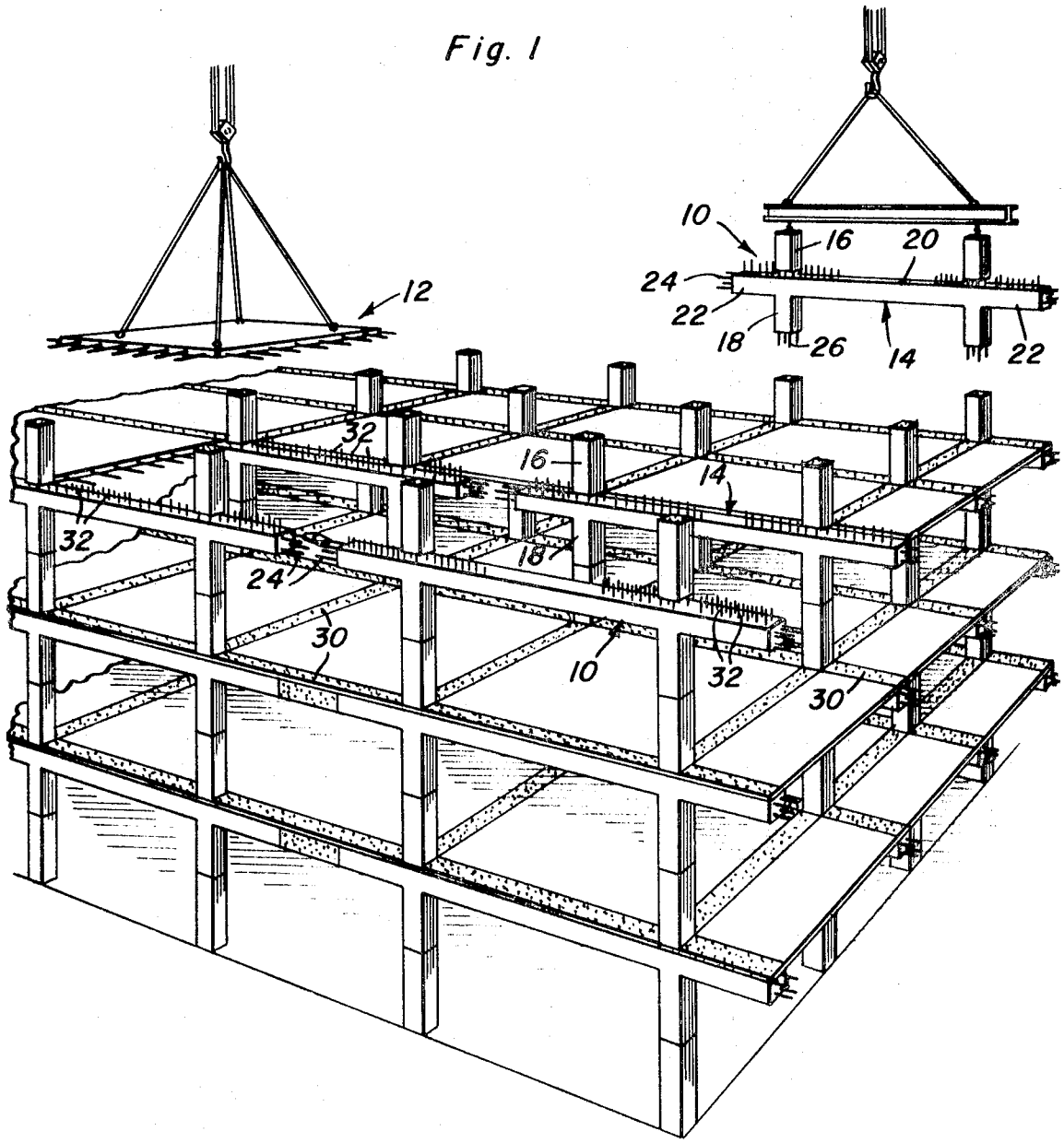
Oct. 19, 1971 A. A. YEE 3,613,325

CONCRETE CONSTRUCTION

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Fig. 1



