June 26, 1962 C. B. MESSENGER 3,040,411

PROCESS OF CONSTRUCTING A CONCRETE SUPPORT STRUCTURE

Filed May 7, 1956 3 Sheets-Sheet 1

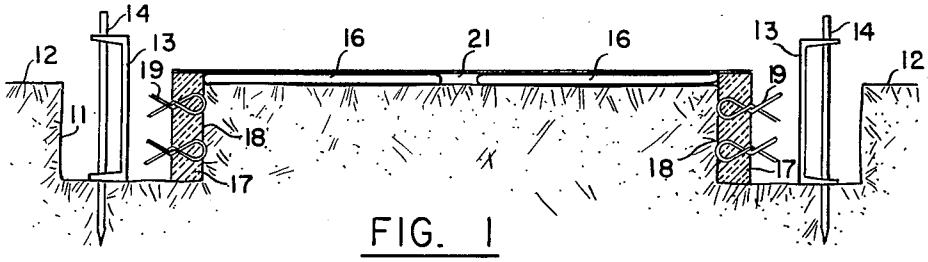

FIG. 1

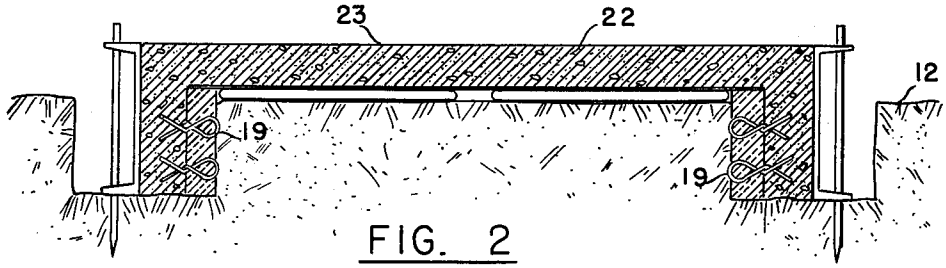

FIG. 2

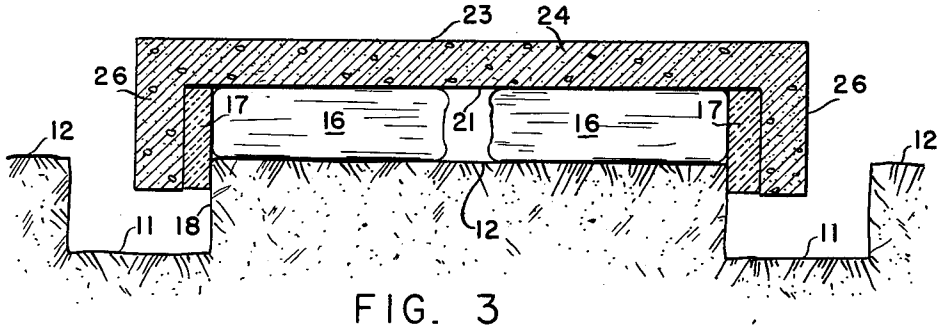

FIG. 3

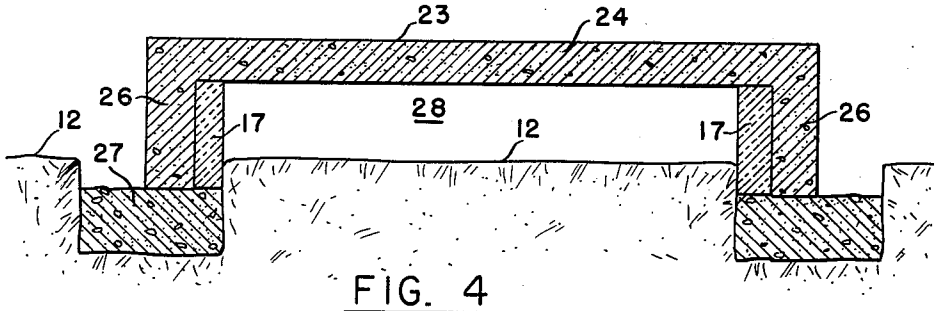

FIG. 4

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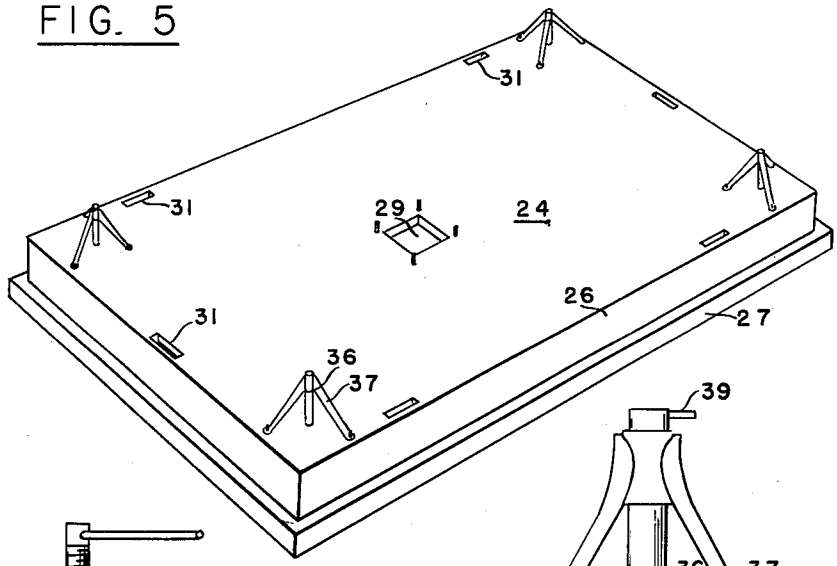
FIG. 5



