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S. S. JOY

2,295,216

BUILDING CONSTRUCTION

Filed April 8, 1939

3 Sheets-Sheet 2

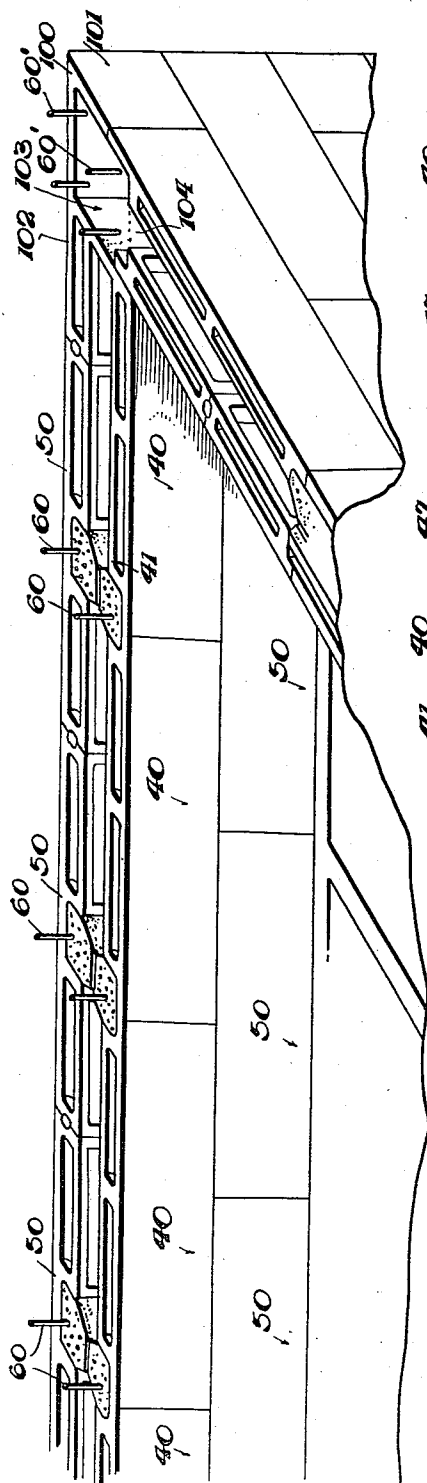
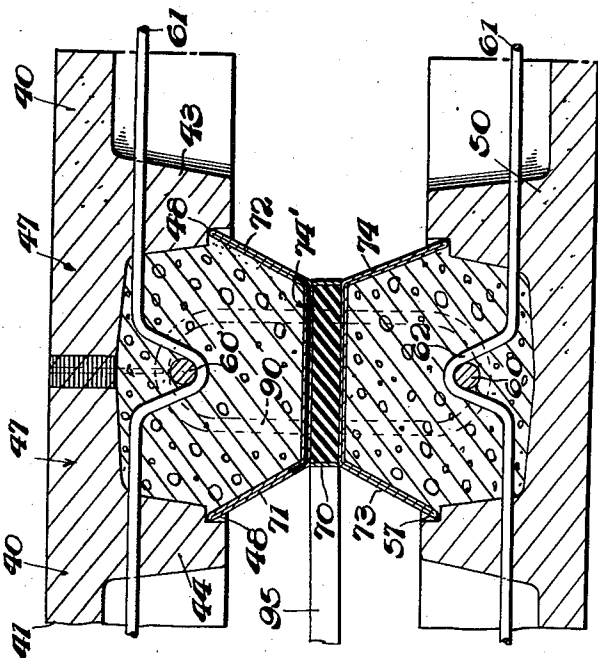


Fig. 4.

Fig. 5.