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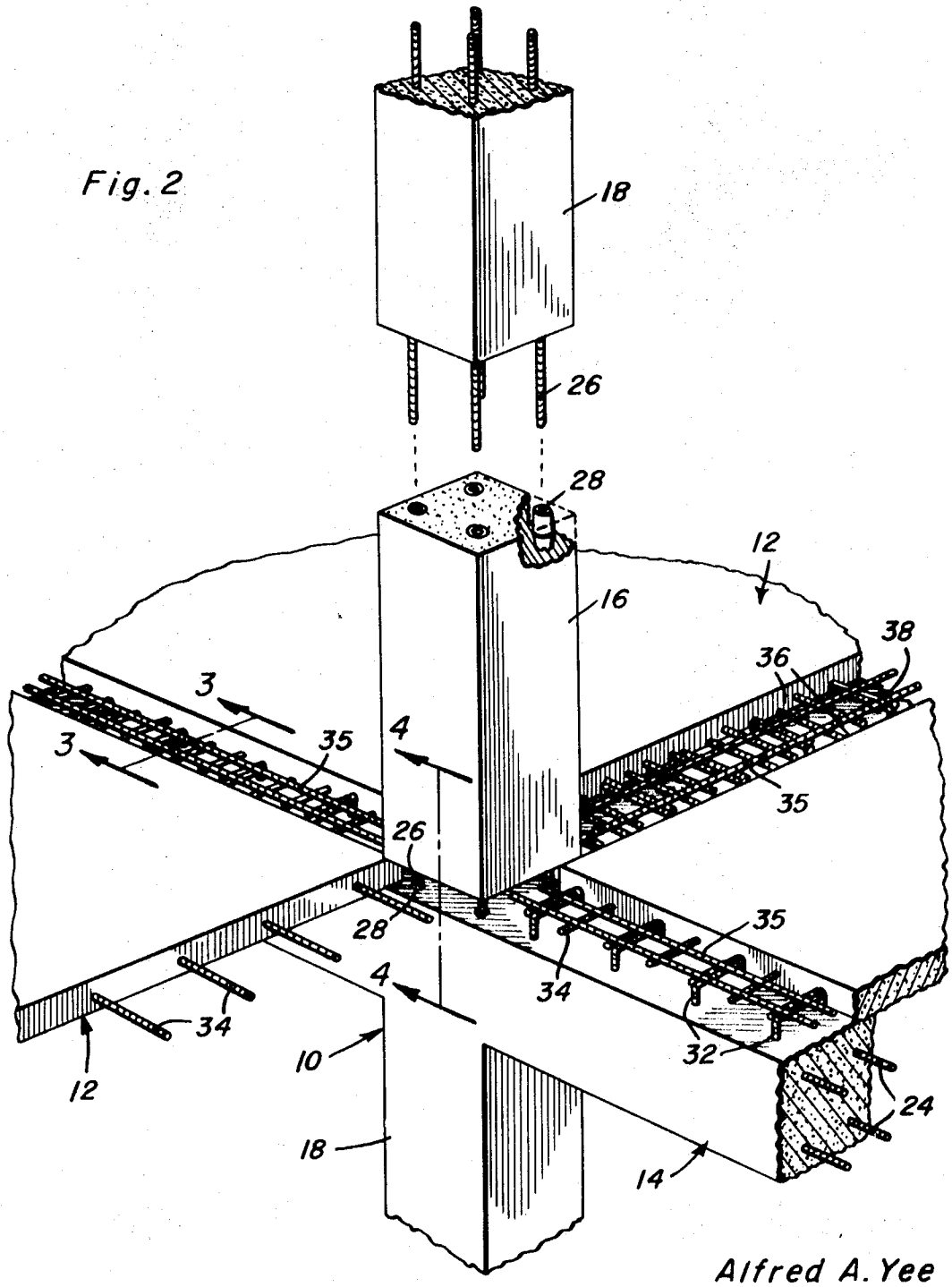
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Fig. 2



