United States Patent [19]

Ohlson

[11] **3,834,095**

[45] **Sept. 10, 1974**

[54] **BUILDING CONSTRUCTION AND METHOD**

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[22] Filed: **July 9, 1973**

[21] Appl. No.: **377,789**

Related U.S. Application Data

[63] Continuation of Ser. No. 97,148, Dec. 11, 1970, abandoned, which is a continuation-in-part of Ser. No. 763,783, Sept. 30, 1968, abandoned.

[52] **U.S. Cl.** **52/122,** 52/236, 52/259, 52/262, 52/587, 52/745

[51] **Int. Cl.** **E04b 2/06,** E04b 5/02, E04b 1/04

[58] **Field of Search** 52/122, 127, 250, 236, 52/251, 745, 259, 234, 238, 262, 284

[56] **References Cited**

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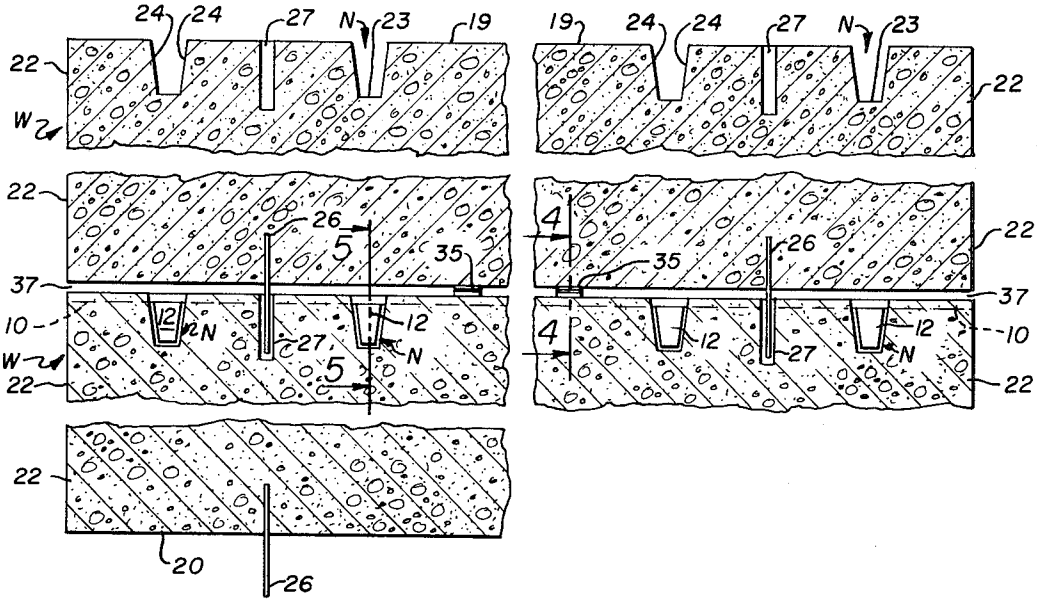
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Primary Examiner—John E. Murtagh
Attorney, Agent, or Firm—Horace B. Van Valkenburgh

[57] **ABSTRACT**

A multiple story building construction and method involving placing reinforcement on top of precast floor panels on opposite sides of a lower precast wall panel supporting the floor panels and a precast wall panel spaced above, then pouring a concrete topping on the reinforcement and through the space between the wall panels and up against the lower end of the wall panel above, to provide a monolithic floor of reinforced concrete extending longitudinally and laterally of the building. The space between superimposed wall panels is adjusted by shims, also used to level the wall panel above, while the reinforcement may extend through the space between the wall panels or may be welded to opposite sides of a channel embedded in the lower edge of the upper wall panel. At the outside walls, the floor reinforcing may be welded to extending reinforcing rods of the outside wall panels, or may be welded to angles embedded in the lower edge of the panels, with upright reinforcing in the wall panels welded to the angles, as well as to the channels referred to above.