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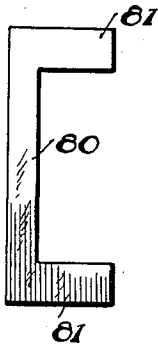
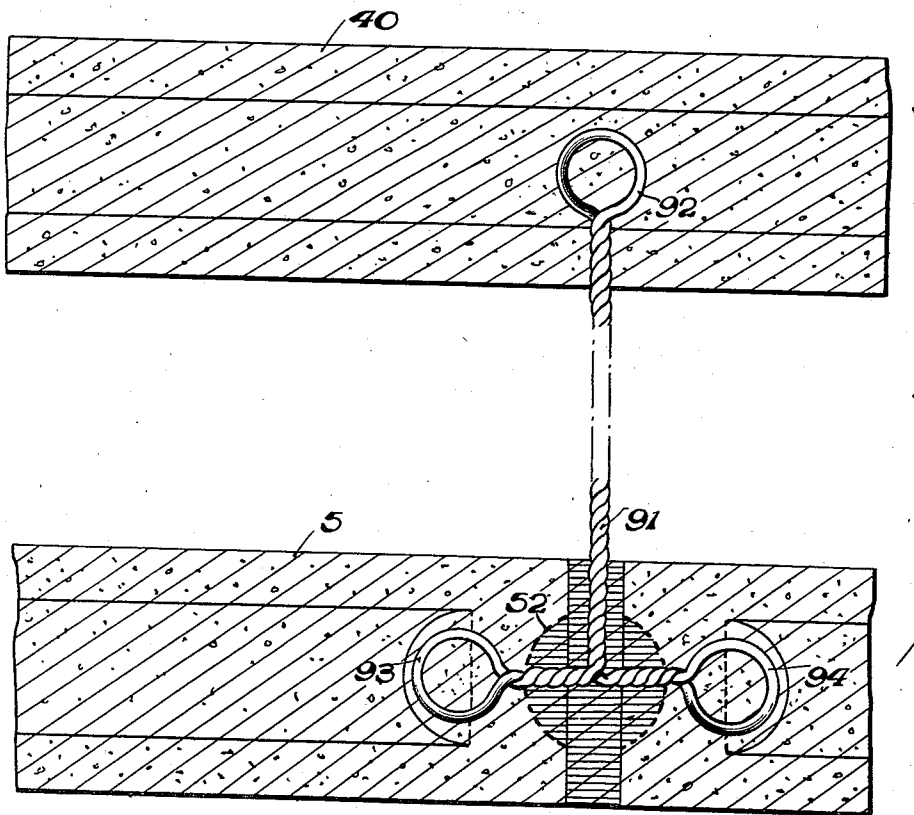


Fig. 6.

Fig. 7.



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BUILDING CONSTRUCTION

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This invention relates to an improved method of building construction, more particularly to an improved method of utilizing precast building units in which the ultimate structure, to a large extent, is comprised of prefabricated building units and, to a lesser extent, of field cast units.

As is known in concrete construction, it has been the practice to prefabricate certain of the heavier, stress taking units, such as beams, columns, girders, and the like, and to form the greater mass of the construction, i. e., floors, walls, and the like, at the site. Such methods of construction necessitated the transportation and handling of heavy and cumbersome units, such as the large beams and girders. Furthermore, under this older method, relatively large volumes of concrete, constituting usually about 80 to 90 per cent. of the total concrete construction, had to be made, transported, and handled at or near the site of the building. In these circumstances, as those skilled in the art know, it was very difficult to insure uniform setting of the concrete because at the building site it was submitted to different, and sometimes inclement, weather conditions. Again, such earlier methods involved the casting of relatively large areas, such as floors and the like. In such circumstances, the difficulties due to the formation of "laitance" were greatly accentuated.

The present invention differs fundamentally from the older methods of construction in that it involves a novel concept. The invention, considered in a broad sense, comprehends the concept of utilizing prefabricated lighter units to a maximum degree, and then juxtaposing these at the site and casting supporting stress taking members, such as beams, girders, columns, and the like, directly in contact with such prefabricated units. As will be seen more fully hereinafter, from such a concept a number of decided advantages flow. The prefabricated units, which comprise the larger proportion of the ultimate structure, may be made at the factory under optimum conditions, rather than at the site, thus insuring greater uniformity and standardization with respect to such factors as size, tensile strength, density, and the like.

Similarly, under the concept of the present invention, the prefabricated members are composed of relatively light-weight or porous concrete and are thus correlated, in a special manner, with the ultimate field cast members. In carrying out the invention, the precast, construction units, such as floor and wall units are suitably juxtaposed in such circumstances that the ultimate stress tak-

ing units are cast in contact with such prefabricated units. This method of construction enables the employment of aqueous concrete for the major stress taking members and, furthermore, enables the aqueous concrete to set and hydrate in contact, over a large proportion of its area, with the more porous prefabricated units. Under these conditions, the precast units, which encase or encompass the plastic, denser concrete, act as absorption units tending to rapidly and uniformly abstract water from the aqueous, concrete, plastic mass. With this type of operation the poured, aqueous concrete tends to set more rapidly and to form a more homogeneous structure. A factor of peculiar advantage, under the improved method of operation, is that the laitance, so common under the older forms of construction, is here completely eliminated, due, as pointed out, to the fact that the precast porous units are positively utilized as absorption members, to take up, disseminate, and ultimately dissipate this undesired aqueous medium.

