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PERMANENT FORM FOR PRECAST TILT-UP CONCRETE MODULES AND PROCESS

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Fig. 2

PRIOR ART

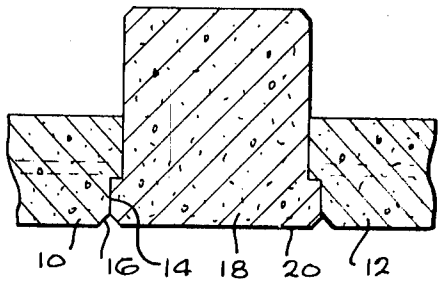


Fig. 1

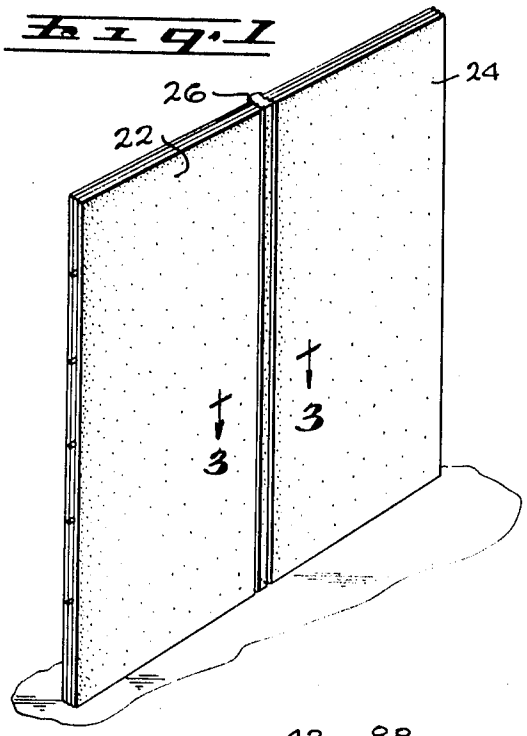
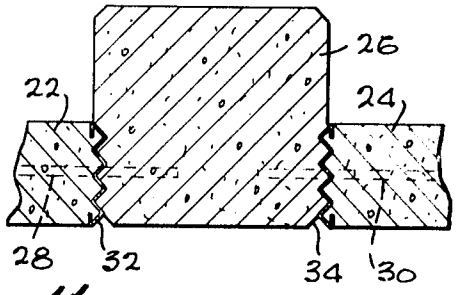