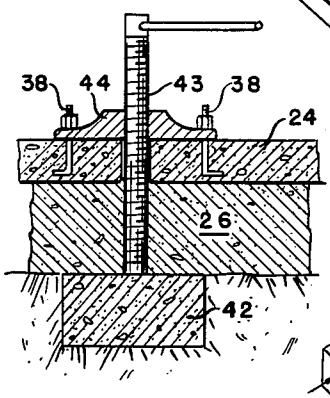


FIG. 6

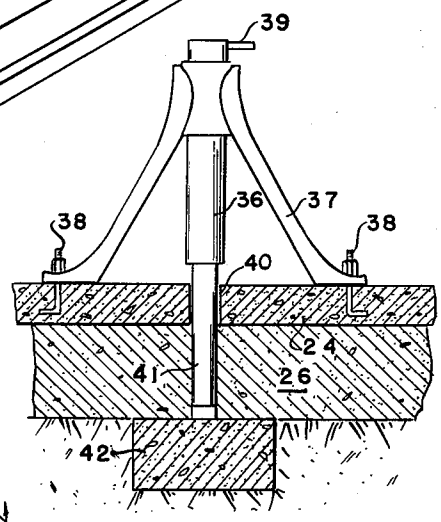


FIG. 7

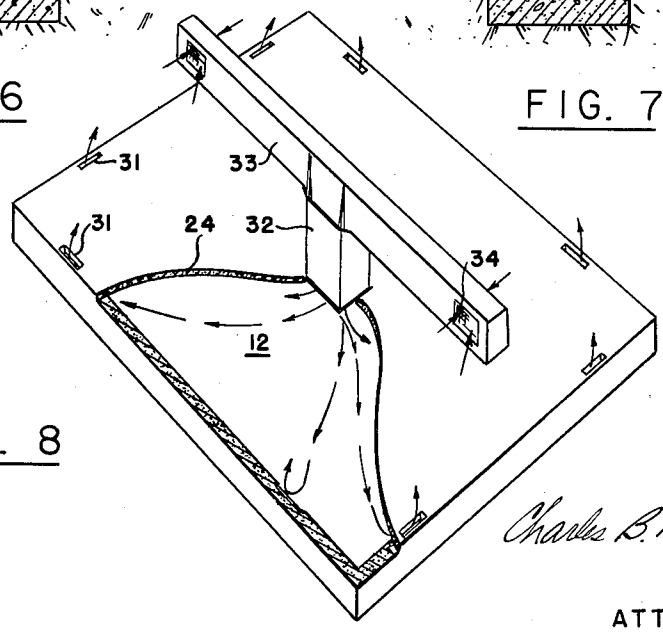


FIG. 8

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PROCESS OF CONSTRUCTING A CONCRETE SUPPORT STRUCTURE

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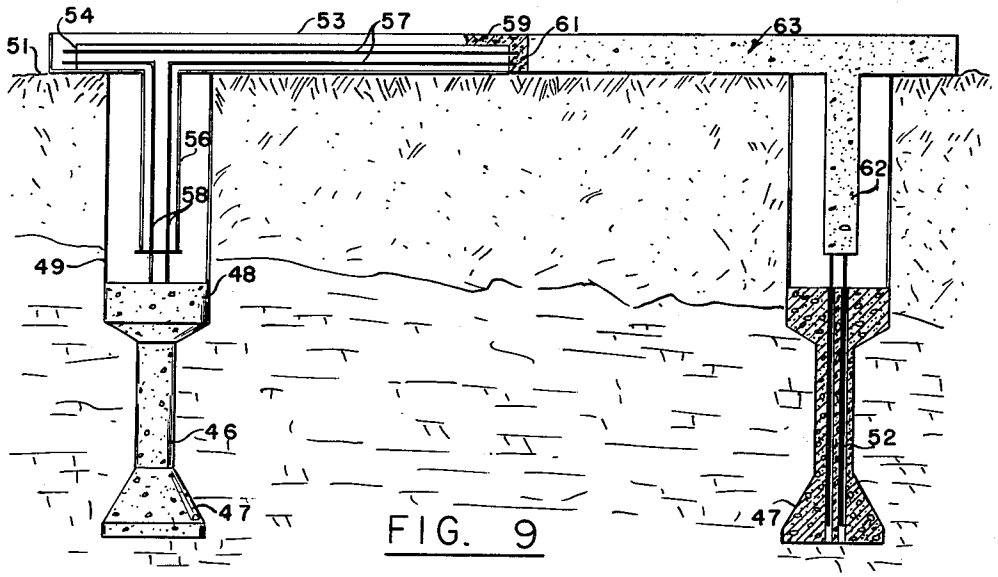