Again, under the present method of construction a mass of aqueous concrete, during the period of its setting, is contacted over a large proportion of its area with precast members. In these circumstances, the aqueous concrete tends, under the influence of such factors as positive hydrostatic pressure, capillarity, and the like, to flow into and fill up the voids or pores in the areas of the precast units adjacent the mass of aqueous concrete. This type of association of a prefabricated unit, with a confined mass of wet concrete, insures the ultimate production of a true monolithic type of structure in that the denser column, beams, girders, and the like, are inextricably locked to the prefabricated units by reason of the positive movement or diffusion of the dense concrete mass into the adjacent areas of the prefabricated members.

Under the new system the respectively juxtaposed precast members are directly employed as moulds for the casting of the denser concrete. A direct saving in the purchase, erection and dismantling mould costs is thus effected to the extent that the surfaces of the precast units contiguous the cast elements replace the older wooden forms. Furthermore, as indicated above, such surfaces form ideal mould forms in that they positively absorb the aqueous constituent from the casting concrete and thus cures the concrete to a higher degree of efficiency without mechanical aid.

The new construction also utilizes a module system of a special type thus insuring rapid and

accurate erection with minimum expenditure of labor and material.

A novel and specially significant feature of the invention is the utilization of precast wall units of such configuration design that a minimum number of standardized units need be employed. As will be seen more fully hereinafter, walls may be erected which are comprised substantially entirely of but two types or forms of prefabricated units.

Under the method of the invention, it is thus possible to erect a concrete structure in which upwards of 80 per cent of the structure is comprised of prefabricated, standardized units, leaving only the remaining 20 per cent to be poured at the site. The structure, as pointed out, may be erected with minimal use of temporary wooden mould forms, with a commensurate saving, while positively insuring improved structural characteristics and optimum waterproofness.

An object of the present invention is to provide a new system of concrete construction.

Another object is to devise a method of building construction which utilized prefabricated building units to an optimum degree.

Another object is to devise a method of concrete building construction in which the use of temporary moulding forms is greatly reduced.

Another object is to devise a method of constructing a waterproof wall made up of prefabricated wall units.

Another object is to erect a wall area with a minimal number of differential shaped prefabricated wall units.

Yet another object is to provide a method of concrete building construction in which the amount of field casting of concrete is reduced to a minimum.

A further object is to provide a method of building construction which insures an ultimate structure of light weight, great strength and low cost.

Yet another object is to devise a method of field casting dense concrete in which a relatively large area of the moulding form comprises a permanent part of the construction.

With these and other equally important and related objects in view, the invention comprehends the concept of erecting buildings by employing simplified precast units to a maximum degree, not only as part of the ultimate structure, but also as a part of the mould for the reception and casting of wet concrete, and casting the wet concrete in contact with such prefabricated units, such that a permanent bond is established. The placement of the precast units is so designed and arranged that the wet dense concrete, when set, forms the major stress taking units, such as the beams, columns, girders, studs, and the like. The invention thus combines minimum erection cost and time with maximum strength and utility in the ultimate structure.

Under the broad concept of the invention, it will be appreciated that a large number of different specific types of structure may be erected. The system is inherently characterized by a wide permissive range in the size of the prefabricated units, the structural design of the stress taking members, and the like. In order to exemplify the principles of the invention, a typical or characteristic physical embodiment is shown in the accompanying drawings, in which:

Figure 1 is a perspective view of a floor and

wall structure of a preferred embodiment of the invention.

Figure 2 is a detail view of one type of prefabricated wall unit, according to the invention.

Figure 3 is a similar detail of a second prefabricated wall unit.

Figure 4 is an enlarged section showing the method of casting columns in contact with the wall units and illustrating the method of waterproofing the wall.

Figure 5 is a perspective of a portion of an erected wall illustrating the new method of construction.

Figure 6 is a detail view of an accessory employed in erection.

Figure 7 is an enlarged section illustrating a method of utilizing wall ties.

As indicated, a major purpose of the present invention is advantageously to utilize a large proportion of prefabricated concrete, or other artificial stone units, and a commensurately smaller tonnage of field cast concrete. This major advantage, together with the other marked advantages hereinbefore enumerated, is secured by the type of construction generally illustrated in the accompanying drawings. It will be understood that the illustrations are here chosen and described didactically to exemplify the fundamental principles involved and not as limiting the scope of the invention to the particular constructions shown. With such an illustrative embodiment, those skilled in the art may utilize a relatively wide range of prefabricated building units of differential composition, design and the like. All such modifications in the construction and design, which embody the fundamental principles here expressed, are considered to be comprehended within the disclosure.

