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(54) METHOD OF STRUCTURAL CONSTRUCTION

(71) I, EDWARD T. DICKER, a citizen of the United States of America, of 2600 Fairmount Street, Dallas, Texas 75201, United States of America, do hereby declare 5 the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a method of construction for walls, buildings and like structures and to a construction built by the method according to the invention.

15 In a method of construction according to the present invention separate units in the form of porous containers containing a dry concrete mixture are arranged in a course or courses and wetted from the top and the wetted mixture in the units sets to 20 form an integrated structure.

25 The term "dry concrete mixture" means in this specification a dry mixture in particulate form, which when liquid is added, sets rigid. Thus a dry mixture of gravel, sand and cement is one example of a dry concrete mixture.

30 Preferably the courses are superimposed. The units may be arranged in close proximity to one another along each course, and may be wetted individually.

35 The structure may include reinforcing members which may be arranged to interconnect adjacent units in the same or adjacent course; the reinforcing members conveniently being in the form of rods. In one method the rods may be driven through superimposed units to extend into the units in an underlying course.

40 A concrete foundation may be laid in a trench to form a concrete beam, in which case the construction units may be arranged in close proximity in superimposed courses on the concrete beam to form an integrated wall structure, and a roof structure may 45 be mounted on top of the wall structure.

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Our co-pending application No. 8643/68 (Serial No. 1195772) describes and claims a method of construction in which separate units in the form of porous containers containing a dry concrete mixture are arranged 50 in a course or courses on a cast concrete slab foundation and wetted so that the mixture in the units sets to form an integrated structure. When a concrete beam is used reinforcing members (preferably of steel) 55 may be inserted in the concrete beam so as to project upwardly from it and the construction units on the first course impaled upon reinforcing members. Additional reinforcing members may be arranged to connect 60 adjacent units in succeeding courses.

When the mixture comprises gravel, sand and cement and the wetting is effected by water, the amount of water added is sufficient only to wet the cement so that 65 there is only a predetermined minimum amount of slump in the unit.

A coating of concrete in the wet state may be applied to a course or courses to penetrate the voids and key thereto to form 70 a continuous coating. Alternatively or in addition a coating of finishing material may be applied to the course or courses.

The invention may be carried into practice in various ways and one specific 75 embodiment, together with various modifications thereof, will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view of one of 80 the discrete building units with part of the container sack shown broken away to illustrate the dry, premixed contents thereof;

Figure 2 is a fragmentary, perspective view showing a wall structure constructed 85 according to the invention with the building units arranged in superimposed courses on a concrete beam;

Figure 3 is a perspective view of a building unit of different dimensions prepared by 90

putting less premixed material in to the porous sack;

Figure 4 is a fragmentary, side elevational view in section of a wall structure showing the details of construction thereof, including a concrete supporting beam and roof structure;

FIGURE 5 is a fragmentary, end elevational view in section of a wall structure illustrating a finishing material such as sprayed concrete applied to the two sides of the wall, and showing a concrete slab flooring that has been poured between the outer walls;

FIGURE 6 is a perspective view of a reinforcing and connecting device that can be employed with the construction units;

FIGURE 7 is a fragmentary, side elevational view in section of a wall structure employing the device shown in FIGURE 6;

FIGURE 8 is a fragmentary, side elevational view in section of a wall structure employing horizontal steel reinforcing rods;

FIGURE 9 is a perspective view, partly broken away showing a construction unit packaged in a water repellent bag;

FIGURE 10 is a fragmentary, side elevational view of a wall structure illustrating one method of wetting from the top only each course of construction units as they are laid;

FIGURE 11 is a perspective view, showing the earth partly broken away, of an integrated or monolithic foundation of a building comprising concrete beams illustrating the excavation of trenches in the earth to coincide with the walls of the building into which concrete is poured to form the foundation thereof;

FIGURE 12 is a fragmentary, side elevational view in section of the concrete beam foundation taken across section lines 12-12 of FIGURE 11, also illustrating a slab flooring that has been poured within the confines of the building units laid on the outer concrete beams, including wall structures constructed over concrete beams;

FIGURE 13 is a fragmentary, perspective view of the wall structure including a door frame around which the wall is constructed;

FIGURE 14 is a fragmentary, perspective view of the wall structure including a window frame around which the wall is constructed;

FIGURE 15 is a fragmentary, elevational view showing a preferred embodiment of the porous sacks and a preferred method of arranging the sacks in superimposed courses; and

FIGURE 16 is a sectional view taken along section lines 16-16 of FIGURE 15.