FIG. 9

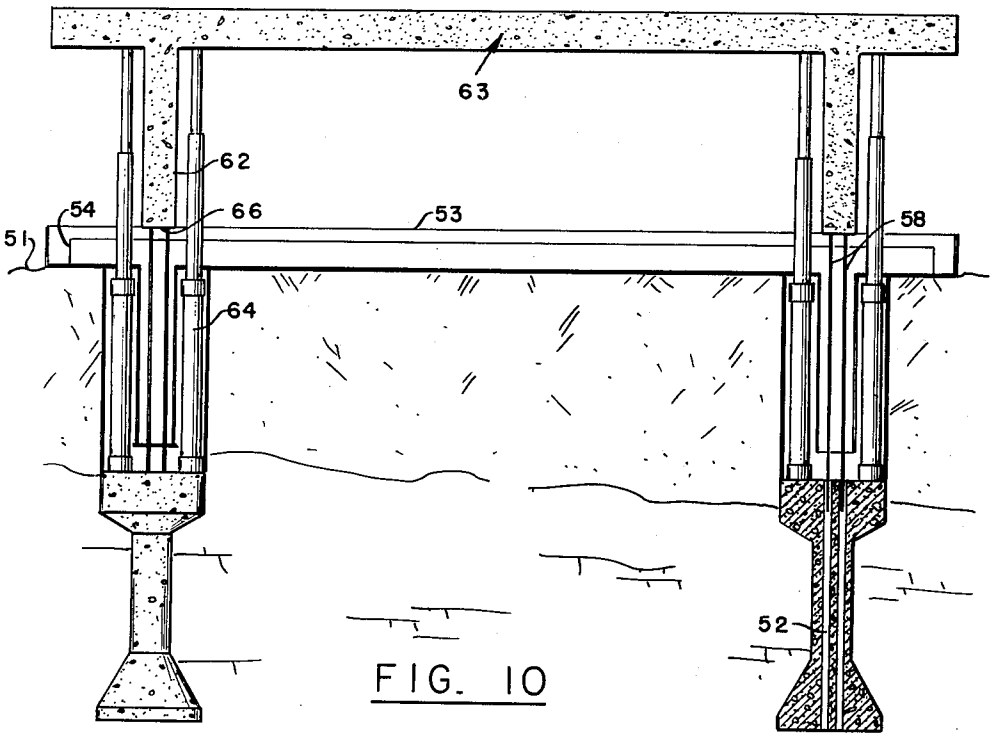

FIG. 10

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3,040,411

PROCESS OF CONSTRUCTING A CONCRETE SUPPORT STRUCTURE

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Filed May 7, 1956, Ser. No. 583,295
9 Claims. (Cl. 25—155)

The present invention relates to methods for modified types of lift slab construction. Previously different methods of lift slab construction have been disclosed and practiced by others, and some of the methods previously known have been adapted and have proved their economic advantages in the construction industry.

It is an object of the present invention to present different improved modifications of the lift slab technique that are especially suited to specific types of building construction and which satisfy specific architectural and structural needs.

A specific object of this invention is to provide a technique for obtaining low cost foundation and floor supports which incorporate heating system features.

Another object of the present invention is to provide a unitary floor and wall support structure which encloses a warm air plenum for a built-in heating system.

A separate object of the present invention is to provide a method of lift slab construction in which the slab floors and integral upright supports or support walls are raised unitarily into positions of use.

Specific objectives of the present invention are to provide methods whereby construction of a multi-floor structure may proceed in orderly manner to early completion of a strong well-designed support structure.

A main object of this invention is to provide separate methods of lift slab construction in which the slab elements of a building, together with unitarily-poured upright wall or column support members for the building, are raised into position before completion of the structural foundation elements of the building.

Further objects and advantages of the present invention will be apparent from the appended description and drawings, in which—

FIG. 1 is an end elevation with parts in section,

FIG. 2 is an end elevation with parts in section showing a second step in the practice of this invention,

FIG. 3 is an end elevation with parts in section showing another step in the practice of this invention,

FIG. 4 is an end elevation with parts in section showing a structure completed in accordance with a first embodiment of this invention,