18 Claims, 16 Drawing Figures



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SHEET 1 OF 4

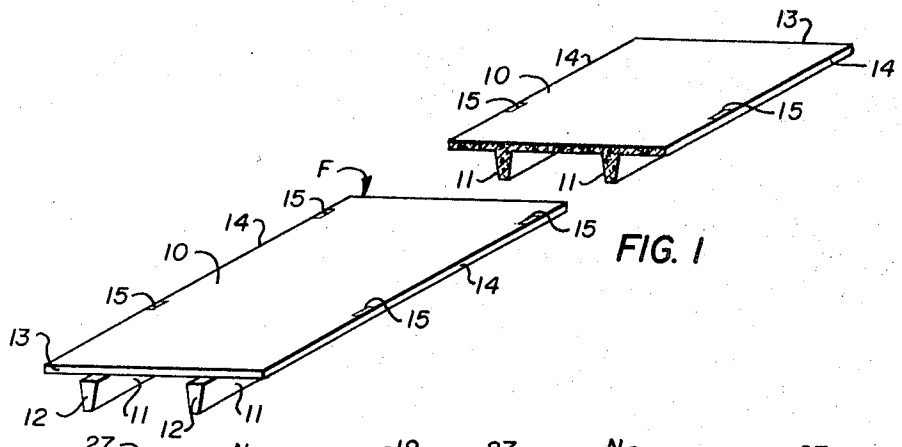


FIG. 1

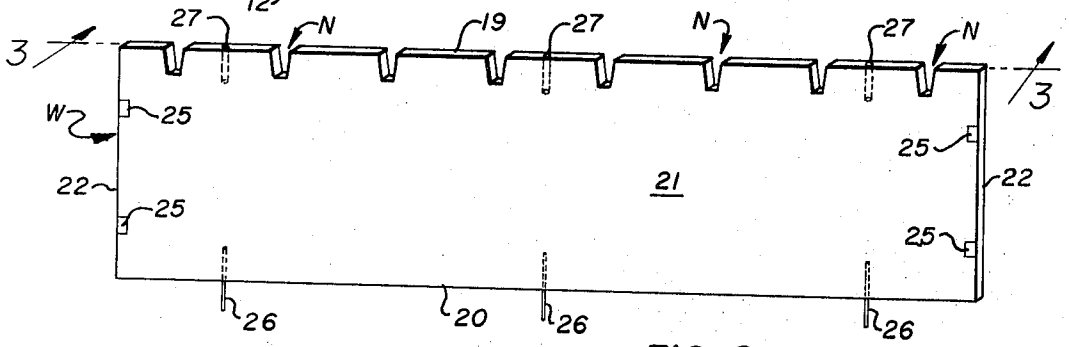


FIG. 2

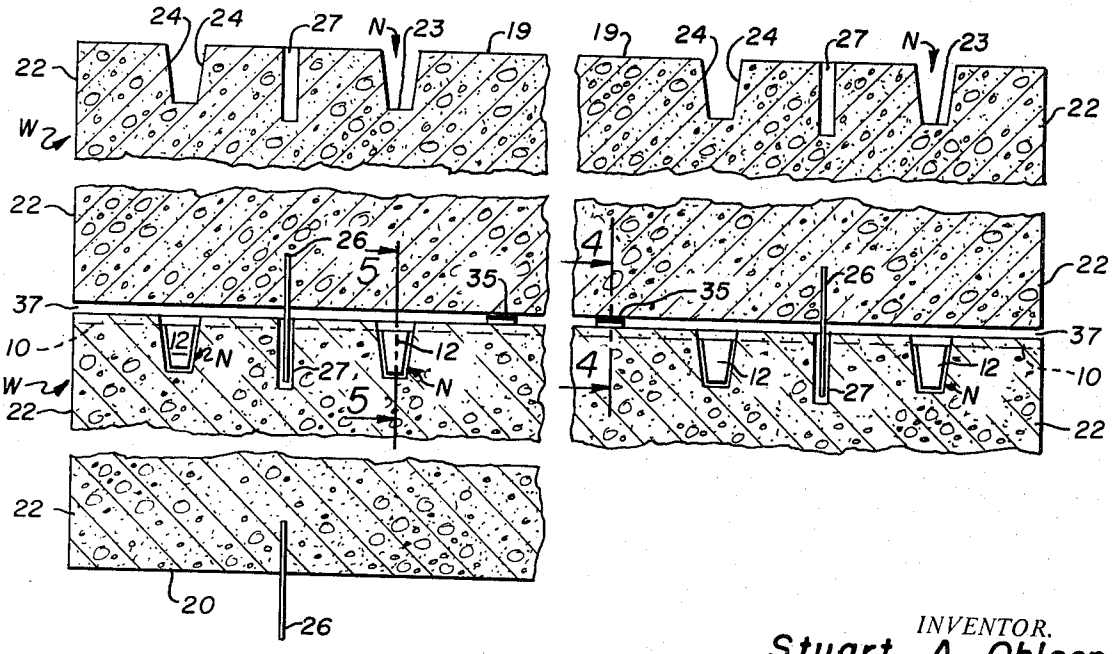


FIG. 3

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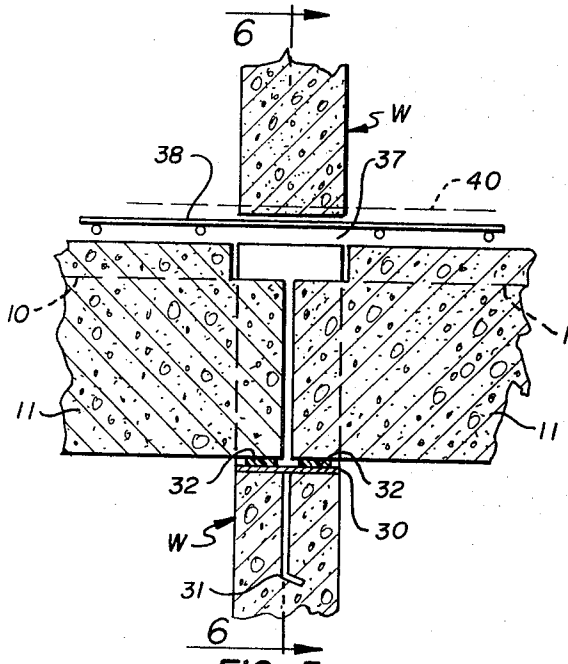


FIG. 5

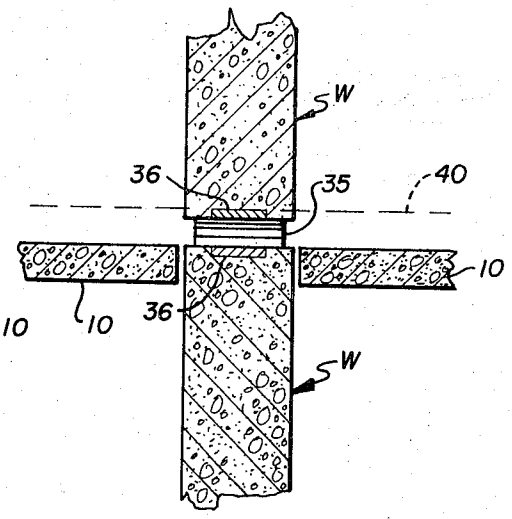


FIG. 4

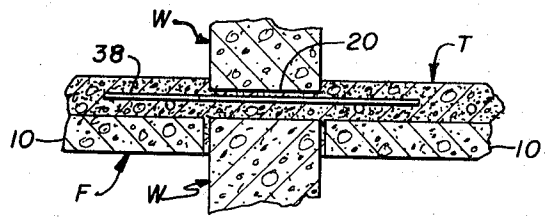


FIG. 7

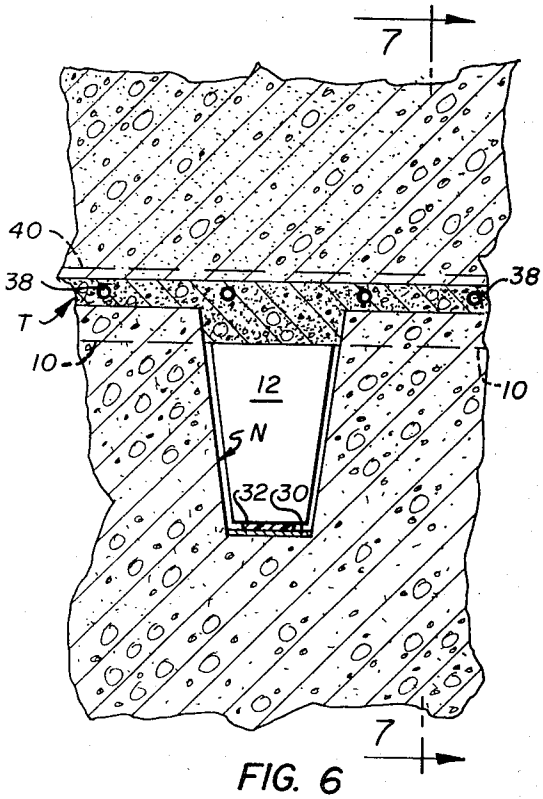


FIG. 6

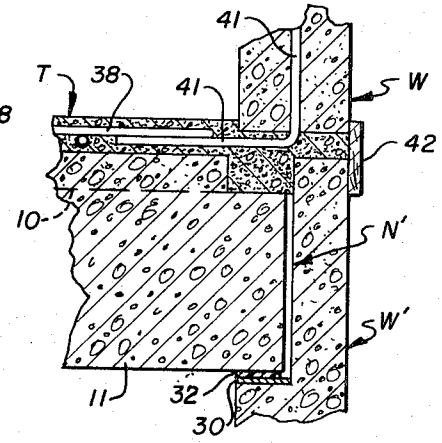


FIG. 8

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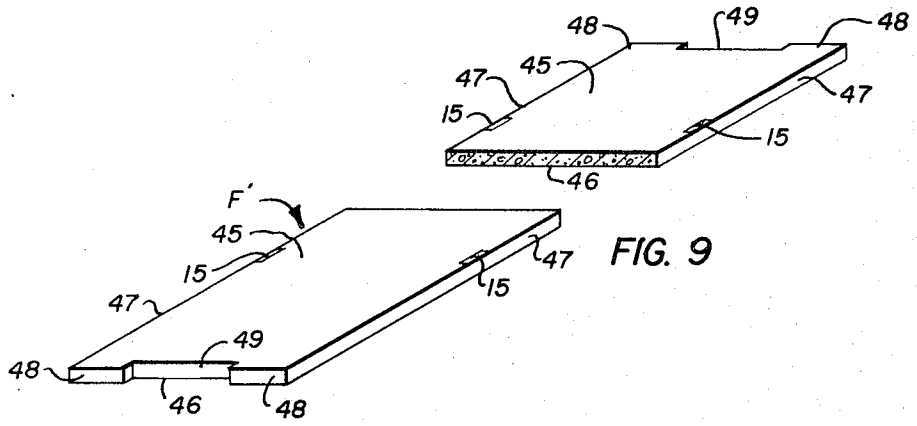