A preferred embodiment of a discrete building unit employed in the invention is shown in FIGURE 1 and comprises a porous sack 10 within which is contained a dry mixture 12 of sand, aggregate and cement

as shown exposed in the broken away portion. The contents are premixed in the proper ratios to yield the desired structural strength when activated by water to set up in a hardened form. Although the sack can be tied off at its open end after filling, this is usually unnecessary and mere lapping the open end 14 over to form a flap 16 is sufficient. The sack has pores 11, such as in murlap, so that application of an amount of water to the top surface of the sack is effective to permit the water to penetrate the contents to activate them to form concrete

The sack can be of any size and shape to form the desired construction unit. As will be seen hereinafter, the flexible sack and the ability to control the amount of contents in any one sack lend themselves to facilitating construction when the sizes of the units need to be varied. This eliminates the equivalent of bracing concrete blocks and bricks in conventional construction techniques at termination points. The sack can be constituted of many different materials such as burlap, cheesecloth or other suitable fabrics, just to mention a few. Moreover, the sack can also comprise moisture absorptive pulp products, such as paper, in addition to others.

As already stated, the material with which the sack is filled is, for most construction purposes, a dry, premixture of sand, aggregate and cement which forms concrete when activated with water. However, there are cases where other construction compositions are desirable or preferred. To mention a few, rock, dirt, mud, clay, straw, sawdust, paper and combinations thereof included with a suitable cement are contemplated, in addition to others that will occur to those skilled in construction materials. Moreover, any suitable acoustical or insulating material can be incorporated in the mix for acoustical or insulating purposes, respectively, wherein the amount of cement in its ratio to other constituents can be varied, if necessary, to maintain the desired strength when the unit is activated to harden.

A fragmentary perspective view of a building wall constructed according to the invention is shown in FIGURE 2. A trench 20 is excavated in the earth 22 to correspond to the wall to be built. Concrete is then poured into the trench to approximately ground level to form a concrete beam 24. This wall foundation can also be poured, without forms, to a level above that of ground level by piling up the dirt removed from the trench at the edges of the trench. Pouring concrete in a trench eliminates the necessity for concrete forms for foundations so that skilled labor need not be employed. A concrete slab flooring can also be poured

between the beams as will be described later with reference to FIGURE 5.

Detailed steps of the preferred process for laying the various horizontal courses of superimposed construction units will be described in conjunction with FIGURE 4, although reference to FIGURE 2 illustrates the appearance of the construction. The construction units 10 are laid on top of the concrete beam 24 in juxtaposed relations, or in end to end relation, until a first horizontal course is laid along the length of one wall, or along the length of all of the walls as the case may be. The units are arranged in a course before wetting. An amount of water is then added or poured onto the top only of the first horizontal course of construction units in a quantity just sufficient to activate the dry premixed material throughout the construction unit. This water can be added by any suitable means or method, such as by applying the water on top of the construction units from any suitable container or source. The amount of water that is applied is not in an amount great enough, however, to allow more than a predetermined maximum "slump" in the construction units when wetted, wherein the term "slump" is well understood in the concrete construction business and very generally means that the concrete when activated will slump to some extent and tend to spread out. This predetermined amount of slump is detected visually by the worker and is limited to an extent which can be initially detected visually.

It has been found that, when wetting the units after they have been laid, the building units should be wetted with water from the top of each unit of each course only. On the other hand, wetting one or more courses from the sides, or from the sides and top, such as by spraying water thereon, weakens the wall structure to the extent that, in most cases, the weight causes it to collapse. Moreover, only a predetermined maximum amount of water can be added to the top of the course to result in the superior results provided by the invention. To understand the reasons for this particular method, it will be helpful to explain in some detail the characteristics of concrete when formed by adding water to the dry mixture of aggregate, sand and cement.

It is well known that the addition of an excessive amount of water to the dry constituents of concrete causes the setting up or hardening of concrete of inferior strength. To guard against this, engineers at construction sites test samples of the wet concrete for slump before it is poured. If the concrete slumps more than it should, the engineer knows that an excessive amount of water has been added. Unfortunately, with known construction methods, an excessive

amount of water must be added to the dry constituents in order that the concrete remains in a fluid state between the time it is activated with water, or batched, and the time it is poured, and the engineer can only minimize against this.

To control the amount of water that is applied or added to the building units when laid dry in a course, water is applied to the top only as illustrated in FIGURE 10. It has been found convenient to use a spray head 130 having spray holes 134 through which the water emerges as the spray 136. The spray head conveniently has a width approximating that of the width of the wall so that the entire width of a unit is wetted at one time. The spray is connected to a pressurized water source, and a cut off valve is included in the spray head which is operated by means of handle 138. Water is accurately applied as to quantity to the construction units from the top only as the worker observes the water penetrating the sacks and further observes any slump that takes place. The water penetrates throughout the dry constituents in the bag primarily by capillary action. For building construction units of about 24 inches by 6 inches by 6 inches thick, it has been found that permitting the unit to slump by a maximum amount of about 3/4 of one inch vertically will yield a wall construction of superior strength but in which sufficient water is added to activate the entire unit. Thus this method provides for the construction of a wall structure having superior or maximum strength in the concrete, primarily because of the ability to control the water added to activate the concrete. As already noted, this degree of control is not possible when mixing large batches of concrete since an excessive amount of water must be added so that the concrete remains fluid between batching and pouring. It will again be emphasized that water can not be applied to the sides of the bag to activate the units, since the natural gravity flow of water is downward, and an excessive amount of water would have to be added in this manner to activate the entirety of the constituents within the construction unit. In fact, actual attempts to add water in this manner have resulted in wall structures of such inferior strength that the walls collapsed under their own weight.