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Fig. 3

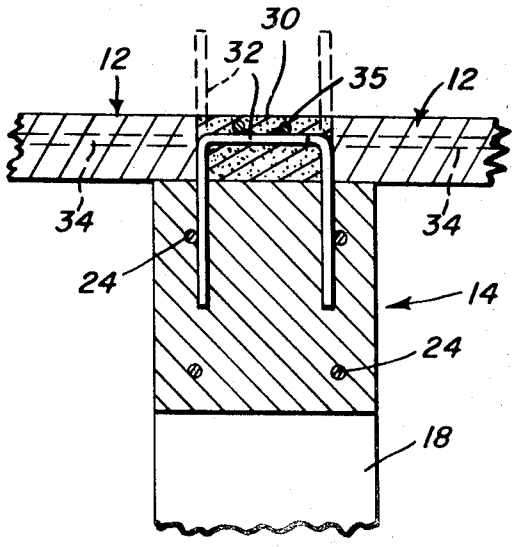


Fig. 4

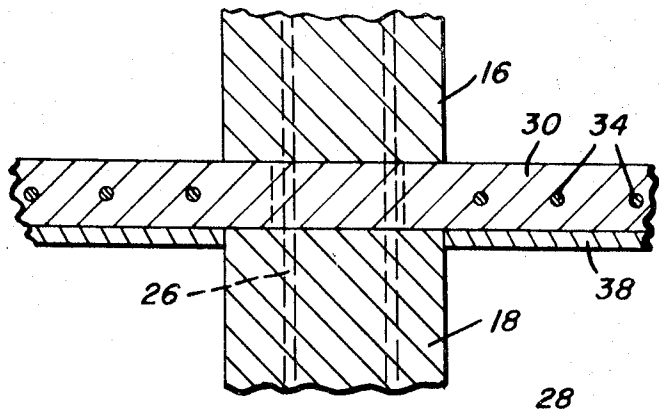
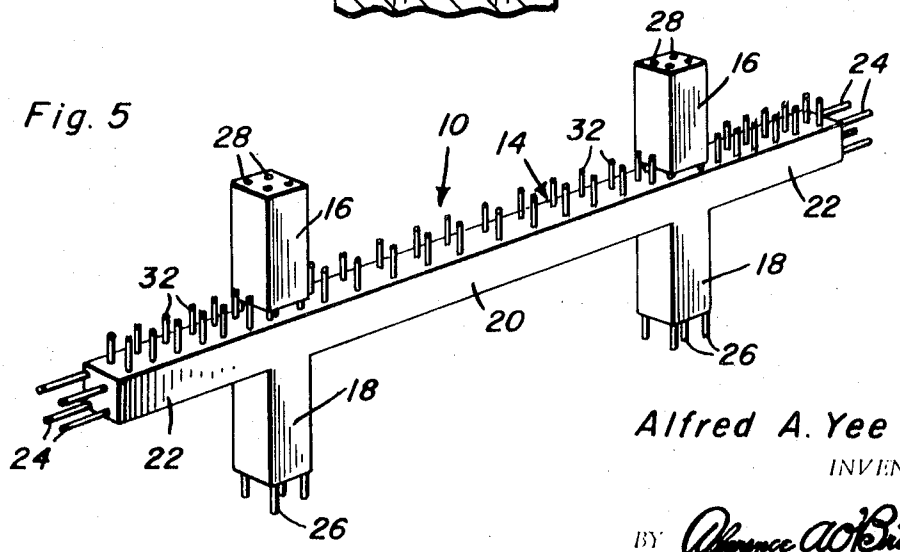


Fig. 5



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3,613,325

CONCRETE CONSTRUCTION

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Filed July 10, 1969, Ser. No. 840,725
Int. Cl. E04b 5/04, 5/16
U.S. Cl. 52—236 4 Claims

ABSTRACT OF THE DISCLOSURE

A construction system utilizing a plurality of combination column and beam units or trees assemblable so as to define a concrete building frame for the reception of a plurality of pre-formed concrete slabs. Each tree consists of upper and lower column sections which join at mid-height to similar column sections on subjacent and superjacent trees, the joining being effected through embedded splice sleeves. Each upper column section is spaced above the transverse tree beam to which it is joined for the accommodation of a slab joining pour whereby a positive interlock between the beam-supported slabs and the frame unit or tree is achieved.

The instant invention is generally concerned with a concrete construction system, and more particularly relates to a system wherein the building frame, as well as the floor slabs, are formed of precast units adapted to interengage and be locked together, utilizing grout and poured concrete, into a highly rigid concrete structure notwithstanding the preformed nature of the major components thereof.