FIG. 9

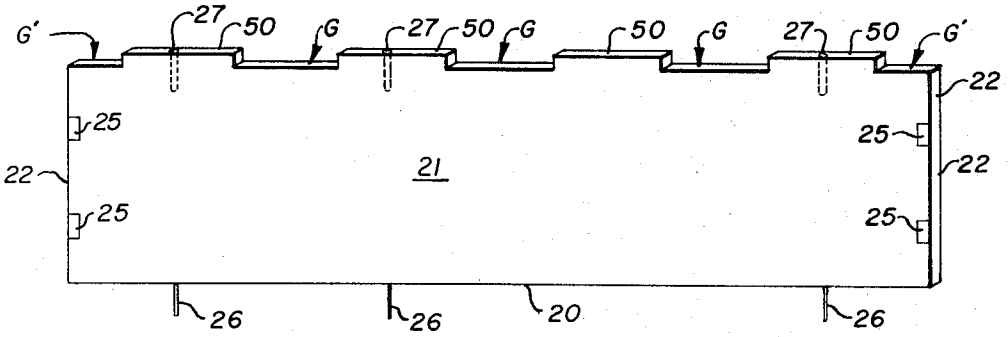


FIG. 10

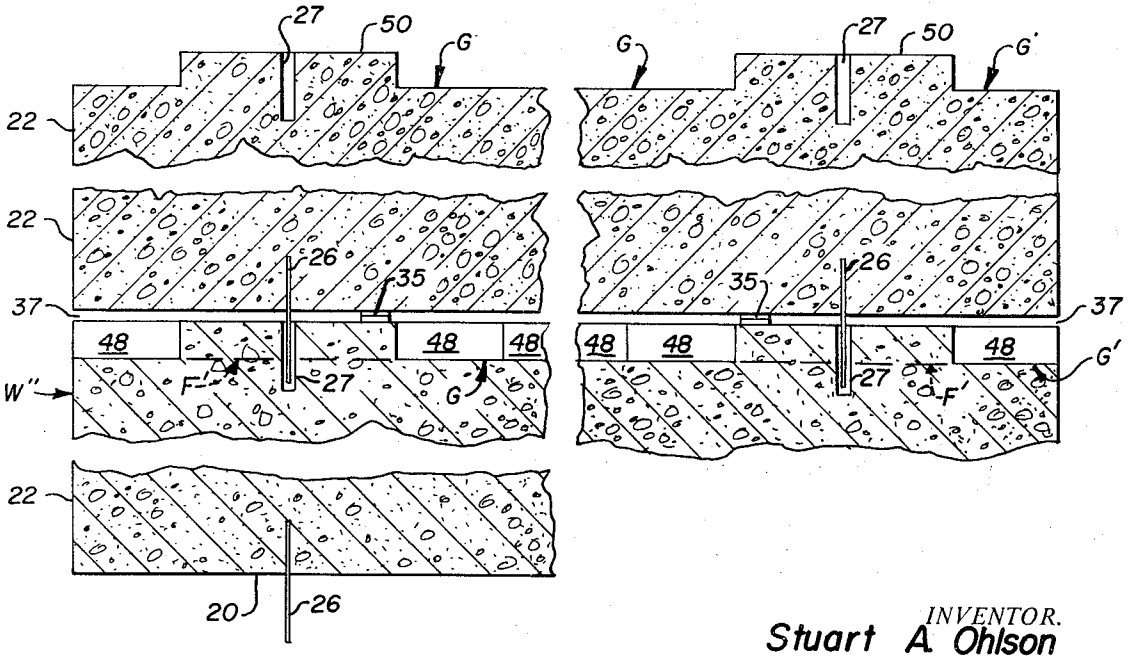


FIG. 11

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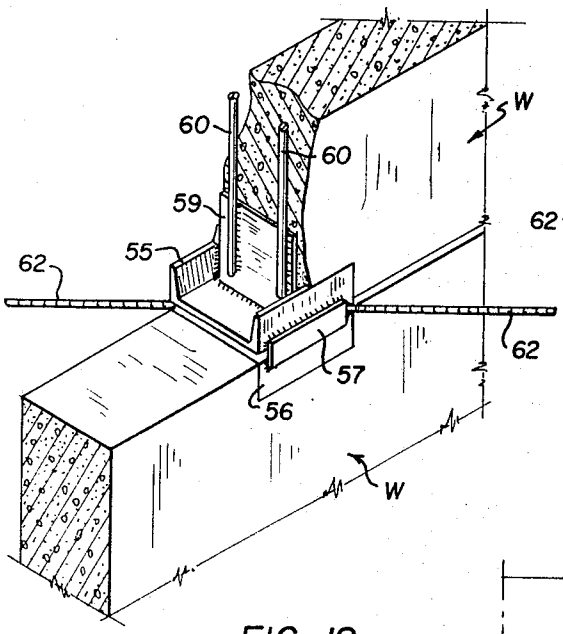