After the first course of construction units has been laid, another course is laid on top thereof in superimposed relation, also in juxtaposed positions, wherein the units are staggered in relation to the underlying units such as is done when laying brick. This horizontal course is also wetted either after laying to activate the dry premixture therein. The result of wetting the construction units, as noted above, activates the cement

in the dry premixture to set up as concrete with the sand and aggregate. Since the sacks are porous, this permits the "latents" of the concrete to permeate the sacks so that the superimposed courses will be bound together as will adjacent units in the same course. The "latents" of the concrete are the fine particles of cement suspended in the water when the cement sand and water are mixed. The first course is also bound to the concrete beam 24. All of this forms an integrated, concrete structure.

The successive superimposed courses are laid one on top of the other until a height is reached at which it is desirable, in the preferred embodiment of the method of the invention, to apply a skin 30 of a reinforcing material on either or both the inside and outside surfaces of the wall structure. This coating preferably comprises concrete and is applied to the surfaces by blowing or forcing under substantial pressure fluid concrete against the wall surfaces. By blowing an initial coating of concrete on the surfaces of the wall structure, the wall structure is reinforced and strengthened to more nearly hold the desired vertical shape, wherein more detail on the coating will be given later. The skin can be blown on after a wall structure is completed or applied at successive heights as the wall construction progresses to further reinforce the wall.

Additional horizontal courses are laid until the height is reached at which windows are to be installed. A suitable window frame 32 is installed directly on top of a horizontal course of the construction units and secured thereto, such as by fastening the frame by flanges or reinforcing rods inserted in the construction units. It will be understood that the construction units are also built up around the sides of the window frame and wetted to activate them as each course is laid. The rods holding the window frame are secure within the construction units when the construction units set up to a hardened state and, in addition, the concrete seals to the window frame to further secure it. It will be understood that door frames are installed in a similar fashion, wherein a more detailed description for installing doors and windows will be given below. Concrete coatings are applied to the surfaces of the wall structure as the wall height progresses, and when the desired height of the wall is reached, a roof structure is installed as will be described hereinafter in conjunction with FIGURE 4.

The flexible sacks in which the dry premixture is contained and the characteristic of the dry premixture to conform to any shape lend themselves to the prepackaging of construction units of any desired shape and size. For example, it is sometimes preferable to employ a smaller sized con-

struction unit to fit into spaces adjacent door jambs, window frames and other places constituting termination points where space does not permit the utilization of one of the more standard size units. A construction unit 40 of reduced size is shown in the perspective view of FIGURE 3 in which a smaller amount of the dry premixture is placed in a standard size sack and larger flap 44 at the open end 42 is folded over. This essentially provides a shorter construction unit. It will also be stated that the thickness or width of the construction unit can be varied as desired by shaping the sack and its contents accordingly. It will also be apparent that some of the fill within the sack can be removed by the construction worker on the site when a variation in the size of the unit is required. This can be performed immediately by the worker on the unit with which he is presently working without stopping his labor and retrieving a unit of different size.

A more detailed illustration of the method of construction is shown in the fragmentary, side elevational view in section of FIGURE 4, wherein there is shown the concrete beam 24 poured into a trench 20 excavated in the earth 22. In the preferred method of construction, steel reinforcing bars or rods are inserted in the construction units to interconnect adjacent units to form a greatly strengthened and integrated structure when set up. According to this method, steel reinforcing rods 50 are inserted in the concrete beam before the latter sets up to provide a structural tie to the first course of construction units. After the concrete beam has set up, the first course of construction units are impaled on the steel reinforcing rods, wherein the latter are so positioned that a pair of the reinforcing rods are inserted in each of the construction units adjacent the opposing ends thereof. These construction units are wetted just prior to laying or after laying to activate the mixture to form a structural tie or bond by means of the concrete setting up around the steel reinforcing rods. The "latents" of the wetting mixture also permeates the sacks to form a bond with the concrete beam, wherein "latents" are the wetted particles of the mixture as is well known. It will be remarked that there is no necessity in waiting until the first course of construction units has set up before the second course is superimposed thereon. Thus the second course is laid in staggered relation, as shown, on the first course in juxtaposed positions. As they are laid, another pair of steel reinforcing rods 54 and 56 are inserted through each construction unit adjacent the opposite ends thereof and are sufficient length to penetrate the adjacent construction units immediately therebeneath and across

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which the construction units span. This course is then wetted to activate the fill mixture, and a third course is layed on top of the second employing reinforcing rods as described. Units of the third course are connected to immediately underlying units of the second course through steel reinforcing rods 58 and 60 penetrating the construction units over which it spans. It will then be seen that each construction unit is tied to four other adjacent construction units through steel reinforcing rods 54, 56, 58 and 60, in addition to which, each unit is also structurally bound to the two opposite adjacent units in the same course by means of the concrete "latents" permeating the sack and binding to these units.