In constructing a building, a level foundation is first built, in any approved manner, and upon such foundation, or upon a wall section of the type or types to be described, a floor unit such as that shown in Figure 1 is erected. As shown, the floor comprises essentially a series of prefabricated units or blocks 1, certain of which, such as blocks 1-1', are closely juxtaposed in aligned position, and certain other series of which are respectively juxtaposed, but which series is spaced from the next adjacent series. This spacing is so designed that the area between the adjacent series is ultimately composed of dense field cast concrete of such mechanical design and chemical composition as to serve as a stress taking member.

In the modification chosen for illustration, the floor unit 1 is a prefabricated unit, cast at the factory, and is preferably comprised of a relatively porous, strong concrete. In order to reduce the weight of the unit or block, such block may be moulded with the cylindrical transverse holes 2. Obviously, during the moulding of such units, any other method of reducing the weight of the block may be utilized. Such apertures may be of any desired size or shape. The block unit is comprised of a substantially flat top surface and either a flat or arc-shaped bottom surface. In casting such blocks, if desired, metal inserts in the form of rods, expanded metal, and the like, may be utilized to increase the strength of the unit.

The side edges of the units are of special design. This design is so chosen, for any particular type of building or construction, that, in conjunction with a cooperating floor unit, it forms a mould for the field casting of a beam of suitable

cross section. Thus, in the units chosen for illustration, each side of the floor unit is comprised of an elongated, vertical section 3 and the two off-set vertical sections 4 and 5, respectively. The vertical sections 3 and 4 are joined by a diagonal section 6. The vertical sections 3 and 5, similarly, are joined by a diagonal section 7. In one form of construction, the diagonal sections 7 are of shorter length than the corresponding diagonal sections 6. In these circumstances, when the laterally adjacent units 1 and 1', are spaced a predetermined distance apart, and when such space is subsequently filled with an aqueous concrete, such concrete, on setting, forms an I-beam 8, having a relatively deep web (determined by the length of the section 3) and upper and lower flanges of differential width, accurately predetermined by the respective lengths and angularity of the surfaces 4 and 6, on the one hand, and 5 and 7, on the other. It will thus be observed that, by a suitable choice of the respective lengths and angularities of the surfaces 3, 4, 5, 6 and 7, any ultimate design of floor beam may be secured.

In erecting such a floor structure, temporary shores 10 are established at desired intervals. Such shores, as shown, may be cut so as to present a mortise type of top bearing surface. Upon the mortises, timbering 11, of suitable strength such as two by fours, four by fours, and the like, may be mounted. Upon the top of such timbering, planks 12, of suitable size are placed. The shoring 10 is so positioned that the aligned shores in a series serve to support temporarily the edges of the adjacent aligned floor units 1 and 1'. It will be observed that, when the several floor units are placed upon the temporary supporting means, the angular surfaces (3, 4, 5 and 6) of the adjacent floor units, together with the planking 12, form a mould which is adapted for the immediate reception of the casting material, such as an aqueous concrete. Depending upon the size of the ultimate structure, the stresses which the beam is to carry, and the like, reinforcing members may be introduced into the mould so as to be permanently embodied in the ultimate beam. Thus, the tension rod 20 and compression rods 21 may be introduced and held in position by any suitable temporary supporting means within the mould. Such rods, for the sake of simplicity, have been shown as being mounted and cast within the lower portion of the beam. However, as those skilled in the art will appreciate, this is a matter of design which may well be varied within wide limits. Similarly, whenever desired, shear rods of any suitable type of material and of any desired configuration may be utilized. Such rods may be held in the desired ultimate position, prior to the casting of the concrete, by suitable wires, bolts, and the like.

As shown in Figure 1 the aligned apertures 2 may be utilized for receiving heating pipes P. Certain of these apertures may, if desired, be so conformed as to serve directly as ducts in a ventilating or air conditioning circuit.

After the floor units have been placed in position, upon the temporary moulding-support, a mass of concrete, of any desired composition and density, is then poured into the space between the adjacent series of floor units. Such concrete flows by gravity into the mould form and, if desired, may be tamped. The concrete is poured up to the level established by the top surfaces of the floor units 1 or, if desired, to a level somewhat below or above this.