A primary object of the instant invention is to provide unique precast combination column and beam units, referred to as trees, which are assembled so as to define a concrete building or tower frame.

Another significant object of the instant invention resides in the provision of a concrete construction system wherein preformed frame units are particularly adapted so as to not only combine with similar units in forming a concrete frame, but also so as to receive, support, and positively interlock with preformed horizontal concrete slabs for the formation of floors and ceilings.

A further significant object of the instant invention resides in the provision of frame units and slabs which are both internally reinforced and include embedded exposed reinforcing rods particularly oriented so as to receive and be bound by selectively poured concrete at the joining areas of the various components.

Another object of the instant invention resides in the provision of a construction system wherein the construction of a concrete frame building can be effected rapidly and continuously, without the delays normally encountered in concrete construction, in view of both the preformed nature of the components utilized and the specific configurations of the components wherein a stacking thereof can be continuously effected while the lower units are being intimately bonded together.

Basically, the objects of the instant invention are achieved through the provision of concrete building frame units consisting of, in the illustrated embodiment, an elongated beam defining, as an integral member, one complete span and two oppositely extending sectional spans, in conjunction with two upwardly projecting column sections and two downwardly projecting column sections. The upper column sections are orientated, through reinforcing rods, in spaced relation above the beam for the accommodation of a concrete pour utilized in bonding the edges of a series of slabs supported on the beams. The slabs are bonded both to each other and to the beam, appropriate projecting reinforcing rods being utilized. The

column sections are in turn joined to adjacent column sections through the utilization of embedded splice sleeves.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a perspective view illustrating a partially completed building being constructed in accordance with the system of the instant invention;

FIG. 2 is an enlarged perspective detail illustrating the various components of the system;

FIG. 3 is an enlarged cross-sectional view taken substantially on a plane passing along line 3—3;

FIG. 4 is an enlarged cross-sectional view taken substantially on a plane passing along line 4—4 of FIG. 2; and

FIG. 5 is a perspective view of one of the column and beam units or trees utilized in the system of the instant invention.

Referring now more specifically to the drawings, it will be noted that the concrete construction system of the instant invention basically includes two types of components, a preformed or precast column and beam unit **10**, and a preformed or precast slab **12**.

Each of the column and beam units **10**, generally referred to as trees, consists of a horizontal beam **14**, one or more upper column sections **16**, and one or more lower column sections **18**. The beam **14**, in the illustrated embodiment wherein two upper and lower column sections are provided, includes a full central section **20** extending between the spaced aligned upper and lower column sections **16** and **18**, and a pair of opposed beam sections **22**, each projecting outwardly from one set of column sections **16** and **18**. The beam **14**, for the full length thereof through the contiuously formed center and two end sections **20** and **22**, is provided with longitudinally extending reinforcing bars **24** which project longitudinally beyond the outer ends of the two end partial beam sections **22**. The lower column sections **18** extend perpendicularly downward from the beam **14** and are integrally formed therewith. The upper column sections **16**, which align with the lower column sections **18**, are positioned in vertically spaced relation above the top of the beam **14** at a height approximately equal to the thickness of the slabs **12** to be used in conjunction therewith. These upper column sections **16** are maintained in vertically spaced relation to the top of the beam **14**, while being at the same time rigidly joined thereto and forming in effect a single unit therewith, by a series of vertically elongated reinforcing rods **26** which extend vertically through each pair of aligned column sections **16** and **18** and across the intervening space provided between the upper column section **16** and the beam **14**. These reinforcing rods **26** terminate, at the upper ends thereof, within embedded splice sleeves **28** of the type illustrated in applicant's copending applications Ser. Nos. 740,646 and 771,262, respectively filed on June 27, 1968 and Oct. 28, 1968. As an optional method, for ease in casting the vertical space between the upper column sections **16** and the top of beam **14** can be omitted and the cast extended to the beam **14**.

The lower ends of the vertical column rods **26** project a substantial distance beyond the lower ends of the lower column sections **18** for the insertion thereof within upwardly opening splice sleeves **28** in the upper column section **16** of a subjacent unit or tree **10**. Once inserted therein, as when forming a concrete frame of the type suggested in FIG. 1, an appropriate locking of the sleeve received rods is effected through the utilization of expanding grout within the sleeve, such a joint structure

having been detailed in applicant's above referred to applications.