The superimposed courses of the construction units are laid until the desired height of the wall is attained, it being understood that a concrete skin is blown onto the wall surfaces at intervals during the construction as the height increases. At this level, bolts 64 are inserted in predetermined spaced apart units in the top course. These bolts are threaded on their top ends and are left protruding above the top course. A suitable top plate 66 having holes drilled therein corresponding to the bolts 64 is seated over the bolts, and suitable nuts 68 or other suitable fastening means, are employed to secure the top plate to the top course. This provides the means by which the roof structure can be added and secured to the building. The roof structure can be of any suitable or conventional construction, such as that comprising roof joists 70 secured to the top plate by conventional means and which span between the walls of the building. Thereafter, a conventional roof 72 can be applied to the top of the roof joists. Of course, truss structures or other roof constructions can be employed.

Some of the more important features of the construction method described herein will now become more apparent. The characteristic of the flexible sack and its contents to conform to the surface on which it is laid to form an integrated part of a course, both in the dry state and especially in the wetted condition, is of considerable importance. By so conforming, no stress points or lines are introduced in the structure between adjacent units when the structure sets up in a hardened form as is so often the case of conventional masonry units which are inflexible. However, the sacks or units should not be kneaded after wetting, as this causes the separation of the concrete constituents to weaken the structure. The constituents are initially well mixed in the dry state and should be left alone as far as possible after wetting. No mortar is used that is invariably of a different material than that of the masonry units with which it is

employed, which eliminates weaknesses due to mismatching materials. Since no mortar is used, water cannot be absorbed therefrom by the construction units which is a typical cause of weak joints. In the present method, concrete is bound to concrete in an integrated structure but without the necessity of using concrete forms. The steel reinforcing rods serve to secure adjacent construction units together to greatly increase the strength of the structure. In the preferred practice of the invention, the sacks are porous enough to permit the penetration by water and by the "latents" or wetted "fines" of the mixture, but not so porous to allow the wetted mixture as concrete to penetrate to any great extent. Therefore, the reinforcing rods, or other suitable means, are employed as a structural means to which the concrete is secured and by which adjacent units are further secured together.

A fragmentary, end elevational view in section of a wall structure is shown in FIGURE 5 which illustrates the additional reinforcing and finishing material added to the surfaces of the wall structure and the details of a slab floor. This figure shows the concrete beam 24 poured to ground level and can include therein suitable steel reinforcing means (not shown) other than rods 50. Since the first course of the wall structure is laid after the concrete beam is set up, a "cold" joint 74 is formed between this course and the beam. The steel reinforcing rods 50 serve to secure the wall structure to the beam with sufficient structural strength. A concrete slab 80 can be poured between beams after at least a sufficient number of wall courses have been laid to provide a form 82 against which the slab can be poured. It will be seen that the concrete beam 24 is preferably wider than the construction units to provide an outside base or surface 75 the width of which an outside surfacing material fills and an inner base surface 76 on which the slab floor is partially supported. The slab can also be poured after completion of the courses. It will be seen that another cold joint is formed between the concrete beam 24 and slab 80 on surface 76 which is desirable, so that shifting of the slab floor does not tend to crack or weaken the wall structures, or at least this effect is minimized.

A fill 78 also can be provided, if necessary, beneath the slab flooring 80 before the latter is poured to level the earth beneath the flooring should the lot on which the building is constructed have substantial grade. By providing this fill, a uniform thickness slab 80 can be poured for the floor of the building. It will be seen hereinafter, however, that such a fill is unnecessary, especially when the building site has no substantial grade.