Fig. 3



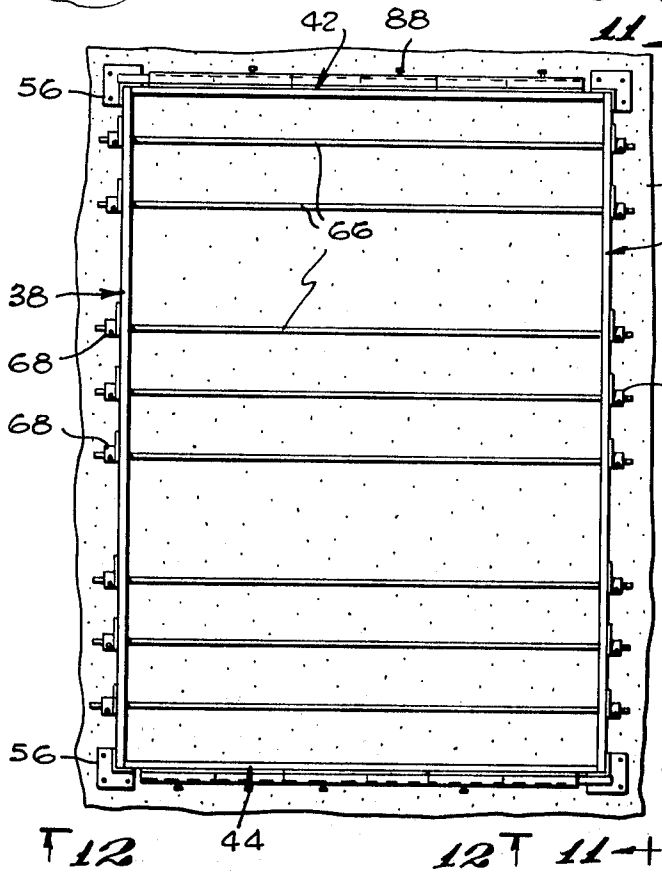


Fig. 4

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PERMANENT FORM FOR PRECAST TILT-UP CONCRETE MODULES AND PROCESS

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Fig. 5

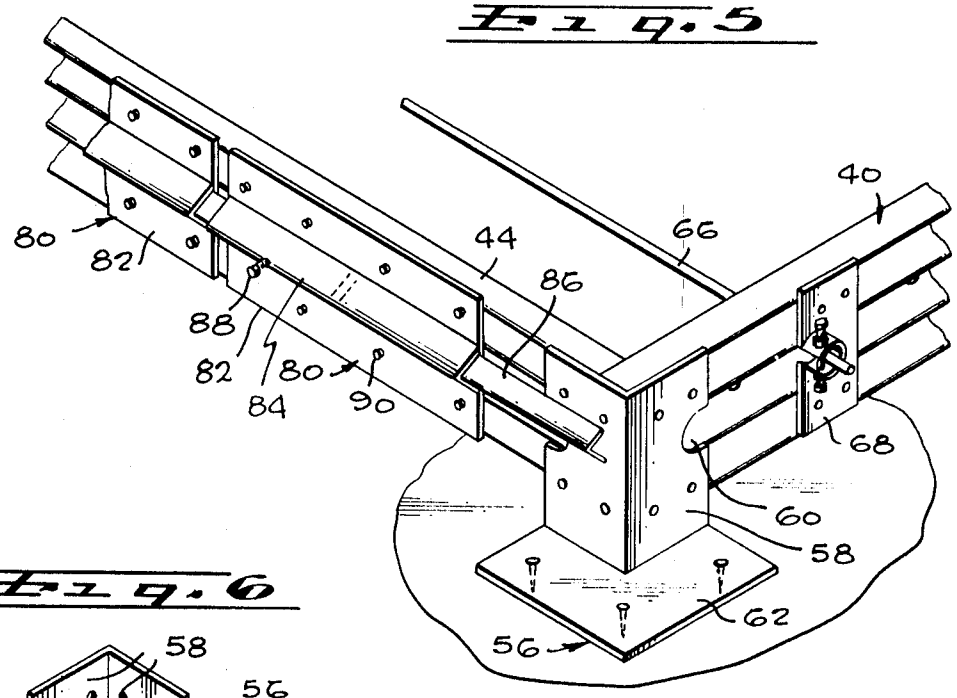


Fig. 6

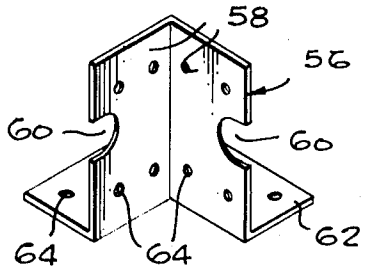


Fig. 7

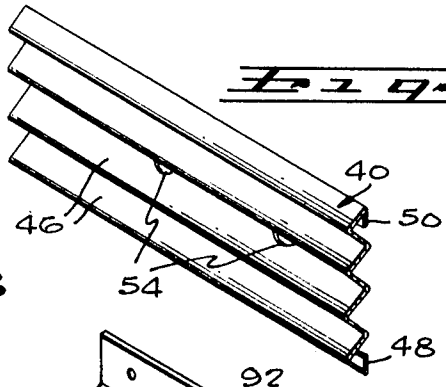


Fig. 8

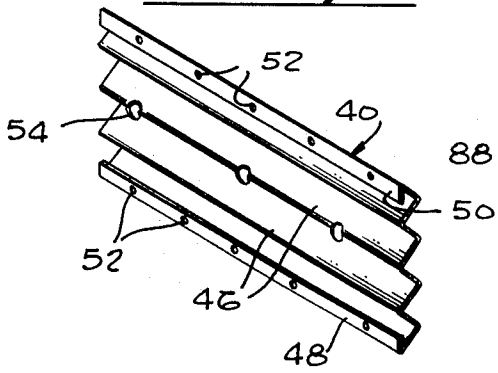


Fig. 9

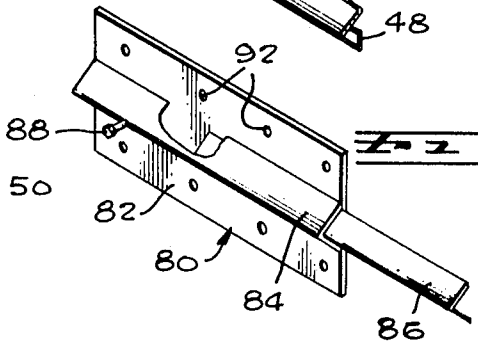
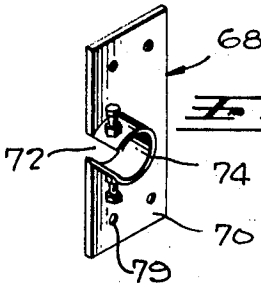


Fig. 10



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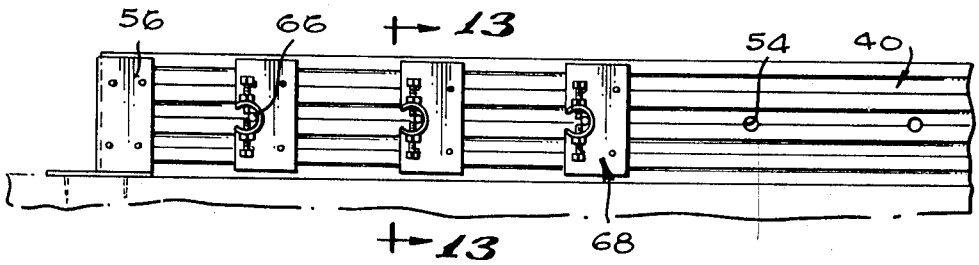
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PERMANENT FORM FOR PRECAST TILT-UP CONCRETE MODULES AND PROCESS

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Fig. 11



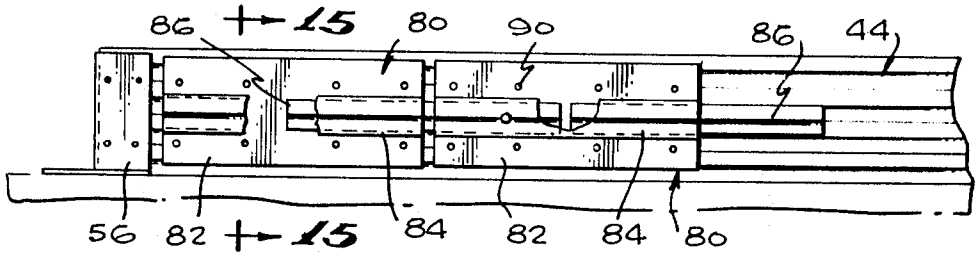


Fig. 12

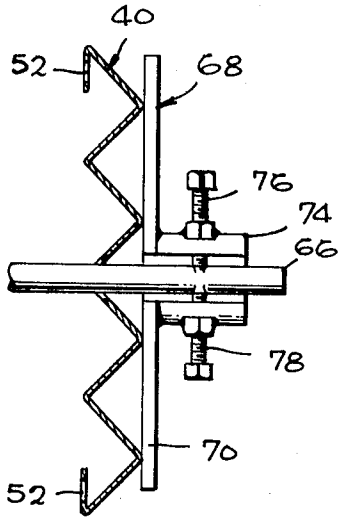


Fig. 13

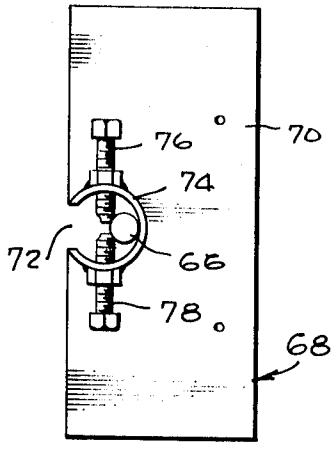


Fig. 14

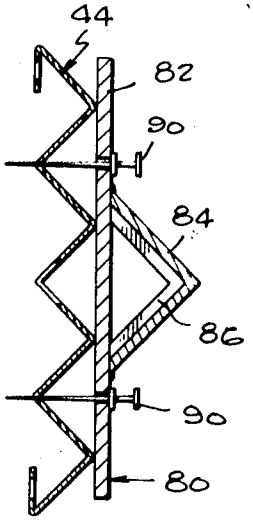


Fig. 15

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PERMANENT FORM FOR PRECAST TILT-UP CONCRETE MODULES AND PROCESS

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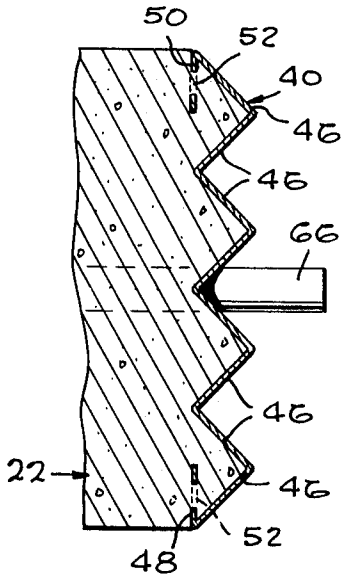