FIG. 5 is a perspective view showing the overall arrangement of a floor slab and support structure made in accordance with this invention,

FIG. 6 is a side elevation in partial section showing an alternate means of raising the floor slab,

FIG. 7 is an elevation in partial section showing a still further means for raising the floor slab and support structure,

FIG. 8 is a perspective view with partial cutaway showing the use of a structure made in accordance with this invention as part of a heating system,

FIG. 9 is an elevation with parts in section showing features of a separate embodiment of this invention, and

FIG. 10 is an elevation with parts in section showing a second step in the practice of this separate embodiment of the invention.

Briefly stated, the present invention provides a modification of the lift slab technique in which the floor or roof slabs and unitarily-poured upright support columns or walls are raised to position before completion of the building support foundation.

A first embodiment of this technique is utilized to provide a floor support for residences and small buildings

of such design and placement that the monolithic floor slab and wall support structure may be used as elements of the heating system of the structure.

Referring now to the drawings, FIGS. 1 through 4 illustrate steps to be followed during practice of the first embodiment of this invention to obtain a floor support structure that is raised but a slight distance above the ground. In FIG. 1 it will be seen that a trench 11 is dug in the ground 12 in position corresponding to the desired location of the building foundation. After the trench is dug, forms 13 are placed in the trench and held in position by stakes 14 to define the outer extremities and dimensions of a desired building floor. Next, inflatable bags 16 are placed on top of the earth mound disposed between the forms 13. Where necessary, solid type insulation material 17 is placed along the inside wall 18 of the trench. This insulation 17 is used only in instances where it is desirable to prevent heat loss through the support walls of the structure. However, it should be noted that the solid type insulation not only prevents such heat loss but is also useful in this type application to prevent crumbling of the wall 18 of trench 11.