Additional reinforcing and surfacing material is applied to the wall surfaces to serve the multiple purposes of an additional reinforcing means, a surface finishing means, and a layer beneath which there can be contained pipes and electrical conduits to provide utilities to the building. As already noted in conjunction with FIGURE 2, additional reinforcing of the wall structure is achieved by applying an initial coating or skin of concrete sprayed or blown under pressure onto the inner and outer surfaces 82 and 84, respectively, of the wall structure at various successive heights during erection of the wall structures. This initial coating is denoted by numeral 30 in FIGURE 5. The skin is blown on under substantial pressure, such as, for example, 60-80 psi in one instance, to achieve the effects enumerated below. Any suitable apparatus may be employed for this purpose, wherein a nozzle having a reduced diameter orifice at the outlet is preferably employed so that the velocity of the spray is increased as it emerges from the orifice. Concrete comprising sand, water and cement is usually employed as the skin material, wherein insulating and acoustical materials can also be added to the mixture. By blowing the skin on under pressure, the skin fills any holes, cracks or crevices that exist between concrete units to seal the wall. Another important aspect is to be noted here. Since there will be some voids between the construction units 10, the concrete sprayed onto the surfaces will fill these voids so as to "key" into the walls as structural members themselves to strengthen the wall structure. Since the sacks are also porous and expose the concrete therein, the surfacing material is bonded directly thereto and keys to the sacks themselves. The rough surface of the sacks facilitates this bonding process. In addition, the rough surface onto which the concrete is blown and the fact that this material keys into this surface means that very little, or negligible, shear or lateral stress is present in the surface material that would tend to cause it to become loose or crack off. This method of applying a skin to a structural wall having the particular characteristics noted also contributes to a wall structure of superior strength, utility and appearance. The skin also provides a moisture proof barrier for sealing the wall and the construction units.

When the wall structure is completed to the desired height with the construction units, an additional coating of concrete can be sprayed onto the surfaces to finish the wall. A coating 88 can be sprayed onto the initial coating 30 on the outside wall and left in a rough, textured condition for appearance. On the inside surface of the wall, it is usually necessary to install pipes

and electrical conduits 90 against the inner surface which can be held in place temporarily by wire ties 92 or other suitable means. Then a finishing surface 94 is sprayed onto the inner surface of the wall and can be left in the rough, textured condition or leveled to a smooth surface as shown in FIGURE 5. Any suitable means may be employed to smooth the surface, such as by screeding the surface with a level board. Coloring may be added to the concrete before spraying the wall surface, or the surfaces may be painted as a last step.

A reinforcing device to connect adjacent construction units in a structural manner is shown in FIGURE 6, and as applied in FIGURE 7. This device comprises an elongated steel member 100 pointed on each end and having a cleft in each end medially of the sides thereof, so that the two sides of each end can be bent oppositely at 90° to the main body. Thus, a pair of opposing barbs or pointed members 102 and 104 are formed at one end, and similarly, a pair of opposing barbs 106 and 108 are formed at the other end. As the courses of units are laid as shown in FIGURE 7, one of the reinforcing devices is inserted into the ends of adjacent units spanning the two units and on each top end of each unit, all as shown. The central portions of the units of the next course are impaled on the protruding barbs so that the units are staggered, and additional reinforcing devices are inserted in the tops of these units as just described. Therefore, each unit is reinforced by four barbs and tied to four adjacent units as before when the mixture sets up in a hardened state.

Additional reinforcing can be provided by inserting elongated steel reinforcing rods horizontally through at least part of the length of a course as shown in FIGURE 8. Here, vertical reinforcing members are likewise employed, and in addition, an elongated steel reinforcing rod 112 is inserted through several units in a course along one direction to form continuous reinforcement. These rods can be employed at each course or, as shown, be employed at predetermined spaced apart courses as denoted by reinforcing rod 114 to further strengthen the structure.

The construction units described herein can be packaged as shown in FIGURE 9, which allows the unit to be shipped, displayed and transported without loss of the material contained within the porous sack, and which packaging prevents moisture in the ambient atmosphere from activating the contents. The basic construction unit is packaged in a water repellant bag similar or the same as that employed in packaging cement, and sealed by any suitable means at the open end 122 thereof, such

as by stitching.

The method of erecting a structural wall, including the provision of a foundation and concrete slab flooring has been described above. The following is a more detailed description of the method of constructing a complete building.

There is shown in FIGURE 11 a perspective view of the concrete beam foundation for an entire building with part of the earth broken away to show the concrete beam. To erect a building or house, the lot on which the building is to be erected is staked out to determine the height of the floor for drainage. Normally the highest point of the lot is selected for one corner of the building and from which the construction is started. After this spot is selected, a determination is made of any fill that will be required to level or elevate the lot, or alternatively and excavation or earth moving to establish the house and the floor thereof at the desired elevation. Next, all of the corners and edges of the building are staked or marked, and all beams constituting the foundation of the building are laid out as to their location with stakes and strings, or the like. The main foundation for the building constitutes a concrete beam corresponding to the outside or exterior wall structure. Preferably, concrete beams corresponding to the interior walls also constitute the foundation for the building. When all of the concrete foundation beams are laid out, corresponding trenches are excavated within which concrete is to be poured to form the foundation.

Referring to FIGURE 11, a trench 20 is excavated corresponding with the exterior walls of the building. In addition, trenches corresponding to the interior walls of the building, and which intersect the exterior wall trench, are excavated. Concrete is then poured to ground level in all of the trenches to form a monolithic foundation structure comprising the several concrete beams in which the foundation comprises what will be referred to as the grade beam 24 providing the major foundation for the building and corresponding to the outside walls thereof, and several other foundation beams corresponding to the various interior walls of the building, such as the beams 152, 154 and 156, as examples. When the concrete beams are poured, reinforcing rods 50 are inserted in the outside concrete grade beam 24 for tying the first course of construction units to this grade beam. In addition, reinforcing rods 172 can be provided in one or more of the interior foundation beams should it be necessary to construct over this beam an interior structural wall such as would be required to help support the roof structure, as compared to a partition wall that is not load bearing, all as will be described below.

