29, and the mesh reinforcement 26, as well as the shear bars and insulation core (not shown) conform to the previously described embodiment.

In fabrication of the panel 70 the same basic technique is used as described above; however, the depth of the concrete mass 17 is limited to a level 75 that is well below the outer lip 76 of the front flange 74 of the channel frame 71. A decorative finish coat 77 is applied on the surface 75 of the concrete mass 17. The decorative finish 77 is also restricted to a level below the outer rim 76 of the channel flange 74. This affords a recessed decorative finish 77 for panel 70 that is better protected against potential damage than in the case of the previously described embodiment, allowing shipment of the panels with little danger of surface damage to the decorative portions of the panels. At the same time, the angled intersection between the channel flanges 74 and 84 of panels 70 and 80 provides a good seat for a caulking bead or other seal material 78, making it possible to achieve a good seal along the joint between the outer surfaces of the two panels. The inner joint can also be surfaces of the two panels. The inner joint can also be caulked as indicated at 79.

FIG. 8 illustrates the juncture of two panels 90 and 100, in a view similar to FIGS. 3 and 7. Panel 90 comprises an external steel channel frame 91 having a flat rear flange 92 joined at a right angle to a side edge plate 93. At the front of panel 90, channel 91 affords a convex flange 94 of generally arcuate cross-sectional configuration. Panel 90 also includes the reinforcing bar 29, the concrete mass 17, and the metal mesh reinforcement 26, and is constructed to include the shear bars and insulation core described above in connection with FIGS. 1-3.

In panel 90, the main concrete mass 17 terminates below the rim 96 of the convex front flange 94 of the channel frame 91. A finish coat 97 for the panel 90 may extend beyond the rim 96, but is kept well below the outermost projection 98 of the front flange 94. Thus, the front flange 94 of channel 91 affords a bumper that effectively protects the finished surface 97 of the panel from damage during transportation and erection. Furthermore, the arcuate conjunction of flange 94 with the corresponding flange 104 on the adjacent panel 100 affords a V-shaped pocket for receiving strip of caulking or other sealing material 99, thus assuring a tightly sealed joint along the outer joining edge of the two panels.

FIG. 9 illustrates another variation in channel frame configuration, embodied in the edge portions of two panels 110 and 120, that is advantageous in achieving good sealing between adjacent panels and in protecting the finished exterior surfaces of the panels. The channel 111 forming the frame for panel 110 comprises a rear flange 112 projecting at a right angle from a flat side edge plate 113. The side edge plate 113 is provided with a series of projections 114. The front portion of channel 111 comprises a flange 115 that is flared outwardly of the edge of side plate 113, at an acute angle to the normal. Flange 115 terminates in a re-entrant lip 116. Panel 110 includes the metal mesh reinforcement 26 and is constructed with the shear bars, insulating core, and side reinforcement members described above in connection with FIGS. 1-3.
In the fabrication of channel 110, the depth of the concrete mass 17 is maintained below the lip 116 on the front flange 115 of the frame channel 111. The decorative surface 117 of the panel, applied over the outer surface of the concrete mass 17, may extend beyond the inner edge 118 of the re-entrant flange lip 116, but is kept well below the outermost projection 119 of flange 115. The flange 115 affords an effective bumper that protects the decorative finish 117 during transportation and erection.

The channel frame 121 for the adjacent panel 120 is of the same configuration as channel 111; it includes a plurality of protrusions 124 along the side edge plate 123 of the channel. Thus, the protrusions 114 and 124 on the two channel members 111 and 121 of the adjacent panels 110 and 120 afford a small space 125 between the two panels when the panels are erected. This space may be of the order of one-half inch, more or less, in thickness. With this arrangement, caulking or gasket seals 126 and 127, at the front and rear joints between the two panels, can be extended into the space 125 and afford a more certain seal than with other constructions. The space 125 does not detract from the insulating qualities of the wall formed by panels 110 and 120, since it can be totally sealed around its external edges and amounts to a dead air space having effective insulation properties.

FIG. 10 illustrates the joint for two panels 130 and 140 that are similar in construction to those described above in connection with FIGS. 1–3, except for the configuration of the channel frames. The channel frame member 131 for panel 130 includes a side edge plate 133 having two offset portions 134 and 135. At one end of the plate 133, there is a re-entrant flange 132; a similar re-entrant flange 136 is provided at the opposite end of plate 133. In cross-section, each of the flanges 132 and 136 is of truncated triangular configuration. The channel frame 141 of panel 140 is of complementary configuration, including a side plate 143 having two offset portions that fit closely with the offset portions of plate 133. The ends of the side plate 143 terminate in re-entrant flanges 142 and 146 of the same configuration as flanges 132 and 136.

In panel 130, the concrete mass 17 that affords the inner frame and main body of the panel does not extend completely to either of the flanges 132 and 136. Instead, the outer surface of the concrete is held within the inner lip of each flange. Decorative surface layers, which may be of exposed aggregate type or of other desired kind, are provided on each of the outer faces of the concrete mass 17, as indicated by the surface coatings 137 and 138. In pouring the concrete mass 17, a thin sheet of plywood or other appropriate form material may be placed in the form, within the confines of flange 132, to permit effective and convenient formation of the surface layer 137 at a depth recessed within flange 132 prior to the pouring of the concrete 17. A similar construction is used in panel 140, so that the panels each provide two decorative faces with the decorative faces recessed below the flanges on the channel frames.