As explained previously, in these circumstances the dense concrete, which is in the cross sectional form of an I-beam, presents a very great surface area relative to its actual volume. Such wet concrete, furthermore, is contacted over a large portion of its surface area with an already preformed, porous concrete block. The concrete floor unit 1, as indicated, may be of any desired composition, such as porous or expanded concrete, cinder block, and the like. In these circumstances, the relatively porous block presents a very effective absorption medium in direct contact with a large quantity of the aqueous concrete. The concrete in the mould, being in plastic condition, tends to enter into and fill up the voids or vesicles in the adjacent areas of the blocks 1. When the mass sets, therefore, there is established a strong bond between the beam 8 and the adjacent, more porous units 1 and 1'. In other words, due to the porosity of the units 1 and 1', a certain amount of the plastic fill may actually penetrate the areas contiguous the side edges and solidify within the vesicles or voids. With this type of construction, therefore, a sharp interface or line of cleavage between the beam and the adjacent units 1 and 1' is eliminated and, on the contrary, the two are intimately bonded, thus insuring, in effect, a monolithic joint.

It will be observed at this point that the porous material of the units 1 and 1' permits a ready control of the setting of the concrete within the beam area. When desired, such units may be wetted with water; due to their relatively porous nature, the units tends to absorb the water and thus serve to wet the cast mass over the entire lateral areas of the web and flange sections.

In laying a floor, as will be appreciated, the front and rear edges, 23, of the floor units may be placed either in abutting or in closely spaced relationship. Depending upon the method of laying a concrete grout or relatively heavy slurry may be filled in between the adjacent edges 23. Also, if desired, the top surfaces of such edges may be formed on a bevel or half U and, on assemblage, the groove thus formed between two adjacent blocks may be filled with concrete of any desired density. Where the circumstances of a construction so indicate, such a groove may be utilized as a recess for the reception of metal reinforcing means or temperature rods, which, after the setting of the fill, is locked in situ within the floor structure.

When the dense concrete has set and the beams 8, or their equivalents, have formed, the shores 10 and associated timbering are removed. A ceiling finishing material, if desired, may then be applied to the undersurface of the blocks 1 and 1', and the beams 8. By casting metal nuts or other similar units in the beam 8, furring strips or other attachments may be fastened securely to the beam after the casting operation. Similarly, the block or unit 1, if desired, may be cast with any suitable type of metallic or non-metallic insert, which then becomes available as an attachment unit for any desired type of ceiling finish.

The present method of erection also permits the rapid application of floor surfaces. For example, if desired, before pouring the aqueous concrete, which is to form the ultimate beam 8, wooden or metal strips 30 may temporarily be fastened to the units 1 so as to extend along the aligned lateral edges of such units (as shown in the right-hand portion of Figure 1). The aque-

ous concrete may then be poured up to the top level of such strips. After the concrete is set, these strips may be removed, leaving a section of the I-beam 8' projecting above the top surfaces of the blocks. Thereafter, a finished concrete, or other plastic finishing material, may be applied to the top surfaces of the block and leveled off flush with the top of the I-beam 8. Obviously, by proper choice of the finishing surface, a wide range of different specific ultimate floor surfaces may be obtained.

It will thus be observed that, under the present method, a floor may be erected in a relatively short period of time. This floor is characterized by the fact that it is largely comprised of precast units, which units, during the casting operation, function as mould members and which units after the casting are intimately bonded to a dense concrete beam of optimum composition, size and physical characteristics. It is particularly to be observed that this method of erection involves but a minimum of temporary moulds, such temporary moulds being comprised solely of the flat surface 12. As pointed out hereinbefore, the cross sectional design of the beam and the composition of the concrete may be varied within very wide limits, so that the system is adaptable to any load and span.

This same fundamental principle of construction is utilized in the remainder of the building. A simple embodiment of this principle in a wall structure is shown in Figure 5. The flooring, previously described, forms a base upon which such a wall may be erected. As shown in Figure 5, the wall is built of courses which comprise the precast wall blocks 40 and 50.

The wall block 40, as will be observed, is of a generally cellular type having a continuous flat face 41 on one side and two cells on the other, such cells being defined by the central vertical web 42 and the end vertical walls 43 and 44. This type of structure presents top and bottom faces 45 of full width for application of mortar while greatly reducing the weight of the unit. The top and bottom faces 45 are formed as shown, with longitudinal grooves 46 which are adapted to receive a mortar bed in which metallic reinforcing rods are placed in a manner to be described. At each end the block is formed with the projecting end 47. Adjacent this end the end walls (43 and 44) are cut away at 48 so as to provide an angular shaped recess or undercut section for the reception of a special mould form in a manner more particularly to be described.