A fragmentary side elevational view in section taken across section lines 12-12 of FIGURE 11 is shown in FIGURE 12, which illustrates a concrete slab flooring poured over the concrete foundation beams and wall structures erected thereover. Concrete beams 24, 152, 154 and 156, in addition to the other interior foundation beams of the building, are poured to ground level. Then, at least one course of construction units is laid on the outer grade beam 24 by impaling them on the reinforcing rods 50 and then wetting the units to produce concrete that will harden. A sufficient number of courses of the units are laid on the outside grade beam 24 to act as a form against which the concrete slab flooring can be poured. In the particular example shown, no dirt fill is required within the confines of the outside grade beam 24, as it is assumed that the building site is substantially level. The concrete slab is then poured between the confines of the partially erected wall structure atop the outside grade beam 24 and which directly overlies the interior foundation beams. As already noted, the concrete slab floor rests on a ledge of the outside grade beam 24, and is further supported by the interior foundation beams. The outside wall structure is then completed according to the foregoing description.

It may be necessary to provide structural or load bearing walls in the interior of the building for any number of purposes, such as, for example, to additionally support the roof structure. For this purpose, reinforcing rods 172, which protrude above an interior foundation beam 152 sufficiently to also protrude above the concrete slab floor 160 after poured, are provided as an added measure for securing a structural wall to the concrete slab flooring. Thereafter, construction units 170 are laid on the floor directly overlying the concrete beam 152, and additional reinforcing rods 174 are employed to further reinforce the wall structure. It will be noted that the reinforcing rods 172 can be eliminated in many, if not all, instances, since this wall is not a load bearing wall to the extent as are the outside walls. The outside walls primarily support the roof structure and withstand wind and other external forces. If the reinforcing rods 172 are eliminated in the interior wall, the weight of the interior wall is sufficient in conjunction with concrete bond between the lowest course and the concrete floor.

In most instances, the interior walls are for partition purposes only, for example, a metal or wood partition 180 can be erected above an interior concrete foundation beam 156, and suitable panelling material can be installed in the wall, all as is well known. Such partition wall can be secured in

place by any suitable means, such as by securing the partition to the floor with suitable pins 182 shot through an apertured flange 184.

- 5 The interior concrete foundation beams also underlie openings in the interior walls and partitions constituting doors. Such is the case as shown with interior concrete foundation beam 154 wherein no wall or
10 partition is erected over that portion of the beam as shown in FIGURE 12.

- A detailed illustration of a door frame as installed within a load bearing wall structure is shown in FIGURE 13, wherein
15 the door frame 190 comprises a pair of spaces apart vertical side frames connected together at the bottom by a base frame or plate. The two vertical side frames include laterally, outwardly opening channels 191,
20 and suitable T flanges 192 and 194 held in the channel of the door frame are employed for securing the frame to the wall structure. Assuming that the door frame illustrated in FIGURE 13 is provided in an exterior wall
25 of the building, the bottom plate of the door frame is placed directly on top of a course of the construction unit that is level with the inside concrete slab flooring. The door frame is secured in place by inserting rein-
30 forcing rods through suitable openings, such as through holes 193 in the lower flange 192. Thereafter, the wall is erected around the door frame by the successive laying of courses of the construction units, wherein
35 the construction units are laid directly in the channels 191 directly against the door frame. This locks the door frame in place as the construction units set up. As many securing flanges can be employed as desired,
40 wherein another flange 194 is shown intermediate the height of the door frame and which is secured to the construction unit directly underlying the flange.

- Since most door frames are not substantial
45 enough to constitute a load bearing member, it is desirable to eliminate any substantial load bearing down on the door frame itself. To avoid such a load, the wall structure is laid flush with the top of the door frame,
50 at which level a load bearing plate or lintel 196 is employed to span across the top of the door frame and act as the top portion of the frame. The lintel has suitable holes 198 through the ends thereof and through
55 which reinforcing rods can be inserted into the construction unit directly underlying the ends of the lintel. After the structure has set up, substantially all of the weight of the wall directly above the door frame will be
60 carried by the lintel, and which weight is transferred to the structural wall itself.