Fig. 16

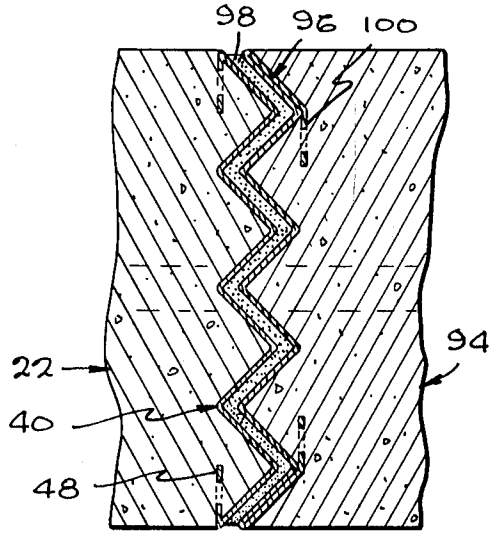
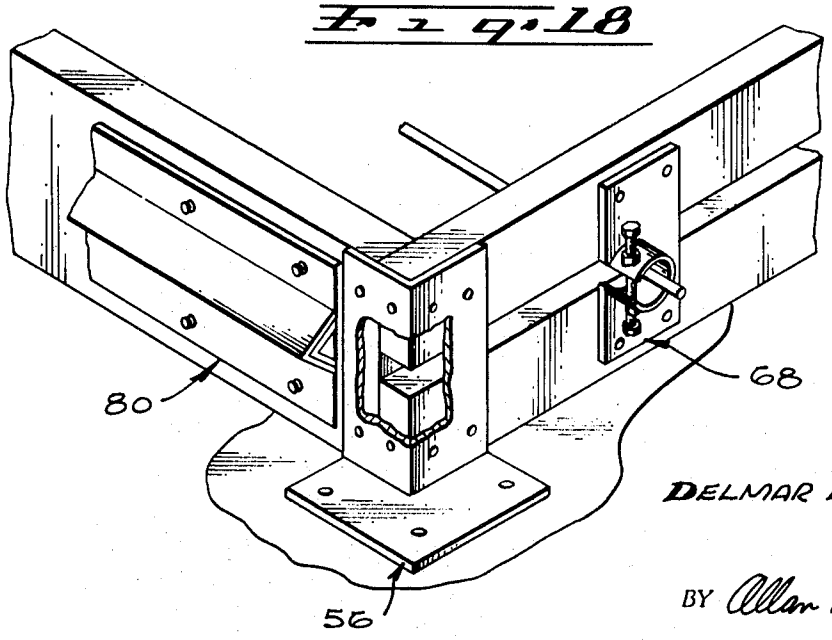


Fig. 17

Fig. 18



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PERMANENT FORM FOR PRECAST TILT-UP CONCRETE MODULES AND PROCESS

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Fig. 19

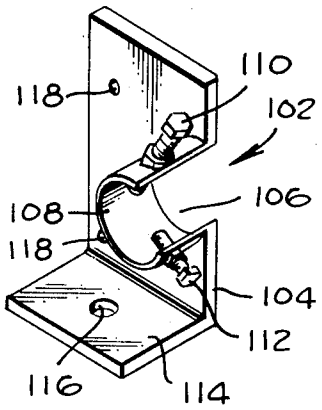
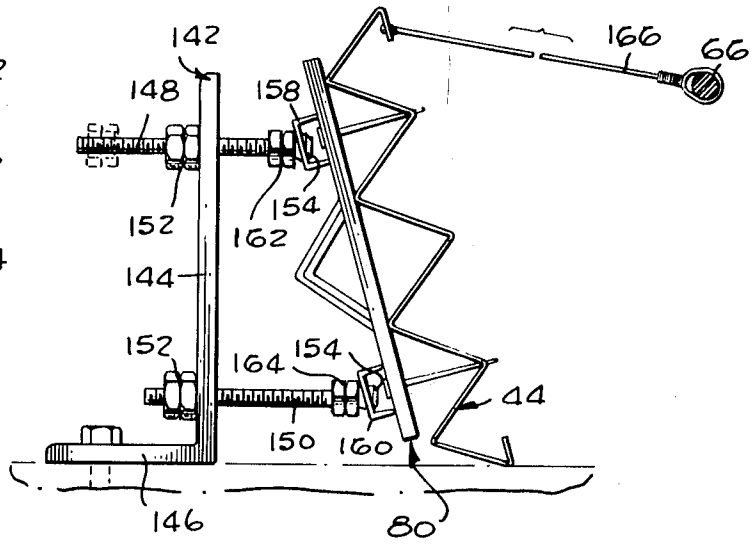


Fig. 22



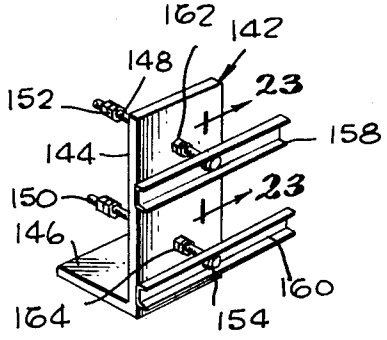


Fig. 21

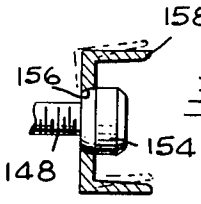


Fig. 23

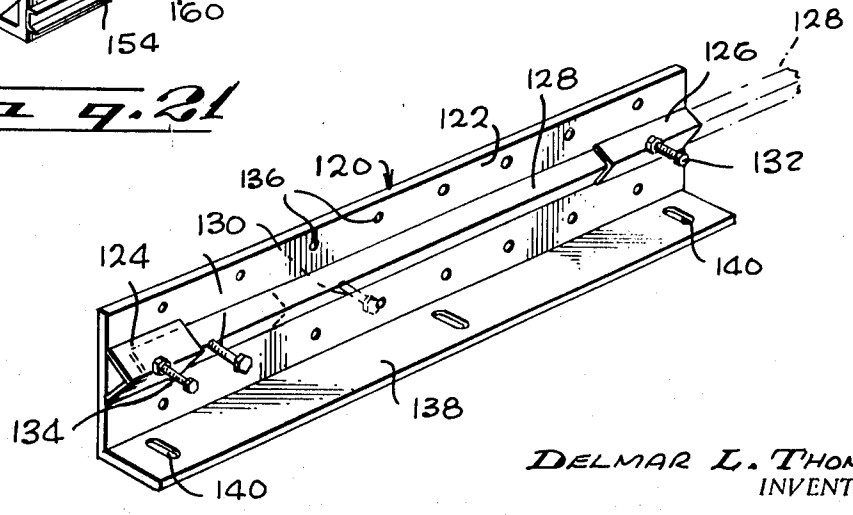


Fig. 20

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United States Patent Office

3,609,935

Patented Oct. 5, 1971

3,609,935

PERMANENT FORM FOR PRECAST TILT-UP CONCRETE MODULES AND PROCESS

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(13449 Branford St., Arleta, Calif. 91331)