The block 50 is of the same general exterior outline as block 40 but is of specifically different design on the back section. As will be observed from an inspection of Figure 3 this block unlike block 40 is formed with the vertical end faces 51 which extend the full width of the block. Each such end face is formed with the central groove 52. This block is formed with the top face 53 and bottom face 53 which, as shown, are cut away or reduced at the central section of the block. Such cut away section or recess is formed by the face of the block and the vertical walls 55 and 56. At the rear portion of the block these faces are cut away as at 57 to present an angular or undercut recess extending the length of the vertical walls. Such recesses in block 50 generally conform in size and shape to the vertical recesses 48 of block 40. Block 50, like block 40 is preferably formed with the longitudinal grooves 58 in the upper and lower faces.

The blocks 40 and 50 may be moulded or cast

of any suitable material, for example concrete. These may be of any suitable size to conform to the structural and architectural requirements of a particular construction. In one system which has been found effective these blocks are each 24 inches long 6 inches high and 2½ inches wide. In each block therefore a mortar bed of substantial width is provided. The end sections or flanges 47 of block 40 may be 2 inches long, that is to say the ends 47 may project beyond the walls 43 and 44 a distance of 2 inches.

By referring to Figures 1 and 4 it will be observed that when two blocks 40 are placed end to end either closely juxtaposed or abutted a generally U shaped recess is formed. Such recess is made up of the two aligned ends 47 and their respectively adjacent (recessed) vertical end walls 43 and 44. If these aligned blocks 40 are then spaced from a block 50 such that the recess formed by the adjacent ends 47 lies opposite the central recess of block 50 an area is presented which may be utilized for a column or stud. This is a salient feature of the invention. The blocks 40 and 50 are juxtaposed in the manner mentioned and by the utilization of simple and efficient forming means, extending between blocks 40 and 50 a mould for a column is provided. When such mould is filled with aqueous concrete and the concrete is allowed to set a column of optimum structural characteristics is formed to which column the wall members or units 40 and 50 are inextricably locked.

At this point it is to be observed that the erection of a wall is a very simple procedure. As shown, particularly in Figure 5, a double wall is erected by first laying a course of units of one type such as units 40. A parallel course, spaced the desired distance is then laid utilizing the units 50. As will be observed the units are so positioned that the central channels or vertical recesses of units 50 lie opposite the recesses formed by the contiguous end walls 47 of units 40. Thereafter the second courses of the wall are laid, but in this case the positions of the blocks 40 and 50 are alternated, that is to say a second course of units 50 are laid on the first course comprised of units 40 and conversely a second course of units 40 are laid on the first course of units 50. Each course in each wall section is therefore comprised of units of one type and the wall units are alternated in each succeeding course.

In erecting a wall the first parallel double courses are laid on a mortar bed spread on a suitable base, for example as shown in Figure 5 a course of units 50 are laid for the inside wall and a spaced course of units 40 for the outside wall. During such laying mortar is spread on the tops of both units and the grooved ends of unit 50. A second course is then laid on each of these first two courses but as shown in Figure 5 the positions are reversed thus a course of units 40 is laid on the inside wall and a course of units 50 on the outside wall. These units are set on the module and hence in each course the walls 55 and 56 of block 50 are vertically aligned with walls 43 and 44 of block 40. The vertical reinforcing rods 60, as will be understood are previously embedded in the base structure. As shown in Figure 5 the temporary sustaining struts 80 are placed over the tops of the upper blocks adjacent the columnar area.

As shown in Figure 6 these comprise simply a central section 80 having the depending integral arms 81. The central section 80 is adapted to lie

on the upper edges of the parallel courses of blocks and the arms 81 contact the outer faces of the blocks. These units may be made of any suitable material such as wood, metal stampings and the like. These units as will be appreciated, are employed temporarily to hold the blocks in position while the aqueous concrete is being poured.

After a double course is thus established a special multiple functioning mould member is inserted. As is shown more particularly in Figure 4, this comprises a member 70 of suitable material such as a relatively heavy cellulosic board which is formed with the four wings 71, 72, 73, and 74. To one surface of the member 70 a strip of water impervious material 74 is attached. In a preferred method of construction the material comprises a copper sheet of relatively small gauge. The member 70 is placed in position such that the wings 71, 72, 73 and 74 snap into the recesses 48 of blocks 40 and the recesses 57 of blocks 50.