- A more detailed illustration of installing a window frame in the wall structure as the latter is erected is shown in FIGURE 14.
65 The window frame 32 constitutes a rect-

angular framework having an outwardly opening channel 200 provided about the entire perimeter thereof. When the level of the wall is attained during erection that corresponds to the lower sill of the window,
70 the window frame is installed by setting it down directly over this particular course of construction units so that the channel 200 spans the wall, as shown. Suitable T flanges 202 and 204 are employed to secure
75 the frame to the various underlying construction units by inserting reinforcing rods through holes 202 in flange 201, for example. Again, as many of these flanges can be employed up the side of the frame as
80 desired. The wall is successively laid about the window frame so that the construction units key into the channel 200 at the sides thereof, as shown. As with the door de-
85 scribed in FIGURE 13, it is desirable to transfer the weight of the wall above the window away from the window frame. As one example, a lintel was employed to bear this load over the door frame in FIGURE
90 13. As another example, a horizontal reinforcing rod or member 206 can be inserted through a plurality of the construction units that directly overlie the window frame
95 adjacent the top thereof, so that this reinforcing rod takes the load of the wall above the window frame and transfers it to that part of the wall adjacent the sides of the frame.

It has been found advantageous to employ elongated porous sacks for most building
100 construction as will be described in conjunction with FIGURES 15 and 16. In addition, a preferred method of stacking the sacks will be described with reference to these figures. As shown in FIGURE 15, an
105 elongated porous sack 220, such as comprised of burlap for example, is filled with a dry mixture of sand, aggregate and cement as earlier described. The sack is stitched along the bottom in a seam 222, thus
110 leaving a short tail 224. Similarly, the sack is stitched along one side in a seam to leave an edge 230 running along the side. As before, it is unnecessary to sew up or permanently close the open end of the sack,
115 wherein the open end 26 is folded over to abut against the adjacent sack end 228.

When the sacks are filled with the dry constituents, the sacks tend to become circular shaped in cross section, but because
120 of the seams in the sack, the shape is actually oval having its widest dimension intersecting the seam along the side of the sack. There is shown in Figure 15 an array of these sacks stacked on each other in
125 superimposed courses, and FIGURE 16 is an end section view taken through section lines 16-16 of FIGURE 15. This slightly greater dimension in cross section will be seen more clearly from FIGURE 16. It 130

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will also be seen that the sacks are not turned inside out after being stitched, since more mixture can be placed in each sack when the edges are left on the outside as shown.

A preferred method of stacking the sacks comprises arranging a first course of the sacks 220 on a concrete beam 221 with the longest cross sectional dimension of the sack being arranged vertically. That is to say, the seam along the side of the sack is faced directly upward, and the seam 222 at the end of the sack is arranged as nearly as possible along the vertical. The next course of sacks is laid on top of the first course so that the end seam 222 of the next course of sacks is aligned, vertically, with the end seams of the sacks directly beneath this course. This is more clearly seen in FIGURE 16. Thus, as the wall height progresses, the wall remains straight and vertical and does not get out of plumb. Thus, the seams become an aid for visual alignment for erecting vertical walls. It will be understood that suitable reinforcing rods (not shown) are employed between adjacent sacks, wherein these reinforcing rods are inserted directly through the top seams of the sack.

The invention has been described with reference to specific embodiments thereof. However, modifications and substitutions that do not depart from the true scope thereof are contemplated. For example, it may be desirable in the construction of some buildings to space apart adjacent construction units contained within one or more courses to provide a partially open construction. Other variations will undoubtedly occur to those skilled in the art. Therefore, it is intended that the invention be limited only as defined in the appended claims.

WHAT I CLAIM IS:—

1. A method of structural construction in which separate units in the form of porous containers containing a dry concrete mixture, as herein defined, are arranged in a course or courses and wetted from the top, and the wetted mixture sets to form an integrated structure.

2. A method as claimed in Claim 1 in which the units are wetted only from the top.

3. A method as claimed in Claim 1 or Claim 2 in which each of the units is wetted individually.

4. A method as claimed in any one of the preceding claims in which the structure includes reinforcing members.

5. A method as claimed in Claim 4 in which the reinforcing members are arranged to interconnect adjacent units in the same or adjacent courses.

6. A method as claimed in Claim 6 in which the reinforcing members are in the

form of rods.

7. A method as claimed in Claim 6 in which the rods are driven through superimposed units to extend into the units in an underlying course.

8. A method as claimed in any of Claims 4 to 7 in which a first pair of reinforcing rods in each construction unit are also inserted in an adjacent pair of said units immediately underlying each construction unit to tie the construction unit to each of said adjacent pair of said underlying units, and a second pair of reinforcing rods in each construction unit that are also inserted in an adjacent pair of said units immediately overlying each construction unit to tie the construction unit to each of said adjacent pair of said overlying units.

9. A method as claimed in any one of the preceding claims in which a coating of concrete in the wet state is applied to a course or courses to penetrate the voids and key thereto to form a continuous coating.

10. A method as claimed in any of the preceding claims in which a coating of finishing material is applied to the side of the course or courses.

11. A method as claimed in Claim 10 in which the finishing material is applied under pressure.

12. A method as claimed in any of Claims 9 to 11 in which the coating is applied to a course of units, and then a further course is superimposed on that course and a further coating is applied to the two courses.