Continuation-in-part of application Ser. No. 803,534, Mar. 3, 1969. This application May 1, 1969, Ser. No. 826,771

Int. Cl. E04b *1/35;* E04g *21/12*

U.S. Cl. 52—745 7 Claims

ABSTRACT OF THE DISCLOSURE

A special permanent form member serves as the form for a precast tilt-up concrete module as it is poured on a curing floor. The form member remains in place during tilt-up and serves as a joint against the pilaster. The form member serves as the concrete module form and as the finished concrete module edge and is formed with a plurality of webs which extend along the edge of the concrete module. The edges of the form member are folded in to be locked into the concrete of the precast module. The form member is used as a form for the sides, top and bottom of the concrete module. Knockouts are provided for transverse reinforcing bars so that the form members can be clamped in place to resist pouring deformation and the rebars extend into the pilasters when the finished concrete modules are are erected. Reinforcement of the top and bottom form members is managed by exterior strongbacks. Corners are employed on the curing floor to aid in initial setup. Special rebar clamps are preferably employed to transfer pouring load to the rebars. By employment of the permanent form member, forms can be more quickly produced, precast tilt-up concrete modules can be more closely spaced upon the pouring floor, and cleanup minimized for a quicker setup into building configuration.

CROSS REFERENCE

This application is a continuation-in-part of copending patent application entitled "Permanent Form for Precast Tilt-Up Concrete Modules and Process and Article," Ser. No. 803,534, filed Mar. 3, 1969 and now abandoned.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention is directed to a permanent form for precast tilt-up concrete modules, the process for producing the modules, the articles employed in creating the modules and the buildings produced by employment of these modules.

(2) Description of the prior art

The pouring and tilt-up of modules of sidewalls for building construction and other uses is well known. Tilt-up modules are presently widely used in building modern factories and warehouses. Furthermore, they may be employed in producing walls for flood control channels and in other locations where large concrete modules are required. Modern engineering has produced techniques for handling very large modules. Panels more than 24 feet in one dimension are often employed in such construction. Furthermore, such modules commonly range in thickness from 6 inches to 20 inches. All dimensions depend upon the size requirement of the building, together with the structural strength required. Thicker modules are employed where large loads are anticipated.

However, present-day techniques of producing precast tilt-up concrete modules employ wooden forms which are laid out upon the curing floor for pouring and which

are removed after pouring. Repetitive use of the form may be obtained but only for a few uses, at best, before the form is worn out or otherwise becomes unsuitable for re-use, thus entailing expensive replacement. Furthermore, considerable labor is expended in the placement and removal of the module forms, for such forms must be strong during pouring to minimize deflection. Additionally, the employment of wooden forms necessitates a fairly simple edge profile which does not fit the optimum needs in joining with a pilaster.

The employment of permanent form structure which can be easily laid out on the curing floor and permanently secured to the edges of a concrete tilt-up module overcomes the foregoing and other disadvantages and provides a superior product. While permanent forms have been known in the field of pouring concrete in horizontal slab work, those are completely unsuitable for employment in tilt-up concrete module construction.

SUMMARY OF THE INVENTION

In order to aid in the understanding of this invention, it can be stated in essentially summary form that it is directed to a permanent form member for precast tilt-up concrete modules, together with the process and articles employed in producing a tilt-up concrete module incorporating the form member as well as the production of a building by employment of the articles in the production of a concrete module and the employment of the module in building construction. The form member has a plurality of angular webs which define a plurality of channels along the outer, finished edge of the module. Inturned edges on the form member lock into the concrete to protect the module edges and define a proper surface for pilaster joining. The form members in the form are arranged so that transverse reinforcing bars can extend therethrough, and reinforcing bar clamps provide rigidity to the side form members during pouring. Additionally, and separately, a particular form of the reinforcing bar clamp aids in speedy assembly. Furthermore, corners are employed on the curing floor for laying out the forms prior to pouring. Strongbacks are secured to the portions of the form which become the top and bottom of the finished tilt-up module.

Accordingly, it is an object of this invention to provide a permanent form for precast tilt-up concrete modules, which form can be laid out upon the curing floor for the pouring of concrete therein, and the form remains upon the module and is tilted up into position. It is a further object of this invention to provide a permanent concrete form for precast tilt-up modules wherein the form is of such construction and configuration as to provide a superior joint with pilasters poured between adjoining modules. It is another object to produce a building by producing a plurality of precast tilt-up concrete modules by employment of the permanent form member of this invention, including production of the modules on the pouring floor and tilt-up of the modules into building wall position.

It is still another object of this invention to provide a permanent form for precast tilt-up concrete modules wherein the form is of maximum rigidity for the particular amount of form material so that deflection during pouring is minimized. It is another object of this invention to provide forms for precast tilt-up concrete modules wherein reinforcing bars can extend through the forms which are positioned on the sides of the module so that the extending reinforcing bars can be cast into joining pilasters. It is still another object to provide a reinforcing bar clamp in association with the permanent form of this invention so that the clamps can be quickly and tightly engaged to the reinforcing bars to inhibit deflection of the side form members of the module. It is another object

to provide a strongback which can be detachably secured to the form members which will be the tops and bottoms of the finished tilt-up concrete module to provide adequate strength to the top and bottom form members during the pouring operation. It is a further object to provide strongback support which supports the strongback and top form member angularly with respect to the floor to permit casting of modules with angular tops.

It is another object to provide for form corners which are employed on the curing floor to aid in the laying out of the permanent form in preparation for concrete pouring. It is another object to provide an alternative permanent form member of such configuration as to directly interfit with the preferred form member so that flush wall construction without the employment of pilasters can be obtained.