The mould member thus comprises a central section 70 of insulating material with an attached strip 74 of water impervious material together with the wing sections which, together with the body section form a mould unit. The mould member, as will be understood is of sufficient height to contact with and extend between two courses, thus in the illustrative embodiment the mould member is a foot high.

After the mould forms are inserted and the temporary retaining means 80 are set in position, aqueous concrete is poured into the columnar area defined by the mould unit 70 are the adjacent recesses formed by the wall units 40 and 50 respectively. As will be observed, utilization of the mould member 70 establishes a double column since the central insulating section 70 constitutes in effect a vertical insulating wall between the two sections of the column of dense concrete. The aqueous concrete is poured up to the top level of the course. Then a link or strut 90 is slipped down over the rods 60 thus rigidly tying in the two wall sections. Preferably, the upper and lower edges of the mould unit 70 are formed with grooves so that the parallel bar sections of link 90 fit therein.

Thereafter a mortar bed is laid on top of the upper blocks in each course and the horizontal reinforcing rods 61 are laid in the mortar bed such that the U shaped central bends 62 fit around the vertical rods 60 and the ends of adjacent rods are interlocked.

After such a double vertical course is laid the operation is repeated. Referring to Figure 5, a course of blocks 50 is laid on the blocks 40 of the interior wall and a course of blocks 40 is laid on the blocks of the exterior wall. In laying these courses, a mortar bed is spread on the top, bottom and edges of each block or unit. A second course is then laid such that the positions of the blocks are alternated, i. e. a course of units 50 is laid on the course 40 on the interior wall and a course of units 40 on the underlying course of units 50 in the outer wall. The struts 80 are then placed in position, the mould units 70 are then inserted in position all along the course and the aqueous concrete is poured to form a further section of the columns. Thereafter the links 90 are slipped down into position and the rods 61 are laid to complete that section. This operation is continued up to the desired height of the wall.

When it is desired to increase the impact resistance of the wall structure additional lateral

struts or wall ties 91 may be incorporated in the wall structure. As shown in Figures 5 and 7 this may comprise simply a tie of twisted wire of suitable gauge formed with a single loop 92 at one end and the double loop 93-94 at the other. This unit, as shown in Figure 7, may extend between the adjacent ends of wall units 50 and the center portion of wall unit 40. Such ties may be thus mounted in vertical courses alternating with those containing rods 61 to rigidify the structure.

The particular wall structure shown is an 8 inch wall, although as will be understood, this dimension may be varied if desired. In such a structure, therefore there is established an effective insulating space between the exterior and interior wall section. Such open space may be utilized for natural ducts, for the introduction of insulation media or for the installation of pipes thus eliminating the building of chases as is now the general practice.

If desired, and as is illustrated in Figure 4, the wall may further be insulated by mounting insulating board 95 of any approved type, in the air space. It will be observed that the configuration of the mould member 70 permits easy installation of such insulating board, since it can be simply slipped into position in the groove formed by the wings of the mould. If desired also, partition members may be used in lieu of the insulating board 95 and the space between such partition and the interior wall may be filled with fibrous or granular insulating material such as rock wool, expanded mica pellets and the like.

At this point it is particularly to be observed that the novel method of casting the columns so as to prevent seepage of water renders such insulation particularly effective. In the finished wall structure the water impervious material 74 is embodied in the column itself and extends for the full height. Any moisture that may seep in to the column will therefore, be arrested by the copper sheeting and the condensed moisture will gravitate down the sheeting to the base of the wall. Such condensation is removed by providing a small section of bleed pipe in the bottom course adjacent each column so that it is discharged to the outside.

The principle of the utilization of the wall units themselves for mould forms may similarly be invoked in the corner construction. As shown in Figure 5, specially shaped corner units or blocks 100 are utilized. These are of the same height as blocks 40 and 50 and are formed with a short side 101 which may, for example, be 6 inches long and a longer side 102 which is disposed at right angles to side 101. These blocks like blocks 40 and 50 are provided with longitudinal grooves on the upper and lower edges. The block 100 is further provided with the web section 103 which extends inwardly from face 102, thus establishing an area for the reception of aqueous concrete. At a corner section a special mould form 104, as shown, may be fitted between the aligned ends of the wall blocks 40 and 50. In constructing the wall the corner blocks 100 are placed in position so that the long and short faces 101 and 102 respectively are alternated in position. It will be understood, that in the corner construction the horizontal rods 61 are bent around and locked on the corner vertical reinforcing rods 60 in the usual manner. Aqueous concrete is poured into the corner column after the erection of two courses in the manner described.