FIG. 12

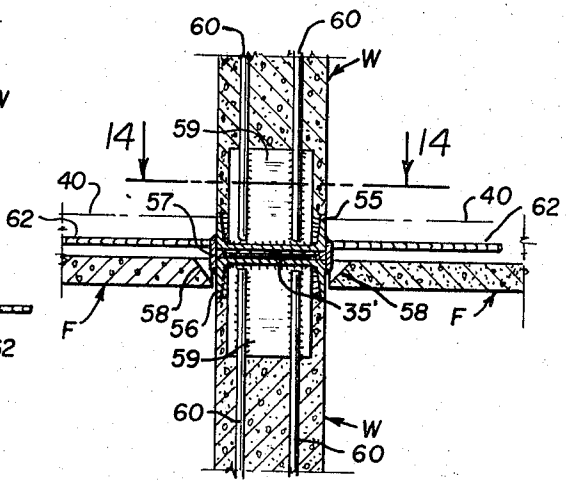


FIG. 13

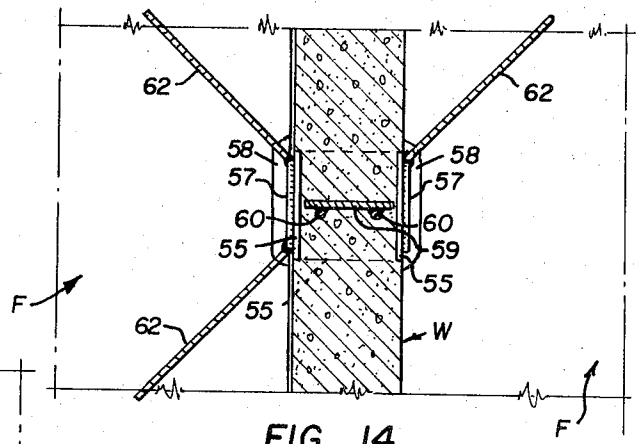


FIG. 14

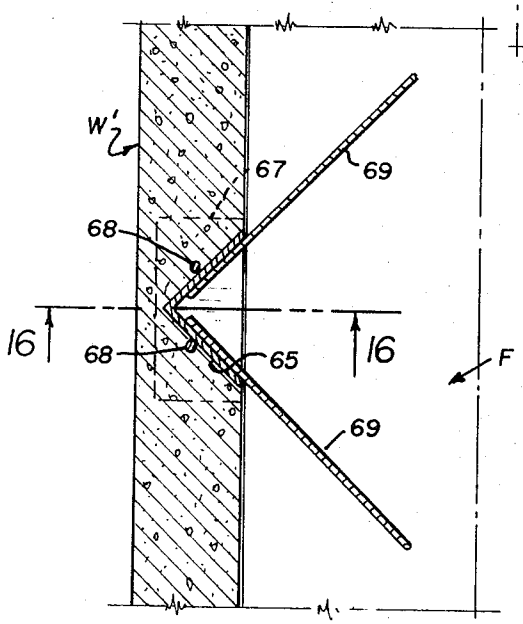


FIG. 15

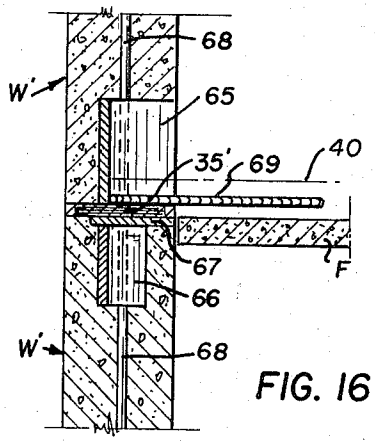


FIG. 16

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BUILDING CONSTRUCTION AND METHOD

This application is a continuation of my copending application Ser. No. 97,148 filed Dec. 11, 1970 (now abandoned), in turn a continuation-in-part of my copending application Ser. No. 763,783 filed Sept. 30, 1968 (now abandoned).

This invention relates to multiple story building constructions and methods, and more particularly to such building constructions in which precast concrete panels or slabs are utilized.

In the usual construction of buildings, considerable hand labor, on the site, in involved, as when the walls are formed of brick or some type of block, each of which must be placed in position, along with mortar. When the walls and floors of a building are formed of reinforced concrete, the forms for each floor and each wall must be placed, scaffolding or other type of support for the workmen being erected, and the reinforcement for the concrete placed within the forms. Even when premixed concrete is utilized, transported by special trucks from a point of mixing, considerable labor is involved in pouring the concrete. Also, after the concrete has initially set, the forms must be stripped away, which again involves an undue amount of hand labor.

It has previously been proposed to utilize panels or slabs of concrete for walls and floors of multiple story buildings, at a considerable saving in labor costs, but numerous problems still remain to be solved, including the accurate positioning of the wall panels or slabs and adequate connection between the floor panels on one side of a wall and the floor panels on the opposite side of the same wall.

Among the objects of the present invention are to provide a novel multiple story building construction, in which precast panels or slabs of concrete may be utilized; to provide a novel method of constructing a multiple story building, particularly involving the use of floor and walls slabs or panels of precast concrete and the like; to provide such a construction method by which the erection of the wall panels is facilitated; to provide such a construction in which the floor panels on one side of a wall are adequately and securely attached to the floor panels on the opposite side of the wall; to provide such a construction and method in which a series of wall panels may be superimposed, one upon the other, without delay, due to the finishing of the floor or floors below; to provide such a construction and method in which a series of floor panels may be placed to be supported by a wall panel below, additional wall panels may be erected and adequately supported by the wall panels beneath, and the floor panels for the floor above may be placed in position without undue delay; to provide such a construction and method in which the upper edge of a wall panel may be readily and easily leveled, in order to receive the floor panels placed on the upper edge thereof, without any delay due to inaccuracies in erection of such wall panels; to provide such a construction which will result in a building resistant to shear and other stresses; and to provide such a method which is efficient and effective in use and saves considerable amounts in labor costs.

The foregoing and additional objects, as well as the advantages of the present invention, will become apparent from the description which follows, taken in

conjunction with the accompanying drawings, in which:

FIG. **1** is a condensed perspective view of a floor panel adapted to be utilized in the building construction of this invention;

FIG. **2** is a perspective view of a wall panel adapted to be used in the building construction of this invention and is also adapted to receive a series of the floor panels of FIG. **1**, on both sides thereof;

FIG. **3** is a condensed, fragmentary vertical section, taken at the position of line **3—3** of FIG. **2**, showing a pair of superimposed wall panels of FIG. **2** at one stage in the erection procedure and also illustrating one step in the method of this invention;

FIG. **4** is a fragmentary vertical section, transverse to FIG. **3** and taken along line **4—4** of FIG. **3**;

FIG. **5** is a vertical section, transverse to FIG. **3** and taken at the position of line **5—5** of FIG. **3**, illustrating additional steps in the method of this invention, showing particularly reinforcing placed on a series of floor panels of FIG. **1** and indicating the level to which a topping or additional concrete is to be poured;

FIG. **6** is a vertical section, taken at the position of line **6—6** of FIG. **5**, but illustrating the completed joint between the wall panel and floor panels, and also showing the additional concrete or topping poured onto the floor panels, after the reinforcing of FIG. **5** has been placed in position;

FIG. **7** is a fragmentary vertical section, taken transversely of FIG. **6** and along line **7—7** thereof;

FIG. **8** is a transverse vertical section, similar to FIG. **4** but taken at an outside wall;

FIG. **9** is a condensed perspective view of an alternative floor panel, also adapted to be utilized in the building construction of this invention;

FIG. **10** is a perspective view of an alternative wall panel for use with a series of floor panels of FIG. **9**;

FIG. **11** is condensed, fragmentary vertical section, similar to FIG. **3** but taken at the position of line **10—10** of FIG. **9**;

FIG. **12** is a fragmentary perspective view, partially broken away, partially in section, and with the floor panels omitted for clarity of illustration, showing an alternative stage in the erection procedure and an alternative construction by which floor reinforcing on opposite sides of a wall panel is connected;

FIG. **13** is a fragmentary vertical section, corresponding to FIG. **5** but showing the alternative construction of FIG. **12**;

FIG. **14** is a fragmentary horizontal section taken along line **14—14** of FIG. **13**;

FIG. **15** is a fragmentary horizontal section showing an alternative connection of the floor reinforcing to the reinforcement of a wall panel at the outside of a building; and

FIG. **16** is a fragmentary vertical section, taken along line **16—16** of FIG. **15.**

A multiple story building construction of this invention involves a series of precast, reinforced concrete floor panels F of FIG. **1**, which may be on the order of 8 feet wide and 25 or more feet long, and a series of precast reinforced concrete wall panels W of FIG. **2**, which may be on the order of 8 to 9 feet high and 32 feet long, having a suitable thickness, such as 6 inches. The floor panels F and the wall panels W may be precast in forms provided for that purpose, as at a concrete casting plant, so that a smooth finish of the sides of the

wall panels and a smooth finish of the bottom of the floor panels may be obtained, without the necessity for workmen having to move about on scaffolding or the like, or for mixed concrete to be transported to a distant site and elevated to a height corresponding to the part of the building at which the concrete is being poured. It will be understood that conventional reinforcing rods (not shown), such as interlaced in a grid, are provided in the floor panels and wall panels.