Tie wires 19, which are engaged with insulation 17, are provided so that the insulation will be integrally secured to concrete which is subsequently to be poured into the void created between the forms 13, the insulation 17 and the support bags 16 or, as shown, the membrane covering 21 which covers the bags 16. This subsequent step in the practice of the invention is shown in FIG. 2 where the concrete 22 is shown in place and finished to provide a smooth level top floor surface 23. When the concrete is sufficiently hardened and when it has cured so that it has the requisite strength, the unitary structure, inclusive of the floor 24 and upright support walls 26, may be raised upwardly out of contact with the supporting ground 12. Since the insulation 17 is secured to the support walls 26 by the ties 19, the support walls and insulation 17 will be moved upwardly out of the trench 11.

One means for raising the floor structure 24 would be to introduce air under pressure greater than atmospheric into the bags 16. This means of elevating the structure is shown in FIG. 3, where the bags 16 are shown in expanded shape.

After the structure has been raised to its desired position and leveled by differential adjustments of the air within selected bags 16, additional concrete is poured into the footing trench 11 to provide a footing structure 27, as shown in FIG. 4. As soon as the footing has hardened, the bags 16 may be deflated and removed from the resultant cavity 28 formed by the floor structure 24, the insulation 17 on the upright supports 26 and the supporting ground 12.

This raised floor structure is architecturally desirable and advantageous for several different reasons. First, the cavity 28 may be utilized to provide a dead-air space which acts as an insulator to prevent transmission of ground temperatures into a structure erected above the floor 24. Such dead-air insulation space has been found desirable in northern climes, especially when the structure is intended for habitation. Likewise, this type of structure providing an air space between the ground and the floor support structure is desirable and advantageous where heavy ground moisture conditions are prevalent. If the moisture is kept out of contact with the concrete slab, improved health conditions result, and the application of various type floor coverings to the top surface 23 may be made without fear of later damage due to moisture. In regions where expansive soils are encountered, the provision of the air space 28 between the ground 12 and the floor structure 24 will prevent cracking of such floor.

A main advantage in the provision of such air space

is the possibility of utilizing this space as a plenum chamber in conjunction with a building heating system. This utilization of the structure made in accordance with this invention is shown in FIGS. 5 and 8. In FIG. 5 a slab structure is shown in which the floor **24** is supported above the footings **27** and the ground **12** by the unitarily-poured support walls **26**. As shown in the previous drawings, insulation **17** should be attached to the inner face of the upright support walls **26** to prevent heat loss through such walls, which will in part be exposed to the weather. In pouring the slab structure shown in FIG. 5, a central opening **29** is provided together with a plurality of smaller openings **31** disposed about the periphery of the slab structure. These elements, when combined with the air space **28** between the slab **24** and the supporting ground **12**, may be used as a warm air heating system for the structure. An arrangement of such heating system is shown diagrammatically in FIG. 8, where it will be noted that a forced air downdraft furnace **32** is positioned above the opening **29**. A main cold air return trunk **33** is provided to conduct return air into the furnace **32** where it is forced by means of a fan (not shown) downwardly through a heat exchanger (not shown) to be warmed and discharged into the air space **28** or plenum existing beneath the floor slab **24** and above the supporting ground **12**. This heated air will course outwardly from its point of introduction along paths, as shown by the arrows, to the outlet openings **31** along the periphery of the structure.