13. A method as set forth in Claim 12 in which the coating is of concrete, and including the step of applying a finishing coat of material onto the concrete coating.

14. A method as claimed in any one of the preceding claims in which the mixture comprises gravel sand and cement and the wetting is effected by water, the amount of water being sufficient only to wet the cement so that there is only a predetermined minimum amount of slump in the unit.

15. A method as claimed in any preceding claim in which the construction units after wetting are allowed to set up and harden without further handling.

16. A method as claimed in any preceding claim in which the porous containers comprise sacks having seams along the end and the superimposed courses of units are arranged by positioning the sacks with the seams vertical.

17. A method as claimed in any one of the preceding claims in which a concrete foundation is laid in a trench to form a concrete beam and the construction units are arranged in close proximity in superimposed courses on the concrete beam to

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The invention has been described with reference to specific embodiments thereof. However, modifications and substitutions that do not depart from the true scope thereof are contemplated. For example, it may be desirable in the construction of some buildings to space apart adjacent construction units contained within one or more courses to provide a partially open construction. Other variations will undoubtedly occur to those skilled in the art. Therefore, it is intended that the invention be limited only as defined in the appended claims.

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7. A method as claimed in Claim 6 in which the rods are driven through superimposed units to extend into the units in an underlying course.

8. A method as claimed in any of Claims 4 to 7 in which a first pair of reinforcing rods in each construction unit are also inserted in an adjacent pair of said units immediately underlying each construction unit to tie the construction unit to each of said adjacent pair of said underlying units, and a second pair of reinforcing rods in each construction unit that are also inserted in an adjacent pair of said units immediately overlying each construction unit to tie the construction unit to each of said adjacent pair of said overlying units.

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10. A method as claimed in any of the preceding claims in which a coating of finishing material is applied to the side of the course or courses.

11. A method as claimed in Claim 10 in which the finishing material is applied under pressure.

12. A method as claimed in any of Claims 9 to 11 in which the coating is applied to a course of units, and then a further course is superimposed on that course and a further coating is applied to the two courses.

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14. A method as claimed in any one of the preceding claims in which the mixture comprises gravel sand and cement and the wetting is effected by water, the amount of water being sufficient only to wet the cement so that there is only a predetermined minimum amount of slump in the unit.

15. A method as claimed in any preceding claim in which the construction units after wetting are allowed to set up and harden without further handling.

16. A method as claimed in any preceding claim in which the porous containers comprise sacks having seams along the end and the superimposed courses of units are arranged by positioning the sacks with the seams vertical.

17. A method as claimed in any one of the preceding claims in which a concrete foundation is laid in a trench to form a concrete beam and the construction units are arranged in close proximity in superimposed courses on the concrete beam to



form an integrated wall structure.

18. A method as claimed in Claim 17 in which a roof structure is mounted on the top of the wall structure.

5 19. A method as claimed in Claim 17 or Claim 18 in which reinforcing members are inserted in the concrete beam to project upwardly from it and the construction units on the first course are impaled upon the
10 reinforcing members.

20. A method as claimed in Claim 19 wherein the beam is wider than the said construction units.

21. A method as claimed in Claim 20
15 in which the beam foundation corresponds to the exterior walls of a building, and in which concrete is poured within the confines of said foundation beam against one course of structural units on the beam acting as a
20 form to provide a slab overlying said foundation beams and corresponding to interior walls.

22. A method as claimed in Claim 21 in which at least one course of construction
25 units is arranged on the foundation beam spaced from the interior edge thereof and said concrete slab overlies the inner portion of the foundation beam between said interior edge thereof and said at least one course.

30 23. A method as claimed in any of Claims 17 to 22 in which trenches corresponding to exterior and interior walls are excavated so that each trench corresponding to a wall of a building is intersected by at
35 least one other trench corresponding to

another wall of the building, and a monolithic beam foundation structure is formed when said trenches are filled with concrete.

24. A method as claimed in any preceding claim in which a framed opening is
40 inserted by placing a rigid frame comprising a pair of spaced apart vertical members secured to a pair of spaced apart horizontal members, said pairs of members forming a
45 rectangular frame, the ends of said horizontal members extending past the ends of said vertical members, in a wall being built of units, securing the ends of the lower
horizontal member to the wall adjacent
50 thereto with vertically disposed reinforcing members adjoining said ends and disposed within the adjacent wall, positioning the
ends of the upper horizontal member to the
bags adjacent thereto with vertically dis-
posed reinforcing members adjoining said
55 ends and disposed within said adjacent bags.

25. A method as set forth in Claim 24 wherein said vertically disposed members have an outwardly disposed channel and
said ends of said subsequently arranged
60 courses are positioned with said channels.

26. A method as set forth in Claim 24 or Claim 25 wherein said horizontally disposed members have an outwardly disposed
channel and wall portions adjacent said
65 horizontal members are positioned within said channel.

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