Each floor panel F may comprise a deck **10** having a thickness on the order of 2 inches, sufficient to support the concrete which is to be poured thereon later, with a series of spaced beams **11** having tapering sides depending from the underside of the deck **10** and extending longitudinally of the floor panel. Each end **12** of a beam **11** preferably extends longitudinally beyond the end **13** of the floor panel, as to a distance of 2½ to 3 inches, for a purpose described below, while the side edges **14** of the deck **10** may be provided at spaced positions with exposed reinforcing rods **15,** which may be welded to similarly exposed reinforcing rods of adjacent floor panels, when the floor panels are installed. The floor panels may also be provided with conventional longitudinally extending hollow spaces (not shown), such as located along the neutral axis, to reduce the total weight without impairing the load bearing ability of the panel.

Each wall panel W, as in FIG. **2,** may be provided with a flat upper edge or top **19,** into which extends a series of notches N spaced in accordance with the spacing between beams **11** of the floor panels F, as well as with a flat, horizontal bottom **20,** flat sides **21** and flat ends **22.** Each Notch N, as in FIG. **3,** may be provided with a flat bottom **23** and downwardly tapering sides **24** corresponding to the taper of the sides of beams **11** of the floor panels. Along each of the ends **22,** a pair or more of corner plates **25** may be embedded in the concrete, preferably being welded or otherwise suitably connected to the reinforcing rods inside the wall panel. The corner plates **25** are welded to corresponding corner plates of adjacent wall panels, either in alignment with the particular wall panel involved or perpendicular thereto. Plates similar to plates **25** may be embedded at appropriate positions in the sides **21** of the wall panels, for connection to the end of another wall panel perpendicular thereto but which abuts the first wall panel intermediate the ends thereof. A series of guide rods or dowels **26,** preferably having an irregular outer surface similar to conventional reinforcing rods, are also embedded in the wall panel, to extend from the bottom **20** thereof, and into a corresponding dowel hole **27** formed in the top of each wall panel, so that the dowels **26** may enter the dowel holes **27** of the panel beneath, during erection, as in FIG. **3.** As shown, one dowel **26** is positioned at the center of the wall panel and the other two dowels at points closer to the ends **22,** although other arrangements of the dowels may be utilized. Preferably, when a wall panel W is lowered onto the wall panel beneath, the dowel holes **27** are filled with grout, so that, when the upper wall panel is placed in final position, the grout will set and hold the wall panel in lateral and longitudinal alignment with the wall panel beneath. Dowel holes **27** may be cylindrical, as shown, or may be rectangular or have any other desired cross section. Also, the dowel holes **27** may flare outwardly and downwardly, so that the grout, when set, will form a plug which resists being pulled out and provides means for resisting tensile stresses. Such a downwardly flaring dowel hole may be produced by a sheet metal sleeve of appropriate shape having a closed inner end, which may be merely left in the panel after casting.

In order to construct the building in accordance with this invention, the wall panels W and floor panels F are suitably precast, as described above, and then transported to the site of the building. The wall panels forming the first floor may be erected upon conventional foundations in which holes similar to the dowel holes **27** may be provided. After the wall panels of the first story have been erected and the corner plates **25** of abutting and perpendicular wall panels welded together, the floor panels for the second floor may be placed in position on the wall panels so erected. The wall panels for the outside wall of the building may be modified in a manner described later. The floor panels on each side of an interior wall, as in FIG. **5,** are placed with the ends **12** of the beams **11** entering the corresponding notches N, but spaced a fraction of an inch apart, as shown. The base of each notch N, as in FIGS. **5** and **6,** may be provided with a rectangular bearing plate **30,** which may be on the order of 4 by 6 inches and provided with an angular reinforcing rod **31** of any suitable shape, which extends downwardly into the concrete, to anchor the bearing plate **30.** The ends **12** of the beams **11** of the floor panels are conveniently placed on bearing pads **32,** as of plastic, in order to prevent damage to the concrete of the beam ends **12** by the steel bearing plate **30.** After a series of floor panels have been placed in position on each side of an intermediate wall panel and the exposed reinforcing **15** of abutting floor panels welded, the next wall panel W above may be placed on the wall panel beneath, with the dowels **26** entering the holes **27,** in the manner described above.

In accordance with this invention, an adjustable supporting and spacing means, such as a series of shims **35,** as in FIG. **4,** are placed upon the top **19** of the wall panel beneath, to support the wall panel. Only two sets of shims **35** are necessary, these being conveniently placed at positions approximately one-third of the distance inwardly from each end of the wall panel. By adjusting the number of shims **35** of each set, the top **19** of the wall panel above may be leveled readily, to compensate for any slight inaccuracies in the parallelism between the upper edge **19** and the lower edge **20** of the wall panel being erected. If desired, bearing plates **36** may be embedded in both the top **19** and bottom **21** of each wall panel at the position of shims **35.** The adjustable supporting and spacing means, exemplified by shims **35,** comprise an important feature of this invention, since they are used not only to level the upper edge of the wall panel being erected, but also support the wall panel being erected from the wall panel beneath, so that additional floor panels may be placed on the upper wall panel, without undue delay. In addition, the shims **35** provide a space **37** between the superimposed wall panels, as on the order of 1½ inches, for an important purpose described below.

In further accordance with this invention, a series of reinforcing bars **38** or a reinforcement grid, such as a screen formed of rod, is placed atop the deck **10** of the floor panels, on each side of a wall panel W, and also extending through the space **37** between the two superimposed wall panels involved, or otherwise connected

on opposite sides of the wall panel, such as in the alternative construction hereinafter described. It will be noted, as in FIG. **5**, that the ends **12** of the beams **11** are proportioned in height so that the top of the deck **10** of each floor panel will be flush with the upper edge **19** of the wall panel by which the floor panels are supported. After the reinforcement **38** has been placed, a layer of concrete or topping T is poured onto the floor panels, on each side of the wall panel W thereabove, and also muddled into the space under the wall panel W, as up to the line **40** of FIGS. **4, 5** and **6**, on each side of the lower edge of the wall panel extending upwardly from that floor. The depth of the concrete topping may be on the order of two inches, since the topping need extend upwardly onto the lower end of the wall panel for a short distance only, to securely anchor the lower edge of the wall panel against lateral movement. As in FIG. **6**, the concrete topping T will also flow into the space between the end edges of the deck **10** of the abutting floor panels, thus completing the floor having a reinforced concrete thickness, as on the order of four inches, with depending beams to resist the stress of loads placed on the floor. As will be evident, the reinforcing **38** which extends through the space **37** between the superimposed wall panels, particularly after the concrete topping T has been poured, will connect the floor on each side of the wall, so that the floor is made solid completely across, and also the entire length of the building. Thus, lateral stresses on the building, due to wind on one side, earthquakes or the like, will be adequately resisted by the reinforcing in the topping and the monolithic characteristic of the entire floor.