Since the warmed air in the plenum will be in contact with the floor structure **24**, the floor itself will be warmed to provide a moderate radiant heat factor in addition to the considerable comfort advantage over usual type of cold concrete floors. The warm air on discharge through the openings **31** may likewise be directed throughout the building or separate rooms thereof in a manner similar to that used in warm air heating systems. In this illustration the cold air return vents **34** are shown in relatively elevated position. With a downdraft furnace the elevated position would, of course, be most economical; however, this positioning also is advantageous if it is desirable to incorporate air conditioning features into the proposed heating system.

It is realized that raised concrete floors have previously been used as elements of a warm air plenum type heating system, and accordingly the advantages of such heating system design are previously known. However, the method of the present invention provides improved and more economical means for obtaining such features.

Alternate means for raising the unitary floor slab and structure are shown in FIGS. 5, 6 and 7. In FIGS. 5 and 7 the use of hydraulic jacks is illustrated. Here it will be noted that a hydraulic jack **36** mounted on a tripod support **37** is secured to anchor bolts **38** in the floor structure **24**. With the application of hydraulic pressure through the line **39**, the cylinder **41** will be extended downwardly through an opening **40** in the floor **24** to engage a prepoured foundation pier **42** thereby lifting the floor slab **24**. When the floor slab **24** is in the desired elevated position, the support foundation **27** will be poured under the upright walls **26** in the manner previously described.

An alternate means for accomplishing the same purpose is shown in FIG. 6, in which a mechanical screw jack **43** is threaded through a collar **44**, which is attached to the anchor bolts **38**. Extension of the screw **43** will necessarily cause raising of the floor slab **24**, so that the building footing may be poured under the floor slab support or wall **26**.

An alternate application of the basic feature of this invention is shown in FIGS. 9 and 10. This embodiment of the invention is intended for use in the construction of larger type and multi-storied buildings. As in the previous embodiment, a main objective of this system is to pour monolithically a floor slab and upright supports for such slab at ground or operational level, and subsequently to raise such unitary structure above the operational level for the pouring of successive elevations of the building. After all elevations have been poured and raised, a footing or foundation for the building may be completed under the raised structure.

The steps followed in practice of this modification of the invention would include the excavation of footing piers downwardly into the earth structure at spaced positions on the building site. After the pier holes have been dug, a working level below the ground or operational level is obtained by pouring concrete into a portion of the pier holes. Next, forms are set at ground or operating level for a floor slab and for any beams used to support the floor slab. Additional column forms are attached to the slab or beam forms and allowed to extend downwardly into the pier hole opening. Next, concrete is poured to complete a unitary floor slab beam support and upright column structure.

After the concrete is properly hardened, this unitary structure will be raised above operational level or to approximately the level of the floor slab forms, so that a second structural elevation may be poured in similar manner. After all building elevations have been poured and cured, the entire building will be raised to its final position, and subsequently the foundation below the operational level will be poured to complete the structure.

In FIGS. 9 and 10 the foregoing method for carrying out these steps is illustrated. In FIG. 9 it will be seen that a foundation pier **46**, having a belled footing **47**, is provided. A support working level **48** is established by enlarging the size of the foundation pier **46**, and a caisson **49** extends above such work support **48** up to the ground or operational level **51**. An improved feature of this construction which permits continuity for the reinforcing steel is possible if openings are provided, as by tubes **52** extending downwardly through the foundation pier **46**. If such openings are provided, the reinforcing steel for the upright support columns may be extended all the way down into the belled footing **47** portion of the pier.

After the footings have been poured and the caissons **49** set, slab forms **53** and slab support beam forms **54** may be placed at the operational level. Likewise, forms **56** for the upright columns are extended downwardly into the cavity within caisson **49**. After the forms have been set, reinforcing steel **57** may be placed in the beam and slab forms and upright reinforcing rods **58** may be extended downwardly through the column forms **56** and down through the open tubes **52** in the foundation pier **46**. After all the forms and reinforcing steel has been set, a monolithic concrete pour is made to complete slab **59**, support beams **61** and upright columns **62** as a unitary structure or building elevation designated **63**.