The trees **10**, as will be noted in the drawings, are specifically utilized to support the slabs **12** which are to be intimately bonded thereto by an appropraite concrete pour **30**. Accordingly, each beam **14**, along the full length thereof, is provided with a series of embedded and upwardly projecting reinforcing or tie rods **32**, normally arranged in pairs and positioned inwardly from the opposed side edges of the beam **14**. These rods **32**, as suggested in FIG. 3, can constitute positioning abutments for the edges of adjacent slabs **12**. The rods **32** will be bent at a height sufficient so as to be completely received within the slab joining pour **30**.

Each of the slabs **12** is rectangular, preformed of poured concrete and reinforced by internal reinforcing and/or prestressing rods **34** crossing each other at right angles and projecting laterally beyond all four edges of the slab **12**.

With particular reference to FIG. 1, it will be appreciated that the column and beam units or trees **10** are arranged in stacks spaced both longitudinally and laterally of each other, the number and arrangement of stacks depending upon the ultimate size and shape of the building being constructed. The corresponding units **10** in the longitudinally spaced stacks have the outer ends of the adjoining beam end portions **22** spaced from each other a distance sufficient so as to normally define a bay of a width equal to that formed by the adjoining central beam portion **20**. The projecting exposed ends of the beam reinforcing rods **24** are joined by grout filled splice sleeves of the type detailed in the previously referred to copending applications, with the exposed rod ends and associated splice sleeves subsequently being embedded within the joining pour **30**. As an optional method, simple lap splicing of extended reinforcing bars **24** may be used.

The laterally spaced stacks of units **10** support and are interconnected by the precast slabs or slab units **12**. Each of the slabs **12** is of a size, in one dimension, so as to fit closely between adjacent ones of the upwardly projecting column sections **16** lengthwise along the beams **14**. The slabs **12**, at right angles to the column received dimension thereof, are of a dimension so as to span the distance between the adjacent tree stacks and sufficiently overlap the laterally spaced beams **14** so as to firmly seat thereon, note for example FIGS. 2 and 3. The projecting ends of the slab rods **34** will, along the beam supported edges of the slabs **12**, lie adjacent and bypass those of the adjoining beam supported slabs for a reception within the binding concrete pour **30**, which also intimately bonds with the corresponding beams **14** through the upwardly projecting rods **32** thereon. Additional longitudinally extending reinforcing rods **35** can also be provided between the various slab edges so as to strengthen the joint formed therebetween.

The actual slab and beam interlocking pour **30** utilizes, between adjacent beam supported slabs **12**, the top of the beam **14** itself as the form. However, between the non-beam supported edges of adjacent slabs **12**, for example the edges indicated by reference numeral **36** in FIG. 2, an appropriate underlying forming deck **38** must be provided which can be conveniently removed after an initial setting of the pour **30**. As will be best appreciated from FIGS. 1 and 2, the pour **30**, for any one floor, extends peripherally about each slab, as well as within the vertical space normally provided between each upper column section **16** and the underlying beam **14**, and the spaced ends of adjacent end beam sections **22**. The extension of the pour between the spaced beam end sections **22**, as will be appreciated, also require the utilization of some minor form work. Incidentally, it will be noted that the slab rods **34**, between adjacent unsupported edges **36**, cross each other and the rods **35** and form a positive interlock with the pour **30** received between the edges **36**.

Upon completion of the pour **30**, it will be recognized that a positive binding network has been provided both about the slabs **12** and laterally between adjacent stacks throughout the full horizontal extent of each floor of the structure. The spacing of each upper column section **16**, through the utilization of the vertical reinforcing rods **26**, above the corresponding beam **14** is of significance in that such enables the pour **30** to extend continuously therebeneath and positively bind the adjoining slabs both to each other and to the reinforcing rods of the column portions of the tree **10**.