For the outside walls of the building, a modified wall panel W′ may be utilized, as in FIG. **8**, having notches N′ approximately one-half the depth of the notches N, in the upper edges of the intermediate wall panels, and conveniently provided with bearing plates **30′** supporting the beam ends **12**, with the latter resting on plastic pads **32′**. As will be evident, such a notch will readily accommodate the ends **12** of beams placed in these notches. Also, for the outside walls, several reinforcing bars, such as bar **41**, are preferably placed, during casting, so as to extend downwardly from the lower edge of the outside wall panel, then given an angular configuration, as shown, to extend within the space between the wall panels and then inwardly for a suitable distance, such as twelve inches. The floor reinforcing rods **38** are placed so that one of them will overlap or lie alongside each of the rods **41**, so that the two can be welded together, before the topping is poured, the angular reinforcing rods extending from the lower edges of the wall panels forming the outer walls of the building may be welded to an appropriate number of reinforcing rods **38**, to complete the anchoring structure and form a continuous reinforcement between the outside walls and the floor, both from side to side and end to end. The floor reinforcing rods may also be tied together between an inside wall panel and outside wall panel by rods **38** of FIGS. **5** and **8** as individual rods which extend from the wall on the order of 8 feet and are either superimposed on or beneath a screen type reinforcing structure, with the overlap being a sufficient distance that the bond of the topping between the reinforcing rods and the screen structure is sufficient to withstand the stresses involved. Of course, welded connections between the reinforcing rods and the screen structure may be utilized, if desired.

To cover the space between the outside wall panels W′, to prevent leakage when the topping is poured, a suitable plug may be utilized, or a form board **42**, as in FIG. **8**, may be placed outside. Each form board **42** may be held by wires, on the outside of the lower wall panel W′, while the upper wall panel W′ is being placed and the shims **35** adjusted. Then, the form board **42** may merely be pulled flush against the outside of the wall panels by the wires and the wires secured to the reinforcing **38.** As will be evident, the stripping of such form board is a relatively simple matter, compared to the stripping of the form boards from a section of the outside walls corresponding to a panel W′.

Although the topping is poured in situ at the building site, it will be evident that it is unnecessary to erect any forms to contain the topping T, except at the outer building walls, and the space there is only 1½ inches high. Thus, the topping T may be quickly and readily poured, such as after the placement of the wall and floor panels for the second or third floor above, i.e. it is unnecessary to wait to pour the topping, in order to place the floor panels above, since the wall panels above are supported by the shims **35.** For pouring the topping after the floor panels of the floor above have been placed, a relatively fine aggregate may be used for the topping, so that the concrete may be pumped through piping and a flexible hose. The topping T may be finished in a conventional manner. Of course, in addition to the reinforcement, conduits for electrical wiring, as well as piping for plumbing or the like, where necessary, may be placed on the floor prior to pouring the topping T. Also, suitable apertures for doors, windows and the like may be provided in the wall panels W in a conventional manner.

When the floor panels F of FIGS. **1–8** are utilized, the beams **11** will, of course, appear at the ceiling of each room in the building. If the appearance of the beams is undesirable, a false ceiling may be placed across the bottoms of the beams. In order to avoid the use of such a false ceiling, floor panels F′ of FIG. **9** may be utilized, in association with wall panels W″ of FIG. **10.** A floor panel F′ has a flat upper surface **45**, which may be left rough to receive the topping T, but a flat lower surface **46**, which may be finished if it is to be exposed as the ceiling, although preferably at least painted as the building interior is being completed. Exposed reinforcing **15** may also be provided along each side **47**, for the purpose described previously. Floor panel F′ is thicker than deck **10** of floor panel F, such as having a thickness of eight to ten inches, and provided with reinforcing, as well as longitudinal spaces along the neutral axis, each being conventional and therefore not shown. At each end, panel F′ is provided, as shown, with a pair of tongues **48** separated by a notch **49**, with each tongue **48** extending for 2½ to 3 inches and conveniently being on the order of two feet wide when panel F′ is 8 feet wide. Except for the upper edge, wall panel W″ is similar to wall panel W, having flat sides **21**, a flat bottom **20** and flat ends **22**, as well as corner plates **25**, dowels **26** extending from the lower end and dowel holes **27** in the top. However, to accommodate tongues **48**, the top of panel W″ is provided with a spaced series of transverse, rectangular grooves G, each adapted to receive a pair of tongues **48** of adjacent and abutting floor panels F′, as in FIG. **11**, and end grooves G′ adapted to receive one end tongue **48** of a floor panel. The respective grooves are separated by lands **50**, each

corresponding in width to a notch **49** of a floor panel. The bottom of each groove G and G' may be provided with a bearing plate corresponding to bearing plate **30** of FIGS. **5** and **6,** but of appropriate size, while the floor panels are installed in a manner similar to that previously described. The spacing of dowels **26** and holes **27** may be slightly varied, so that each hole **27** will be in a land **50,** while the shims **35** are also positioned to rest on a land **50,** with bearing plates similar to bearing plates **36** of FIG. **4** being embedded in the lands **50** and in the bottom of each wall panel W'' at the position of shims **35,** if desired. The panels for the outside walls of the building may also be modified in a manner similar to that previously described, i.e. grooves G and G' are modified to be half grooves, in a manner corresponding to the half notch N' of FIG. **8.**

The method of this invention, using the floor panels F' and wall panels W'' is similar to that previously described. Thus, assuming that the wall panels below have been erected, the floor panels F' are placed in side by side relation and on opposite sides of each interior wall panel, with extensions **48** in grooves G and G' and in a relation corresponding to that of beam ends **12** in notch N, as shown in FIG. **5.** After the exposed reinforcing rods **15** of abutting panels are welded, the next wall panels above are lowered into position, with dowels **26** being grouted into holes **27** and shims **35** adjusted to level the top of the wall panel above. After corner plates **25** of abutting wall panels have been welded, or simultaneously therewith, a grid of reinforcing rods **38** of FIGS. **4–7** is laid on the floor panels and extended through the space **37** of FIG. **11,** and the rods corresponding to rod **41** of FIG. **8,** extending from the lower end of the panels for the outside walls, welded to the appropriate reinforcing rods **38.** Then, the topping T may be poured, being muddled into the space between the superimposed wall panels and poured up to a level so as to firmly embed the lower end of each upper wall panel in the topping.