After the concrete is properly hardened and cured, lifting apparatus, such as the hydraulic cylinders **63**, shown in FIG. 10, may be used to raise the unitary structure **63** to a position above the operational level **51**. As shown in FIG. 10, the structure **63** is preferably raised, so that the bottom **66** of the columns **62** is just even with the top of the slab form **53**. As the structure **63** is raised, it will be noted that the upright reinforcing steel **58** is raised upwardly out of the tubes **52**. Accordingly, a subsequent elevation for the building structure may be poured beneath the first or top elevation **63** that will be bonded to such top structure by the continuous reinforcing rods **58**. Necessarily, additional rods can be introduced into the tubes **52** and secured to the rods **58** before subsequent elevations of the building are poured.

Once all the proposed floors or elevations of the building have been poured and have been raised to their intended level, additional concrete can be introduced into a form within the caisson **49** to complete the foundation pier structure **46**. In actual practice of the invention a slab would probably be poured at the ground or opera-

tional level prior to the setting of forms for intended upper elevations. This step would be followed to provide a smooth bottom support surface for the pouring of the raised slabs.

Since each of the raised elevations, such as **63**, will have to be allowed to cure a considerable length of time after they are poured and before they are raised to an elevated position, it is desirable that other building, mechanical and finishing operations be carried out on the structure as soon as each separate slab is poured and before the structure is raised. With proper design it would be possible to finish each of the raised floors of the building while such elevation is at the operational level. With the present day use of aluminum face panels and other modern construction mthods, this type of construction schedule could be carried out without addition of too much extra weight to the building before it is raised into position.

Further improvements and modifications of this type building system are possible for different types of building applications. All such modifications as come within the scope of the hereunto appended claims are deemed to be a part of this invention.

What is claimed is:

1. The method of constructing a concrete support structure for buildings which comprises excavating earth away from the intended location of foundation elements of the building, erecting forms for a floor slab at an operational level positioned above said foundation excavation, providing forms for upright floor slab support members beneath the slab forms and extending downwardly toward the foundation excavation, monolithically pouring in said forms a floor slab and the upright support members for holding said slab in elevated position, raising the resultant monolithic structure to the desired elevation, and subsequently completing the foundation of said building under said upright support members in their raised position for holding said structure in desired position.

2. The method of constructing a concrete support structure for buildings which comprises excavating foundation footings for the building, pouring concrete in said excavations in such manner as to provide footing elements having openings extending downwardly therethrough, establishing an operational level above the top of the footing elements, setting forms for a floor slab at said operational level, setting forms for upright support members as necessary to support said floor slab beneath said floor slab forms and extending downwardly toward said footing elements, placing reinforcing materials that extend through said upright member forms and downwardly through the openings in said footing elements, monolithically pouring the formed floor slab and the upright support members necessary for holding said slab in elevated position, raising the resultant monolithic structure to the desired elevation whereby the reinforcing materials will be raised outwardly from the openings in said footing elements, and subsequently completing the foundation of said building under said support members in their raised location for holding said structure in desired position.

3. The method of constructing a concrete support structure for buildings that is useful as a plenum chamber for the heating system of the building which comprises excavating a trench in the earth of a size and placement to provide for the foundation footings of the building, placing insulation materials along the inside upright wall of the footings trench, erecting forms in the trench disposed away from said inside upright wall of the trench and the insulation therealong, said forms extending above the enclosed earth's surface within the perimeter of the footings trench, pouring concrete in the forms to provide a monolithic structure inclusive of a slab disposed above the enclosed earth and upright slab support foundation walls disposed between the forms and the insulation on the upright inside wall of the trench, unitarily raising said monolithic structure and the insulation to a desired elevation where the slab is out of contact with the enclosed earth to provide an open space between said slab and the earth, subsequently pouring a foundation footing for the building in the trench and under said slab support foundation walls to hold said monolithic structure in raised position and to close off said open space, and forming openings through the slab portion of said structure for the selective ingress and egress of the circulating air of the heating system into and out of said open space beneath the slab.