Still other objects, features and attendant advantages of the present invention, together with various modifications, will become apparent to those skilled in the art from a reading of the following detailed description of the preferred embodiments constructed in accordance therewith, taken in conjunction with the accompanying drawings wherein like numerals designate like parts in the several figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of two tilt-up concrete modules in the tilted-up position and employing the permanent form of this invention therewith.

FIG. 2 is a fragmentary horizontal section showing adjoining prior art tilt-up concrete modules and the pilaster poured therebetween.

FIG. 3 is an enlarged fragmentary horizontal section taken generally along the line 3—3 of FIG. 1, in the same aspect as FIG. 2.

FIG. 4 is a top plan view of the permanent form of this invention laid out on the curing floor and ready for pouring.

FIG. 5 is an enlarged fragmentary perspective view taken from a corner of the form shown in FIG. 4.

FIG. 6 is a perspective view of the corner employed on the curing floor to aid in setting up of the form for pouring.

FIG. 7 is an outside perspective view of the form member of this invention.

FIG. 8 is an inside perspective view of the form member of this invention.

FIG. 9 is a perspective view, with parts broken away, of an alternative embodiment of the strongback employed with the top and bottom form members of the form.

FIG. 10 is a perspective view of an alternative embodiment of the reinforcing bar clamp employed to prevent deflection of the side form members of the permanent form of this invention.

FIG. 11 is an enlarged partial side elevational view, taken generally along line 11—11 of FIG. 4.

FIG. 12 is an enlarged partial end elevational view, taken generally along line 12—12 of FIG. 4.

FIG. 13 is an enlarged section taken generally along line 13—13 of FIG. 11.

FIG. 14 is an enlarged side elevational view showing the alternative clamp engaged on a reinforcing bar.

FIG. 15 is an enlarged section taken generally along line 15—15 of FIG. 12.

FIG. 16 is a section taken through a portion of a concrete tilt-up module showing the permanent form thereon.

FIG. 17 is a sectional view showing the preferred embodiment of this invention in engagement with another embodiment of a permanent form member which directly interengages therewith.

FIG. 18 is an enlarged fragmentary perspective view of a form for precast tilt-up concrete modules, which form employs wooden form members together with some of the other form structures in accordance with this invention.

FIG. 19 is a perspective view of the preferred embodiment of the reinforcing bar clamp of this invention.

FIG. 20 is a perspective view of the preferred embodiment of the strongback of this invention.

FIG. 21 is a perspective view of the top and bottom support brackets.

FIG. 22 is an enlarged view showing the support brackets supporting a strongback at an angle with respect to the pouring floor, which strongback in turn supports a top or bottom permanent form member.

FIG. 23 is an enlarged section taken generally along the line 23—23 of FIG. 21.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First referring to the prior art of FIG. 2, portions of prior art panels **10** and **12** are shown therein. These panels were formed on a horizontal curing floor with the employment of wooden forms. Since wooden forms were employed, the edge configuration of panels **10** and **12** is necessarily fairly simple, the configuration including step **14** and beveled edge **16**. After positioning panels **10** and **12** in the vertical position, pilaster **18** was poured therebetween. Pilaster **18** was similarly formed with a beveled edge. Normally, side **20** is the inside of the building formed of panels **10** and **12** because it is preferable to have the flush surface on the inside. Furthermore, the pilaster **18** extending on the exterior provides architectural interest. However, in other situations, side **20** may be the outside. The beveled edges are provided because there is always separation between the panels and pilaster. This separation is primarily caused by ambient temperature changes. Thus, this beveled edge prevents the appearance of an unsightly crack. Since both of the facing surfaces of the panels and the pilaster are concrete, and concrete is hygroscopic, rain which engages the building at the crack seeps through to the interior. It creeps along the concrete surfaces until the interior at the crack is wet.

Referring to FIGS. 1 and 3, two exemplary tilt-up concrete modules employing the permanent form of this invention are indicated at **22** and **24**. In normal building construction, they are tilted up somewhat spaced from each other and pilaster **26** is poured therebetween. Reinforcing bars **28** and **30** extend out of the edges of the modules and are engaged in pilaster **26** as the pilaster is poured therein. Again, bevels **32** and **34** form a V-notch at the junction of the modules and the pilasters to eliminate any unsightly crack appearance.

Referring to FIG. 4, the permanent form is shown laid out on a curing slab **36** ready for pouring. In view of the fact that the module to be poured therein is normally to be erected by tilting it up 90° from its poured position, convenient reference will be made to form member **38** as the left form member, and form member **40** will be referred to as the right form member. Similarly, form member **42** will be referred to as the top form member, and form member **44** will be referred to as the bottom form member. These positions refer to the finished module in the erected position, and it will become clear that the top and bottom form members are identical, and the left and right form members are identical. Thus, the module can be erected with either form member **42** or form member **44** at the top, and in some special circumstances it may be desirable to have them serve as ends. However, it will become clear from the following specification that the tops and bottoms are slightly different than the sides so that, in normal construction, the sides are normally vertically oriented. There is no difference in the form members, but only in the manner of corner treatment. Thus, all form members **38**, **40**, **42** and **44** are identical except as to length.

Referring principally to FIGS. 7, 8 and 16, the form member **40** is shown therein. As previously stated, the form members are all identical so that description of

form member **40** will serve as description of each of the form members. Form member **40** comprises material of substantially uniform thickness formed so as to have a plurality of webs angularly related to each other and extending longitudinally of the form member. The webs are best illustrated at **46** in FIG. 16. Adjacent webs are preferably positioned at 90° with respect to each other, for such construction provides maximum resistance against bending in the lateral direction out of the general plane of form member **40** for a particular weight per unit length. Furthermore, there are sufficient webs **46**, joined by adjacent 90° angles to provide four points and three intermediate channels facing in the outward direction, as seen in FIG. 16, for a form member having a sufficient width to serve as a form for a precast tilt-up concrete module six inches thick. Depending upon the method of manufacture of the form member, various numbers of points and intermediate channels may be employed. However, for the form member of six inch width of this exemplary illustration, four points and three channels is considered the minimum number.

For wider form members, four points and three channels is also considered the minimum satisfactory number, although the maximum number of channels is such that they are not dimensionally smaller than those indicated in the six inch thick concrete module form illustrated for FIG. 16. In this example, the preferable present material is 24-gauge galvanized iron, although any convenient type of material, such as other types of sheet metal, synthetic polymer composition material in extruded or rolled form, with or without reinforcing or filler material, or extruded metal such as aluminum, can be employed.