It is to be observed that the type of construc-

tion herein described presents manifold advantages. By utilizing a module system the floor and wall structure may be erected with minimum of labor but with complete accuracy. The system of operating, as it were, with a two course unit further lessens labor costs, eliminates cutting and waste, also minimizes forming costs and tamping and thus accelerates and simplifies the construction. With this type of construction a major proportion of the construction can be precast leaving a minimum of concrete mixing and pouring at the site of construction. The method of utilizing the precast members as mould surfaces, as previously noted insures improved curing of the aqueous concrete and establishes a permanent bond between the precast units and the stress-taking members.

It will thus be understood that while a preferred modification of the invention has been described, this is given as illustrative of the underlying principles involved and not as exclusive, physical embodiment of these principles. Other equivalent structures may be utilized which invoke the fundamental principles defined herein and are considered to be comprehended in the appended claims.

I claim:

1. A wall construction which comprises a course of precast wall units, each of which comprises a member having a flat exposed surface and a non-planar opposite surface, and each such unit being formed with a vertically extending recess adjacent each end, such that when the said units are laid end to end a recess of columnar form is thereby defined; a parallel course of precast units each of which units has a centrally disposed, vertically extending recess; the said first group of units being so juxtaposed to the said second group that the central recesses of the said second group are opposite and are aligned with the recesses formed by contiguous ends of units of the first group; a mold form between the aligning courses and contacting the units in the parallel courses to form a column and a plastic material within the mold form and contacting the adjacent surfaces of the unit.

2. A method of waterproofing walls constructed of precast units of the class described having recessed portions on one face thereof which comprises, utilizing a mould form having on one surface thereof a sheet of water impervious material, associating such mould form with the recessed portions of the precast units to thereby define a columnar area and in which the said sheet faces toward the exterior surface of the wall and casting a concrete column in the said columnar area to form a column in which said mold form is embodied.

3. A method according to claim 2 in which the said moulding material comprises a cellulosic material.

4. A method according to claim 2 in which said moulding material comprises a cellulosic material and said water impervious sheet comprises a relatively noncorrodible metal.

5. A wall structure of the class described comprising an inner and a spaced outer wall, each wall being comprised of precast wall units; horizontal reinforcing rods embedded in the wall in every alternate course such rods coacting

in interlocking relationship with vertical reinforcing rods at predetermined distances along the wall and separate metallic strut members encircling and engaging the vertical reinforcing rods and extending between the inner and outer wall, said strut members being embedded in a concrete column cast in situ.

6. A wall structure according to claim 5 in which wall ties are embedded in the wall in alternate vertical courses at a point intermediate the concrete columns.

7. A method of erecting walls on a module system which comprises laying two courses of an exterior wall and two parallel courses of an interior wall utilizing precast units having recessed portions in the side walls thereof such that the recessed portions of the unit of the exterior wall are aligned with the recessed portions of the units of the interior wall; inserting a mould form at the module, which mould form extends the height of two courses and contacts the inner surfaces of the outside and inside wall units at said recessed portions and pouring aqueous concrete in the area defined by the mould form and the recessed portions of wall units to form a concrete column, and repeating such operations until the desired height of wall is attained.

8. A method according to claim 7 in which horizontal reinforcing rods are laid in each the interior and exterior walls at every alternate course.

9. A method according to claim 7 in which horizontal reinforcing rods are laid in each the exterior and interior walls at every alternate course and metal struts encircling coacting with the horizontal rods are inserted in every such alternate course and within the said column area.

10. A method of erecting double studs or columns at a construction site which comprises laying parallel courses of preformed units having recessed portions, the recessed portions of the units in each course being respectively juxtaposed, inserting a mold form having water impervious material thereon between said courses and in contact with said recessed portions to form a mold area; pouring aqueous concrete in the mould area and linking the two units of the composite stud thus formed at predetermined vertical intervals.

11. A wall construction which comprises a course of precast hollow wall units each of which comprises a member having a flat exposed surface and a non-planar opposite surface, and each unit being formed with a vertically extending recess adjacent each end, such that when the said units are laid end to end a recess of columnar form is thereby defined; a parallel course of hollow precast units each of which units has a centrally exposed vertically extending recess; the said first group of units being so juxtaposed to the said second group that the central recesses of the said second group are opposite and are aligned with the recesses formed by contiguous ends of units of the first group; a mold form between the aligning courses and contacting the units in the parallel courses to form a column and a plastic material within the mold form and contacting the adjacent surfaces of the units.

SAMUEL SCOTT JOY,