It will be understood that, using floor panels which are flat on the underside, the extent and position of extensions **48** may be varied considerably. For instance, each extension **48** may be spaced toward the center of the panel from the sides **47,** or only one extension may be utilized, such as corresponding in width to notch **49,** or having any other suitable width. Also, more than two end extensions may be utilized. Corresponding changes in the grooves G and G' of the wall panel W'' will, of course, be evident. In some instances, it may be desired to extend the ends of one or more wall panels in a series, so that the entire width of such a wall panel is supported on the wall below, with appropriate means for supporting the wall panel above from the wall panel below, such as principally or wholly through the floor panels.

In the alternative construction illustrated in FIGS. **12–14,** each inside wall panel W is provided with a short channel **55** embedded therein, as at spaced positions along its lower edge, and a similar short channel **56** embedded therein at corresponding positions along its upper edge, so that the channels **55** and **56** will correspond in position when the upper wall panel is lowered onto the lower wall panel. Shims **35'** are placed between the channels **55** and **56,** and after adjustment by the shims to level the top of the upper wall panel, a strap **57** is welded along its edges to each of the channels, to hold the wall panels more securely together during erection of the floor panels and other wall panels above. To provide access to the lower edges of the straps **57,** a notch **58,** which is generally coextensive with the channel **56,** may be provided in the top of the abutting edge of each floor panel F, but is filled with the topping, which is later poured, as to the level of the line **40.** Such channels and straps may be used in lieu of, or in addition to, the vertical dowels **26** of FIGS. **3** and **11.** The channels **55** and **56** are preferably securely attached to reinforcing rods within the wall panels, such as through a plate **59** welded along its edges centrally of and transversely to the corresponding channel **55** or **56,** to which plates upright reinforcing rods **60** are welded. Each assembly of a short channel **55** or **56,** plate **59** and rods **60** is welded together prior to embedment in the prestressed concrete wall panel W.

In order to directly connect floor reinforcing rods on opposite sides of the wall panel, the inner ends of rods or dowels **62** are welded to the channel **55,** on opposite sides thereof and conveniently at the ends of plates **59,** so as to extend angularly, such as at about 45°, to the wall panel. Rods **62** may be on the order of 8 feet in length and are positioned to be embedded in the floor topping, which is poured to a level, as of line **40,** above the lower edge of the upper wall panel. One rod **62** on each side of the wall panel, as in FIG. **12,** may be utilized, or two on one side and one on the other, as in FIG. **14,** or two or more on each side. Each rod **62** is either connected to, overlaps or underlaps additional reinforcement, such as a screen type mesh, with the overlap as great as possible, so that the bond of the topping between the rods **62** and the screen reinforcement will withstand the stress involved. Of course, the rods **62** may be welded to the screen mesh, if desired.

Through the channels **55,** there is a direct connection between the rods **62** on opposite sides of the wall panel W, which direct connection is produced in the construction of FIGS. **5** and **7** by the rods **38** extending through the space between the upper and lower wall panels. The spacing of the channels **55** and the number of rods **62** may be varied in accordance with the stresses expected, i.e. with a closer spacing and a greater number of rods adjacent the ends or sides of the building than near the center of the building. There is also a direct connection between the rods **62** and the reinforcing rods **60** in the wall panel itself, through the channels **55** and the plates **59;** thus, the construction of FIGS. **12–14** provides additional transfer of stress between the floor and wall panels.

Since in the construction of FIGS. **12–14,** the space between the upper and lower wall panels need not be sufficient to permit the reinforcing rods to pass therethrough, such space may be on the order of ½ to ¾ inch, with a consequent reduction in the thickness of the shims and a corresponding increase in height of the topping against the upper wall panel. Nevertheless, because of the welding involved, the construction of FIGS. **5–7** may be found to be less expensive than the construction of FIGS. **12–14.**

In the alternative outer wall construction illustrated in FIGS. **15** and **16,** a short angle **65** is embedded in the lower edge of an outside wall panel W' and a short angle **66,** surmounted by a bearing plate **67,** is embedded in the upper edge thereof, at a corresponding position. Shims **35'** are placed between bearing plate **67** and angle **65,** while upright reinforcing rods **68** within

the respective wall panel are welded to the outside of the respective channels and to the bearing plate **67,** where appropriate. A pair of floor reinforcing rods or dowels **69,** each again on the order of 8 feet long, are welded to the inside of each upper panel angle **65,** the space on the inside of which is left open for this purpose, with dowels **69** each extending from the wall panel above the floor panel F at an angle of about 45° to the wall panel, but below the topping level **40.** A screen or wire mesh reinforcement may be placed under or over the dowels **69,** to transfer stress to and from the dowels through embedment in the topping, although dowels **69** may also be welded to the screen. As will be evident, dowels **69** also transfer stress to and from the upright reinforcing rods **68** embedded in the wall panel. Because of the outside wall, at least two dowels **69** are preferably welded to each angle **65,** while angles **65** may be spaced closer together than channels **55** of an inside panel.

After reinforcement has been placed, the slot between the upper and lower panels is filled by grout **70** and finished flush with the panels from the outside, after which the topping may be poured to the desired level, as to line **40.** When the topping is poured, the space on the inside of each angle **65** may be filled in and finished flush with the inside of the panel. It will be evident, of course, that reinforcing rods may be laid between inside dowels **62** and outside dowels **69,** being welded to each, although the overlapping of screen reinforcement with both the inside and outside dowels will normally accomplish the desired purpose, i.e. to provide each floor as a monolithic structure.

From the foregoing, it will be evident that the building construction and method of this invention fulfills to a marked degree the requirements and objects set forth hereinabove. Particularly advantageous is the reinforcing which extends across and longitudinally of the building, in each floor, and is anchored in place by the concrete topping poured onto the floor panels. Also, the shims or other suitable spacing devices not only permit the upper edge of each wall panel to be leveled at the time of erection in a simple and easy manner, but also produce the space through which the reinforcing for the topping extends between superimposed wall panels, in one of the forms disclosed. In an alternative form, a direct connection between the reinforcing embedded in the topping on opposite sides of an interior wall panel is provided by welding rods or dowels or the like to opposite sides of a channel or similar member embedded in the lower edge of the wall panel. The pouring of the topping to a level above the lower edges of the wall panels above also anchors the lower edges of the wall panels. As will be evident, this invention may be utilized in the construction of office buildings, apartment buildings, warehouses, parking garages and other types.

Although several preferred embodiments of this invention have been illustrated and described and certain variations therein indicated and the preferred steps of the method set forth, it will be understood that other embodiments may exist and that numerous variations and changes may be made, without departing from the spirit and scope of this invention.

What is claimed is:

1. In a multiple story building construction, including vertically superimposed, upper and lower wall panels and at least one floor panel at each side of said wall panels and supported by said lower wall panel at the junction of said wall panels, said panels being formed of precast concrete and the like, the improvement comprising:

interengaging means supporting said floor panels from said lower wall panel with the upper surfaces of said floor panels substantially flush with the top of said lower wall panel;

a member embedded in the lower edge of said upper wall panel;

a member embedded in the upper edge of said lower wall panel;

spacing and supporting means between said members for separating the lower edge of said upper wall panel from the upper edge of said lower wall panel while supporting said upper wall panel during erection, said spacing and supporting means being adjustable and located at spaced positions longitudinally of said upper panel, whereby both the height and the level of the top of said upper panel are adjustable;

reinforcing means immediately above both said floor panels on opposite sides of said upper wall panels;

means directly connecting said reinforcing means on opposite sides of said upper wall panel to said member embedded in said upper wall panel; and

a topping of concrete or the like atop said floor panels, said concrete embracing said reinforcing means and extending through the space between said wall panels.