The edges of the form member are finished by inturning flanges **48** and **50**. These inturned flanges anchor the form member into the edge of the tilt-up concrete module. Holes **52** in these flanges permit the concrete to bond through the holes in the flanges to securely lock the flanges and the entire form member in place upon the edge of the precast tilt-up concrete module.

Additionally, the form members are provided with knockouts **54** which can be knocked out to permit reinforcing bars to be positioned so that they extend through the form members. In the six inch thick form illustrated, a single row of knockouts is satisfactory. However, when wider form members are employed for the pouring of thicker walls, more than one layer of reinforcing bars may be desired. In this case, as many rows of knockouts will be provided as may be required for reinforcing bars. Only those knockouts are removed, to provide holes for the reinforcing bars, as are needed for reinforcing bars. Thus, sufficient knockouts can be provided to permit holes to be made for reinforcing bars for the most difficult situations but, where fewer reinforcing bars are required, no leakage occurs.

In order to aid in the setting up of the form members on the pouring floor or curing slab **36**, corners **56** (see particularly FIGS. 5 and 6) are employed. Each of the corners is identical, and comprises an upright with two flanges **58** secured at right angles to each other. Flanges **58** are notched at **60** to permit the passage of reinforcing bars near the corner should such be required in the particular precast tilt-up concrete module being poured. Flanges **58** are secured to foot **62** which permits the corners to be secured to the casting floor **36**. Holes **64** in the foot permit suitable securement means such as removable anchor fasteners to be driven through the foot into the casting floor.

For layout of the form, four corners **56** are appropriately positioned upon curing slab **36** in accordance with the required dimension of the desired precast tilt-up concrete module. The standard for such modules is 19 feet wide by 21 feet tall, although the size may vary from 7 feet wide to 30 feet tall, for 6-inch thick modules, and other dimensions for thicker modules. After placement of the corners, left and right form members **38** and **40** are positioned within the corners to extend all the way into the corners, as is illustrated in FIGS. 4 and 5. This provides for the points and channels of the side form members to extend all the way from top to bottom of the modules. Thereafter, top and bottom form members **42** and **44** are placed between the left and right form members at the ends thereof, within corners **56**. Thus, the top and bottom form members help hold the side form members out against the corners during further assembly. Additional corner holes **64** in the flanges **58** permit suitable securement means such as sheet metal screws to be driven through the flanges into the form members.

The proper knockouts **54** on the side form members had been knocked out prior to their being placed, as a preferable measure, although the knockouts can be removed after the side form members are positioned in the corners. The next step is the placement of reinforcing bars **66**. A sufficient number of these bars is placed in accordance with the overall dimensions of the particular precast tilt-up concrete module and the concrete strength. Reinforcing bars from ⅜ inch to 1-inch diameter are employed normally in accordance with requirements. Reinforcing bars **66** are of sufficient length to extend out through the openings in the form members so that they can be cast into pilaster **26**, as is illustrated in FIG. 3. In that figure, the reinforcing bars are indicated at **28** and **30** respectively in modules **22** and **24**. Another reason for permitting the reinforcing bars to extend out through the side form members is that, with the installation of appropriate reinforcing bar clamps, the reinforcing bars can be employed as waler rods during the pouring to prevent spreading of the side form members.

The preferred embodiment of the clamp of this invention is generally indicated at **102** in FIG. 19. Clamp **102** has a baseplate **104** which has opening **106** therein. Body **108** is in the form of an open-sided tube and is positioned over opening **106**, and is secured to baseplate **104**. Thus, an opening extends through opening **106** and body **108**. Additionally, the side of both the baseplate and the body are open so that a reinforcing bar may be inserted into the side of the opening in the body.

Clamp bolts **110** and **112** are threadably engaged in body **108** and are angularly related to each other at approximately 90°, and are directed from adjacent the open edges of the opening in the body and the baseplate toward the closed, inner side thereof. Thus oriented, clamp bolts **110** and **112** are adapted to engage on reinforcing bars of any size which are able to pass into the opening. The ends of the clamp bolts engage on the bar and force the bar into the back side of the body, and clamp the bar thereagainst. Thus, tight and rigid clamping is accomplished in the U-shaped body formed by the open-sided tube.

Additionally, clamp **102** has an angularly positioned flange foot **114** thereon. Flange foot **114** is preferably integrally formed with baseplate **104** so that they are part of the same rigid structure. Foot **114** has at least one hole **116** therein which permits clamp **102** to be secured to the slab curing floor. Furthermore, clamp **102** has bolts **118** therein which permits the clamp to be secured against the adjacent form member by the driving of nails and screws therethrough.

An additional clamp in accordance with this invention is illustrated in FIGS. 5, 10, 11, 13 and 14 and is generally indicated at **68**. Clamp **68** has a flat baseplate **70** which is preferably of sufficient size to extend across all of the points on the form member with which it is to be employed. Opening **72** is provided in the side of the baseplate, and U-shaped body **74** is secured to baseplate **70** and is superimposed over opening **72**. As is best illustrated in FIG. 14, a U-shaped body **74** is preferably in the form of a tubular cylinder having one side thereof cut out. The side openings in body **74** and baseplate **70** are of sufficient size as to accept the largest reinforcing

bar **66** with which clamp **68** is to be employed. Opposing clamp bolts **76** and **78** are threadedly engaged in openings in body **74** so that the clamp bolts are substantially axially aligned as is indicated in FIGS. 13 and 14. Either body **74** may be threaded, or threaded members such as nuts can be secured to the body, in the manner illustrated in these figures.

In use, at least one of the clamp bolts is backed off, and clamp **68** is slipped sidewards over the reinforcing bar **66**. Baseplate **70** is engaged against the form member, and the backed off bolt is clamped against the reinforcing bar. Preferably, the reinforcing bar is substantially centered vertically in opening **72**, by appropriate adjustment of the clamp bolts. The clamp bolts may extend different lengths for different diameters of reinforcing bar, but the structure is so dimensioned that it can clamp on any size of reinforcing bar which is employed by tightening the bolts to force the reinforcing bar **66** into the back of opening **72** against body **74**, as illustrated. Securement means such as sheet metal screws or other fasteners may be driven into the form members through holes **79** in the baseplate **70** to prevent lateral or rotary movement of the clamp and reinforcing bar. These figures indicate the employment of clamp **68** in association with the form members in creation of a precast tilt-up concrete module. However, it is equally clear that clamp **102** may be so employed, together with the advantage of more secure clamping and with the advantage of securability of the clamp **102** to the casting slab.

When all of the reinforcing bar **66** and their clamps **68** are installed, the side frame members are ready for pouring because the clamps permit the reinforcing bars to act as waler rods to prevent the side form members from spreading. However, the top and bottom form members need reinforcement to prevent deflection from the load of the poured concrete as it is poured.