The mating channel frames 131 and 141 afford two V-shaped recesses along the external joints between the frames, providing for convenient and effective caulking of the joints or for mounting of sealing gaskets in the joints. The offset between the two side plates 143 and 133 of the two channels 141 and 13, in addition to assuring accurate alignment of the two panels 130 and 140, provides added strength for the edge portions of the channels.

We claim:

1. A pre-cast insulated concrete building panel, adapted for use in an external load bearing wall consisting essentially of a plurality of such panels assembled in edge-to-edge relation and welded together to form a continuous wall structure, comprising:
   a continuous peripheral metal channel outer frame encompassing all sides of the panel and the marginal edges of both the front and rear surfaces of the panel, said metal channel being of generally C-shaped cross-sectional configuration;
   a concrete mass, poured in situ in the outer frame with the outer frame affording a peripheral form therefor, the concrete mass filling the frame;
   a layer of insulation material embedded in and filling the central portion of the concrete mass, the insulation terminating short of the metal outer frame so that a part of the concrete mass affords a complete peripheral inner frame interposed between the edges of the insulation and the steel outer frame;
   upper and lower steel shear bars, each affixed to the sides of the metal frame and extending across the upper and lower edges, respectively, of the panel, within the aforesaid inner frame;
   a wire fabric reinforcement, formed of reinforcing elements much lighter than said shear bars, embedded in one face of the concrete mass, between the insulation and the external surface of the panel;
   and a plurality of short metal reinforcing bars affixed to and projecting horizontally inwardly of the vertical sides of the steel outer frame, into the vertical portions of the concrete inner frame, at closely spaced intervals, strengthening the vertical portions of the concrete inner frame and affording guides for positioning of said insulation during pouring of said concrete mass.

2. A pre-cast insulated concrete building panel according to claim 1 in which said insulation is a unitary slab of foamed resin.

3. A pre-cast insulated concrete building panel according to claim 1 including two upper shear bars, and further comprising a steel retainer affixed to the upper shear bars and having a threaded opening, aligned with an opening in said frame, for receiving a lift member to facilitate erection of the panel without excessive stress on the upper portion of said concrete mass.

4. A pre-cast insulated concrete building panel according to claim 3 and further comprising additional steel reinforcement affixed to said retainer and projecting laterally thereof within the upper part of said inner frame of concrete.

5. A pre-cast insulated concrete building panel, adapted for use in an external load bearing wall consisting essentially of a plurality of such panels assembled in edge-to-edge relation and welded together to form a continuous wall structure, comprising:
   a continuous peripheral metal channel outer frame encompassing all sides of the panel and the marginal edges of both the front and rear surfaces of the panel, said metal channel being of generally C-shaped cross-sectional configuration;
   a concrete mass, poured in situ in the outer frame with the outer frame affording a peripheral form therefor, the concrete mass filling the frame;
a layer of insulation material embedded in and filling the central portion of the concrete mass, the insulation terminating short of the metal outer frame so that a part of the concrete mass affords a complete peripheral inner frame interposed between the edges of the insulation and the steel outer frame; and

a wire fabric reinforcement, formed of light-weight wire reinforcing elements embedded in one face of the concrete mass between the insulation and the external surface of the panel;
the front flange of the outer frame channel projecting outwardly of the side plate of that channel at an acute angle to afford a V-shaped pocket, when the panel is joined to an adjacent panel, for receiving and retaining sealing material along the external joint between the panels.

6. A pre-cast insulated concrete building panel according to claim 5, and further comprising:
upper and lower steel shear bars, each affixed to the sides of a metal frame and extending across the upper and lower edges, respectively, of the panel, within the inner frame, the shear bars being much heavier than the wire elements of the wire fabric reinforcement;
and a plurality of short metal reinforcing bars affixed to and projecting horizontally inwardly of the vertical sides of the steel outer frame, into the vertical portions of the concrete inner frame, at closely spaced intervals, strengthening the vertical portions of the concrete inner frame and affording guides for positioning of said insulation during pouring of said concrete mass.

7. A pre-cast insulated concrete building panel according to claim 5 in which the front surface of the panel is a decorative surface recessed within said front flange.

8. A pre-cast insulated concrete building panel according to claim 7, in which said front flange on said outer frame channel is of convex curved configuration.

9. A pre-cast insulated concrete building panel according to claim 7, in which said front flange on said outer frame channel is of triangular cross-sectional configuration with a re-entrant lip extending back toward the front surface of the panel.

10. A pre-cast insulated concrete building panel according to claim 7, in which said front flange on said outer frame channel is of truncated triangular cross-sectional configuration with a re-entrant lip extending back toward the front surface of the panel.

11. A pre-cast insulated concrete building panel according to claim 5, in which said front flange is of re-entrant configuration extending back toward said concrete mass, and in which the front surface of the concrete mass is recessed within the innermost edge of said front flange, said panel further comprising a surface finish layer, on said concrete mass, recessed within the outermost portion of said front flange so that said flange affords a protective bumper for said surface finish layer.

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