4. The method of constructing a concrete support structure for buildings which comprises excavating foundation footings for the building, pouring concrete in said excavations in such manner as to provide footing elements, establishing an operational level above the top of the footing elements, setting forms for a floor slab at said operational level, setting forms for upright support members as necessary to support said floor slab beneath said floor slab forms and extending downwardly toward said footing elements, monolithically pouring the formed floor slab and the upright support members necessary for holding said slab in elevated position, raising the resultant monolithic structure to the desired elevation, and subsequently completing the foundation of said building under said support members in their raised location and above said footings for holding said structure in desired position.

5. The method of constructing a concrete support structure for buildings which comprises establishing building footing elements for the foundation of the building, setting forms for a floor slab at an operational level above the top of the footing elements, setting forms for upright support members as necessary to support said floor slab beneath said floor slab forms and extending downwardly toward said footing elements, monolithically pouring the formed floor slab and the upright support members necessary for holding said slab in elevated position to complete a building level, raising the resultant monolithic structure to an elevation such that the bottom extremity of said upright supports is positioned adjacent the floor slab forms, pouring at least one more complete building level inclusive of a floor slab and upright support members therefor in said forms and below the previously poured and raised building levels, and subsequently completing the foundation of said building under the lowermost of said raised levels of the building for holding said building structure in desired position.

6. The method of constructing a concrete support structure for buildings which comprises excavating a trench in the earth of a size to provide for foundation elements of a building, erecting forms in the trench disposed away from the inside upright wall of the trench and extending above the enclosed earth within the perimeter of the trench, pouring concrete within the forms to provide a monolithic structure inclusive of a slab disposed above the enclosed earth and upright slab support foundation walls disposed between the forms and the upright inside wall of the trench, unitarily raising said monolithic structure a distance less than the depth of said trench whereby the slab is moved out of contact with the enclosed earth and the said support foundation walls remain partially disposed in said trench to provide an air space between said slab, foundation walls and earth, and subsequently completing the foundation for the building under said raised foundation walls, said air space being useful to isolate the floor slab of the structure from the environmental conditions associated with the supporting earth.

7. The method of constructing a concrete support structure for buildings which comprises establishing building footing elements for the foundation of the building, setting forms for a floor slab at an operational level above the top of the footing elements, setting forms for upright support members as necessary to support said

floor slab beneath said floor slab forms and extending downwardly toward said footing elements, monolithically pouring the formed floor slab and the upright support members necessary for holding said slab in elevated position to complete a building level, raising the resultant monolithic structure to an elevation such that the bottom extremity of said upright supports is positioned adjacent the floor slab forms, adjusting said forms for the upright support members to extend to the building footing elements and pouring at least one complete building level inclusive of a floor slab and upright support members therefor in said forms and below the previously poured and raised building levels for completing the foundation support of said building between the lowermost raised building level and said footing elements.

8. The method of constructing a concrete support structure for buildings which comprises establishing footing elements for the foundation of the building, erecting forms for a floor slab in position above said footing elements, setting forms for upright support members as necessary to support said floor slab beneath said floor slab forms, monolithically pouring in said form a floor slab and the upright support members for holding said slab in upright position, raising the resultant monolithic structure to the desired elevation, and subsequently completing the foundation of said building between said footing elements and said upright support members in their raised position for holding said structure in desired position.

9. The method of constructing a concrete floor and support structure for a building that is useful as a plenum chamber for the heating and air conditioning system of the building which comprises establishing building footing elements for the building, erecting forms for a floor slab and a downwardly depending skirt wall positioned at the periphery of said slab, monolithically pouring said floor slab and said skirt wall in said forms, unitarily raising said monolithic floor slab and skirt wall structure upwardly and away from said forms a distance less than the combined height of said floor slab and skirt wall forms to provide an open space plenum chamber beneath said floor slab, completing a structural support element between said monolithic floor slab and skirt wall structure and said footing elements, and forming openings in said slab and skirt wall structure for the selective ingress and egress of circulating air into and out of the open space plenum chamber beneath the slab.

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