The preferred embodiment of the reinforcement strongback is generally indicated at **120** in FIG. 20. Strongback **120** has a baseplate **122** which is preferably substantially as wide as the points on the top and bottom form members so that the baseplate can engage upon all of the points. Furthermore, the baseplate is fairly long, and may be as long as the top and bottom form members. However, it is preferably somewhat shorter, for example, one-third to one-half that length, for convenience in handling to prevent the weight of a single strongback from becoming too great.

Strongback **120** has housings **124** and **126** thereon which are in the form of angle irons having their flanges secured to the back of the baseplate. Housings **124** and **126** are positioned at the ends of the baseplate to act as a guide for tongue **128**. Tongue **128** is in the form of an angle iron which is substantially equal to the length of baseplate **122**. Thus, when the tongue is not extended, it is retained by housings **124** and **126**. However, bolt **130**, which is threaded through tongue **128**, can be loosened and employed as a handle to slide tongue **128** to the right, to the dotted line position. In that position, bolt **130** is tightened down, as is bolt **132**, to retain the tongue in the extended position. In the extended position, the tongue enters into the housing **124** of the adjacent strongback (not shown) and is secured therein by tightening bolt **134**. Thus, a series of strongbacks can be arranged so that they have an interengaging configuration. Any reasonable length can thus be assembled out of a plurality of strongbacks **120** to accomplish the strengthening of a top or bottom form member.

Holes **136** permit securement of the strongback to the form members by the driving of nails or screws through these holes and through the form member. This reinforcement on the top and bottom form members gives the necessary strength to the form members in the longer length to resist excessive deformation during pouring. Additionally, strongback **120** has foot **138**. Foot **138** is a flanged foot, preferably formed integrally with baseplate **122** so as to be rigid and secure with respect thereto. Foot **138** has holes **140** therein and, by the employment of nails or other suitable securing means through holes **140**, the strongback can be secured to the curing floor. Thus, rigid strongback securement and positioning maintains the strength of the top and bottom form members.

An additional strongback construction is illustrated in FIGS. 4, 5, 9, 12 and 15. The strongback illustrated therein is capable of the same employment, except for the securement to the pouring floor because it has no integral foot. It is clear, however, that the strongback of FIGS. 9 and 12 can employ an integral foot, if such construction is desired. Furthermore, the housing construction of the strongback **120** need not be employed in conjunction with an integral foot, but can be employed on a simple baseplate such as that described with respect to strongback **30**.

Reinforcement strongbacks for the top and bottom form members are illustrated in FIGS. 4, 5, 9, 12 and 15. The strongbacks are generally indicated at **80**. Strongbacks **80** have baseplate **82** which is preferably of sufficient dimension to engage all of the points on the upper and lower form members. To the outside of the baseplate **82** is secured housing **84**, which may be in the form of an angle iron as illustrated. Positioned interiorly of one end of housing **84** and extending therefrom is tongue **86**. Tongue **86** is permanently secured within the housing, and is of such length as to extend therefrom on one end and leave the other end of housing **84** vacant for the reception of an adjacent tongue. Lock bolt **88** is threadably engaged in housing **84** adjacent the vacant end of the housing.

Thus, when adjacent strongbacks **80** are put in place, the tongue on one strongback engages in the vacant end of the housing on the other so that the two strongbacks are rigidly secured together. Securement is enhanced by tightening of lock bolt **88**. In use, an appropriate number of strongbacks **80** are assembled longitudinally of each other and are positioned against the top and bottom form members, as is illustrated in FIGS. 5, 12 and 15. Tongue **86** on the end strongback engages around corner **56** to help hold the top and bottom form members outward prior to the pouring of concrete. The strongbacks are secured to the form members as by double-headed nails **90** or preferably sheet metal screws which engage through appropriate holes **92** in baseplate **82** and through the top and bottom form members, as is illustrated in FIG. 15.

The top and bottom form members have been illustrated in FIGS. 4, 5, 12, 15 and 18 as lying at right angles with respect to the pouring floor. It will be appreciated that in some cases it is desirable that the top of the precast module have an outward slope for the engagement of a roof thereon at the appropriate angle, or roof beams at roof pitch, or for other reasons. In any event, in some cases it is desirable for one or both of the top or bottom form members to lie at an angle other than perpendicular with respect to the pouring floor.

Support bracket **142** is generally indicated in FIGS. 21 and 22 as being employed in association with strongback **80**. It is clear, however, from the manner of employment of support bracket **142** that its utility resides in the angular support of the strongback and this is independent of whether or not the strongback tongue is fixed or movable. Accordingly, either strongback **80** or strongback **120** could be employed therewith, providing the foot **138** of strongback **120** was arranged to be positioned out of the way. Alternatively, a strongback as indicated at **120** could be employed without the foot **138**, and accordingly would be freely interchangeably usable with support bracket **142**.

Support bracket **142** comprises baseplate **144** to which is secured foot **146**. Foot **146** is arranged to be supported on and secured to the pouring floor so as to secure the

support bracket **142** in any desired location. Jack-screws **148** and **150** are threaded in baseplate **144** so that their manner of extension can be selected. A pair of nuts **152** is locked together on the outer end of the jack-screws to serve as a handle means for turning the jack-screws to position them at an appropriate position of extension through the baseplate. The outer end of each jack-screw carries a portion of a sphere, as is indicated in detail in FIG. 23. Here the portion of the sphere **154**, or shape similar thereto, engages in an appropriate mating hole **156** in channel **158**.

As is indicated in dotted lines in FIG. 23, the substantially spherical shape of ball **154** in the appropriate hole **156** permits channel **158** to lie at an angle with respect to the axis of jack-screws **148**. A similar channel **160** is mounted upon a similar ball-like shape on the end of jack-screw **150**. Nuts **162** and **164** are respectively mounted in pairs on jack-screws **148** and **150** behind the channels. Thus, when the appropriate positioning is obtained, nuts **162** and **164** may be tightened up against the back of the channel, while nuts **152** can be tightened up against the back of the support bracket. This maintains the appropriate angular relationship. By this means, both the top and bottom form members can be arranged at the desired angle for the particular module being precast for tilt-up. Furthermore, if the strongback remains in position from one casting to the next, each of the top and bottom angles remains the same, to permit and provide for consistent results. A plurality of restraining wires **166** may be anchored to reinforcing bars **66** as by twisting an end thereabout, with the other end similarly secured to the inturned upper flange **50** at respective holes **52**.