From the foregoing, it should be appreciated that a highly unique construction system has been devised. This system enables the formation of a concrete frame building utilizing preformed or precast sections whereby the rate of construction is substantially accelerated. By the same token, the construction is such so as to provide a highly rigid structure wherein the components are positively interlocked and form what might be considered an integral structure. This is effected basically through the utilization of unique column and beam units and slabs. The column portions of the units are vertically locked to each other through grout containing sleeves. The beam portions of the units are similarly interlocked by splice sleeves or lapped splices and a portion of a continuous concrete pour which also functions so as to interlock the slabs and units and laterally tie the units together. As suggested in FIG. 1, the various components can be assembled through the utilization of any appropriate type of lift equipment.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be restored to, falling within the scope of the invention.

What is claimed as new is as follows:

1. A building construction system including a preformed frame unit, said unit including an elongated beam member and at least two laterally spaced vertically aligned pairs of column members, said column members being at intermediate points along the beam member and rigidly secured thereto, one member of each pair of column members projecting vertically above the beam member, and the second member of each pair of column members projecting vertically below the beam member, each column member terminating in a free outer end incorporating joining means for a locking to an aligned column member end of an adjacent frame unit, said joining means comprising upwardly opening rod receiving splicing sleeves on the upper column member and projecting rods on the lower column member selectively receivable within the sleeves of a second frame unit positioned therebelow, the opposite ends of the beam member including connecting means for a locking thereof to end beams of adjacent units, said connecting means comprising outwardly projecting beam member mounted rods, said beam and column members being formed of precast concrete, said upper column members being orientated in spaced relation above the beam member, and thus maintained by embedded reinforcing rods extending into the upper column members and the associated beam member, and spanning the space therebetween, the outer column members being spaced inwardly from the opposed ends of the beam member a distance approximating one-half of the distance between the pairs of column members, whereby upon a connecting of the ends of a pair of beam members of adjacent units, the adjacent endmost pair of column members, one on each of the connected beam members, will be spaced a distance approximately equal to the distance between the column members of each unit.

2. A concrete building construction system comprising a plurality of preformed frame units assemblable into a

building frame, and a plurality of preformed reinforced concrete slabs supportable on the assembled frame units, each frame unit including an elongated beam member and a plurality of pairs of upper and lower column members secured thereto and projecting therefrom, the lower column members being integrally formed with the beam member, the upper column members being vertically aligned with the lower column members and positioned in vertically spaced relation about the beam member, reinforcing means extending through the upper column members, the beam member and the intervening space therebetween, thereby maintaining the upper column members connected to the beam member in spaced relation thereto, said frame units being arranged in laterally and longitudinally spaced stacks of units interconnected both vertically and horizontally, said slabs extending between the laterally adjacent stacks and having the opposed edge portions thereon supported on equal height beam members in the laterally adjacent stacks, poured concrete being utilized to intimately bond the adjacent slabs and frame units, the poured concrete extending through the spaced defined by the upwardly spaced upper column members, the endmost pairs of column members being spaced inwardly from the opposed ends of the associated beam member a distance approximately one-half the distance between the pairs of column members, whereby upon a connecting of the ends of beam members of adjacent units, the adjacent endmost pairs of column members, one on each of the connected beam members, will be spaced apart a distance approximately equal to the distance between the pairs of column members on each unit.

3. The system of claim 2 wherein each column member terminates in a free outer end incorporating joining means for a locking to an aligned column end of an adjacent frame unit, said joining means comprising upwardly opening rod receiving splice sleeves on the upper column members, and downwardly projecting rods on the lower column members receivable within the upwardly opening sleeves of a subjacent unit.

4. The system of claim 3 wherein the opposed ends of each beam member include connecting means for a locking to the beam member ends of adjacent units, said connecting means comprising outwardly projecting beam embedded rods alignable with similar rods projecting from the adjacent beam ends within an intervening space provided between the beam ends for reception of the slab and unit joining poured concrete.

References Cited

UNITED STATES PATENTS

1,031,044	7/1912	Cowzelman	52—259
3,226,894	1/1966	Burchardt	52—252 X
3,287,865	11/1966	Lockman	52—79
3,466,823	9/1969	Dowling	52—236

FOREIGN PATENTS

803,000	1958	Great Britain	52—283
660,079	1964	Italy	52—259

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U.S. Cl. X.R.

52—251, 259, 434, 722, 726