2. In a multiple story building, as set forth in claim **1,** wherein:

said spacing and supporting means comprises shims.

3. In a multiple story building, as defined in claim **1,** wherein:

said member embedded in said upper wall panel comprises a channel having sides extending upwardly from the lower edge of said panel;

said reinforcing means is attached to said channel by welding; and

said member embedded in the upper edge of said lower panel is a channel at a corresponding position, whereby said spacing means may be placed between said channels.

4. In a multiple story building construction, including vertically superimposed, upper and lower wall panels and at least one floor panel at each side of said wall panels and supported by said lower wall panel at the junction of said wall panels, said panels being formed of precast concrete and the like, the improvement comprising:

spacing and supporting means for separating the lower edge of said upper wall panel from the upper edge of said lower wall panel while supporting said upper wall panel during erection;

reinforcing means immediately above both said floor panels on opposite sides of said upper wall panel;

means directly connecting said reinforcing means on opposite sides of said upper wall panel;

said reinforcing means on at least one side of said wall panels being connected to reinforcement embedded in and extending from the lower edge of a precast wall panel for an outside wall of said building; and

a topping of concrete or the like atop said floor panels, said concrete embracing said reinforcing means and extending through said space.

5. In a multiple story building, as defined in claim **4**, wherein:

said reinforcing means on opposite sides of said wall panels are directly connected by extending through the space between said wall panels.

6. In a multiple story building, as defined in claim **4**, wherein:

a member of limited height is embedded in said outside wall panels; and

said reinforcing means extending from said panel comprises rods attached to the inside of said member in divergent relation.

7. In a multiple story building construction, including vertically superimposed, upper and lower wall panels and at least one floor panel at each side of said wall panels and supported by said lower wall panel at the junction of said wall panels, said panels being formed of precast concrete and the like, the improvement comprising:

interengaging means supporting said floor panels from said lower wall panel, said floor panels being provided with a deck and one or more beams on the underside having sides converging downwardly and said lower wall panel being provided at its top with beam receiving notches having tapering sides corresponding to the sides of the corresponding beam;

spacing and supporting means for separating the lower edge of said upper wall panel from the upper edge of said lower wall panel while supporting said upper wall panel during erection;

reinforcing means immediately above both said floor panels on each side of said upper wall panel;

means directly connecting said reinforcing means on opposite sides of said panels; and

a topping of concrete or the like atop said floor panels, said concrete embracing said reinforcing means and extending through the space between said wall panels.

8. In a multiple story building, as set forth in claim **7**, wherein:

the end of each beam extends beyond the end of said deck, whereby said beam may be received in the corresponding notch with the end of said deck abutting said lower wall.

9. In a multiple story building construction, including vertically superimposed, upper and lower wall panels and at least one floor panel at each side of said wall panels and supported by said lower wall panel at the junction of said wall panels, said panels being formed of precast concrete and the like, the improvement comprising:

interengaging means supporting said floor panels from said lower wall panel with the upper surfaces of said floor panels substantially flush with the top of said lower wall panel, said floor panels being each provided with substantially planar upper and lower surfaces and at least one longitudinally extending tongue at the ends and said wall panel being provided at its top with spaced lands and notches between said lands for receiving said floor panel tongues;

spacing and supporting means for separating the lower edge of said upper wall panel from the upper edge of said lower wall panel while supporting said upper wall panel during erection;

reinforcing means immediately above both said floor panels on each side of said wall panels;

means directly connecting said reinforcing means on opposite sides of said wall panels; and

a topping of concrete or the like atop said floor panels, said concrete embracing said reinforcing means and extending through the space between said wall panels.

10. In a method of constructing a multiple story building using wall panels and floor panels formed of precast concrete and the like, said wall panels and floor panels having interengaging means for supporting one or more floor panels on each side of and at the upper edge of a wall panel, the improvement comprising:

erecting a lower wall panel;

placing one or more floor panels at each side of said lower wall panel with said interengaging means engaged and said floor panels supported by said lower wall panel with the upper surface of each floor panel substantially coplanar with the upper edge of said lower wall panel;

erecting an upper wall panel above said lower wall panel and interposing spacing means between said upper and lower panels at a plurality of positions along the same to provide a space between the upper edge of said lower wall panel and the lower edge of said upper wall panel, with said upper wall panel supported by said lower wall panel through said spacing means;

placing reinforcing means atop said floor panels on opposite sides of said upper wall panel;

directly connecting said reinforcing means on said opposite sides of said upper wall panel; and

pouring a topping of concrete onto said floor panels, whereby said concrete topping embraces said reinforcing means and also extends through said space between said wall panels.

11. In a method as set forth in claim **10**, including:

directly connecting said reinforcing means on opposite sides of said upper wall panel by extending said reinforcing means through the space between said wall panels.

12. In a method as set forth in claim **10**, including:

embedding a member in the lower edge of said upper wall panel; and

directly connecting said reinforcing means on opposite sides of said upper wall panel by attaching said reinforcing means to the respective sides of said embedded member.

13. In a method as set forth in claim **10**, including:

leveling the upper edge of said upper wall panel through adjustment of said spacing means.

14. In a method as set forth in claim **10**, wherein:

said concrete topping is poured to a level above the lower edge of said upper wall panel.

15. In a method as set forth in claim **10**, including:

connecting said reinforcing means to reinforcement extending from the lower edge of a wall panel for an outside wall of said building.

16. In a method as set forth in claim **12**, including:

embedding a member in the upper edge of said lower wall panel; and

placing said spacing means between said embedded members of said upper and lower wall panels.

17. In the method as defined in claim 10, including:

erecting a first outer wall panel to support one or more floor panels;

erecting upon said first outer wall panel a second outer wall panel having reinforcing embedded therein and extending from adjacent the lower edge thereof; and

connecting said reinforcing means atop said floor panel to said reinforcement extending from said outer wall panel, prior to pouring said topping.

18. In a method as set forth in claim 10, including:

erecting a series of lower wall panels in longitudinal alignment at the position of an inner wall of said building;

erecting a series of lower, outside wall panels at the position of the outer walls of said building parallel to said inner wall;

placing said floor panels between the tops of said lower, inner wall panels and the tops of said lower, outside wall panels;

erecting a series of wall panels on said lower, inner wall panels;

erecting a series of upper, outside wall panels on said lower, outside wall panels, said upper, outside wall panels having reinforcement extending therefrom at the lower edges thereof;

placing said reinforcing means and connecting said reinforcing means to said reinforcement extending from said outside wall panels; and

pouring said topping over all of said floor panels to provide a substantially monolithic floor structure.

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