The precast tilt-up concrete module is provided with an appropriate number of suitably located conventional lifting points so that, upon completion of pouring and curing, the finished module can be lifted into place. The forms are now ready for pouring.

After concrete pouring and curing, certain portions are removed before lifting. Clamps **68** are removed by loosening one of the bolts, and strongbacks **80** are removed by pulling the nails **90**. Now the precast tilt-up concrete module is ready for lifting into place. Prior to lifting, during lifting or after lifting, any leakage or flash from the concrete is easily knocked off. There may be some concrete leakage through reinforcing bar holes **54**, but normally, this is not of sufficient volume to warrant correction. Additionally, there will be some leakage at each corner between the juncture of the side forms and top and bottom forms. However, this leakage is normally sufficiently controlled by the corners **56** that hand work is unnecessary.

After placement of the tilt-up module with its form members **38**, **40**, **42** and **44** in place, a suitable pilaster **26** is poured. The extension of the reinforcing bars into the pilaster provides rigid joining. Furthermore, the employment of the forms at the interface between the pilaster and the modules prevents seepage of water through the crack therebetween. Since the form metal is not hygroscopic, any water that reaches the exterior portion of this crack runs to the bottom rather than seeps inwardly into the building. Furthermore, the top form member **42** conveniently aids in finishing off the roof structure because nails more readily attach through the metal form to permit more secure fastening of turret and roof elements.

Referring to FIG. 18, the use of corners **56**, clamps **68** and strongbacks **80** is illustrated in connection with a conventional wooden form. In this case, these articles are employed in the same manner, but are secured to the removable wooden form instead of being employed in conjunction with the permanent form. Thus, corners **56** are secured to the pouring and curing slab and the wooden forms are assembled therein. The corners aid in restraining the wooden form in position during assembly and pouring. Clamps **68** or **102** are positioned on the appropriate wooden side form members and strongbacks **80** or **120** on the top and bottom wooden form members. Upon disassembly, corners **56** need to be removed so that the wooden form members can be removed from the precast slab before tilt-up.

Referring to FIG. 17, module **22** is illustrated as lying against a module **94**. As is clear from FIG. 3, when a pilaster is poured between modules of the preferred embodiment of the tilt-up concrete module, identical form members are used. However, when smooth surfaces are desired on the inside and outside of the jointed modules, an alternative form **96** is employed. Such a form is employed where modules lie directly adjacent to each other, as in walls for flood control channels and the like. In such a case, mastic **98** or a comparable material is employed between the form members upon assembly. Form **96** provides points and channels facing outwardly as to mate with the form member **40**. Inturned flanges **100** are positioned parallel to flanges **48** and are directed inwardly in such a position as to engage in and lock in the concrete of the module. Holes are provided in the inturned flanges to permit concrete bonding therethrough.

The invention having been described in its preferred embodiment, and alternative or modified embodiments disclosed, it is clear that this invention is susceptible to numerous modifications and embodiments within the ability of those skilled in the art and without the exercise of the inventive faculty.

What is claimed is:

1. The process of producing a building from precast tilt-up concrete modules having a permanent form thereon, comprising the steps of:

positioning a plurality of permanent form members on a pouring floor in substantially abutting relationship, with the permanent form members being attached to the pouring floor only for purposes of maintaining alignment, the permanent form members being related to each other in such a manner as to form a sufficiently rigid form without applying tensile stresses in the pouring floor;

positioning reinforcing bars across the area defined by the form members and through opposite form members;

clamping at least some of the reinforcing bars with respect to the opposite form members so that horizontal stresses on the form members as a result of pouring concrete therebetween are equalized between each other and opposed by the reinforcing bars;

pouring concrete in the area defined by the form members to produce a concrete module having a permanent form thereon; and

tilting the module up to form a part of a wall.

2. The process for producing a building from precast tilt-up concrete modules comprising the steps of:

disposing a plurality of permanent form members on a pouring floor in an enclosing formlike relationship;

inter-engaging the form members so that the stresses of pouring concrete therebetween are transferred between the form members without substantial tensile stress on the pouring floor, said inter-engaging step including

positioning reinforcing bars through opposite form members; and

clamping at least some of the reinforcing bars with respect to the opposite form members so that the spreading loads on opposite form members are transferred as tension to the reinforcing bars;

pouring concrete into the enclosure defined by said permanent form members to produce a concrete module having a permanent form thereon; and

tilting up the module with the form members thereon so that the module is positioned to serve as a building wall.

3. The process of claim **2** further including:

tilting up a plurality of precast concrete modules with the edges thereof spaced from each other; and

pouring a concrete pilaster in engagement with the edges of the tilted-up concrete modules.

4. The process for producing a precast tilt-up concrete module having a permanent form thereon, comprising the steps of:

forming a plurality of permanent form members with an inturned flange;

securing corners on the pouring floor;

positioning a plurality of such permanent form members on a pouring floor in substantially abutting relationship and into the corners to restrain the permanent forms;

pouring concrete into the area defined by the form members so that the concrete permanently interlocks with the form members including by flowing behind the inturned flanges so that the form members permanently remain on the module and define the edges thereof; and

tilting up the module with the form members thereon.

5. The process of producing a building from precast tilt-up concrete modules having a permanent form thereon, comprising the steps of:

securing corners onto a pouring floor;

positioning a plurality of permanent form members onto the pouring floor in substantially abutting relationship and into the corners to maintain the permanent form members in alignment prior to and during pouring of concrete therein with the permanent form members being attached to the pouring floor only for purposes of maintaining alignment, the permanent form members being related to each other in such a manner as to form a sufficiently rigid form without applying tensile stresses in the pouring floor;

pouring concrete in the area defined by the form members to produce a concrete module having a permanent form thereon; and

tilting the module up to form a part of a wall.

6. The process for producing a building from precast tilt-up concrete modules comprising the steps of:

disposing a plurality of permanent form members on a pouring floor in an enclosing formlike relationship;

positioning reinforcing bars through opposite form members;

clamping at least some of the reinforcing bars with respect to the opposite form members so that the spreading load on opposite form members of pouring concrete therebetween are transferred as tension to the reinforcing bars without substantial tensile stress on the pouring floor;

pouring concrete into the enclosure defined by said permanent form members to produce a concrete module having a permanent form thereon;

unclamping the reinforcing bars; and

tilting up the module with the form members thereon so that the module is positioned to serve as a building wall.

7. The process of claim 6 further including:

tilting up a plurality of precast concrete modules with the edges thereof spaced from each other; and

pouring a concrete pilaster in engagement with the edges of the tilted-up concrete modules.

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