United States Patent [19]
Boehmig

[11] **3,722,169**
[45] **Mar. 27, 1973**

[54] **METHOD OF BUILDING CONSTRUCTION**

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[22] Filed: **Jan. 4, 1971**

[21] Appl. No.: **103,665**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 829,541, June 2, 1969, abandoned.

[52] **U.S. Cl.** **52/745,** 52/126
[51] **Int. Cl.** **E04b 1/35**
[58] **Field of Search**...................52/66, 745, 126, 236

[56] **References Cited**

UNITED STATES PATENTS

2,758,467	8/1956	Brown	52/126
3,028,143	4/1962	Cheskin	52/126 X

FOREIGN PATENTS OR APPLICATIONS

684,089	6/1930	France	52/745

Primary Examiner—John E. Murtagh
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[57] **ABSTRACT**

A method for construction of a multi-story building wherein the roof may be constructed first at an intermediate level, following which each floor is constructed in an elevation near ground level. After the floors are constructed, the roof and each floor is lifted to its ultimate elevation. The floors are constructed, one at a time, at closely vertically spaced intervals, and each is supported solely by the support columns during the construction. Thus, each floor serves as access to the construction of the next floor above but does not support the same. A constructional joint is provided to permit vertical movements of the floors relative to the columns after the floors are constructed. The joint basically comprises a collar arrangement disposed for receiving a vertical support column therethrough and the collar is shiftable vertically relative to the column. Further, the collar is constructed as an integral part of a horizontal beam extending outwardly from the column.

2 Claims, 21 Drawing Figures

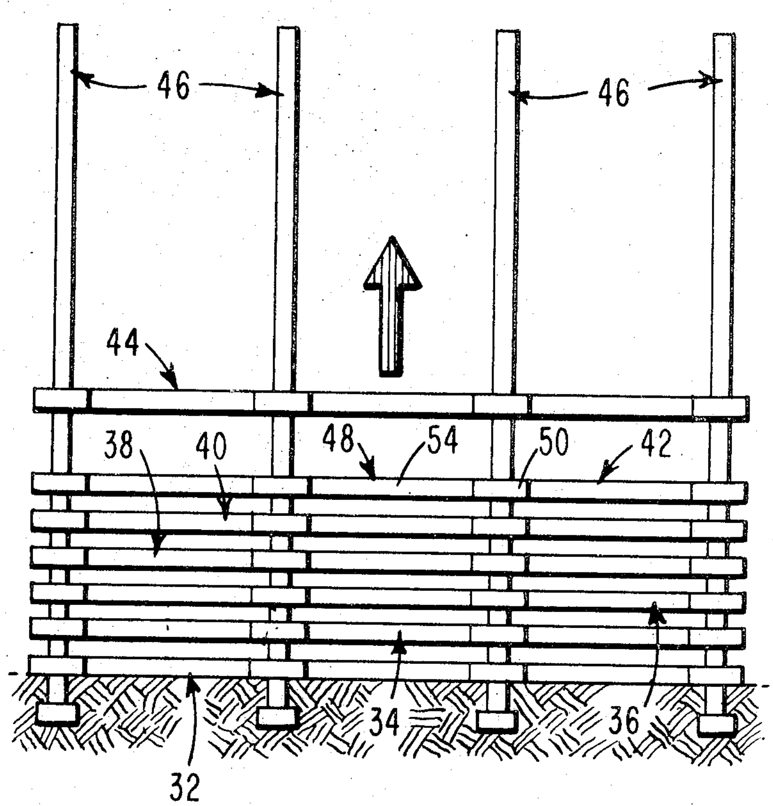

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FIG. 1

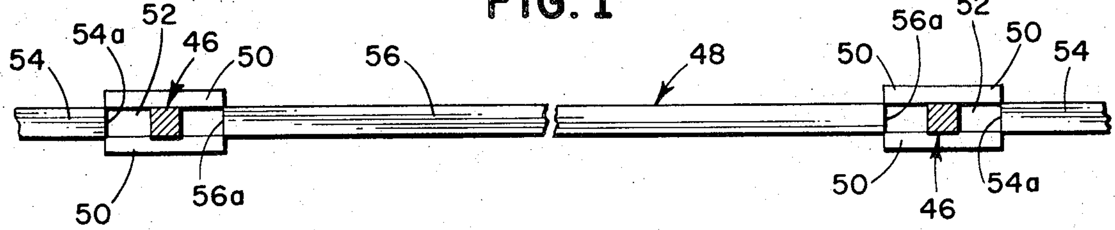


FIG. 2

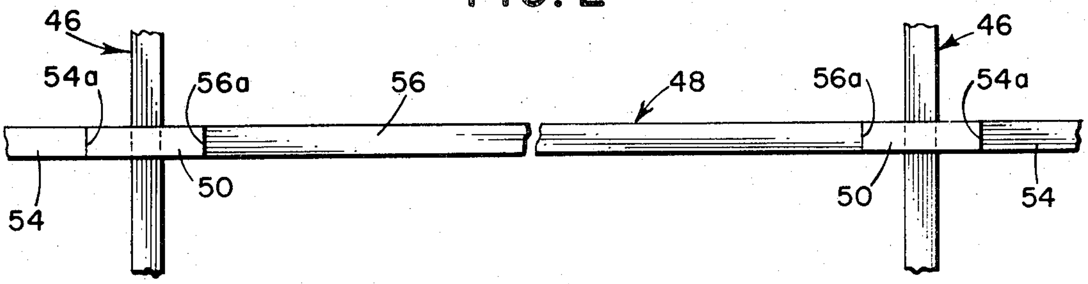
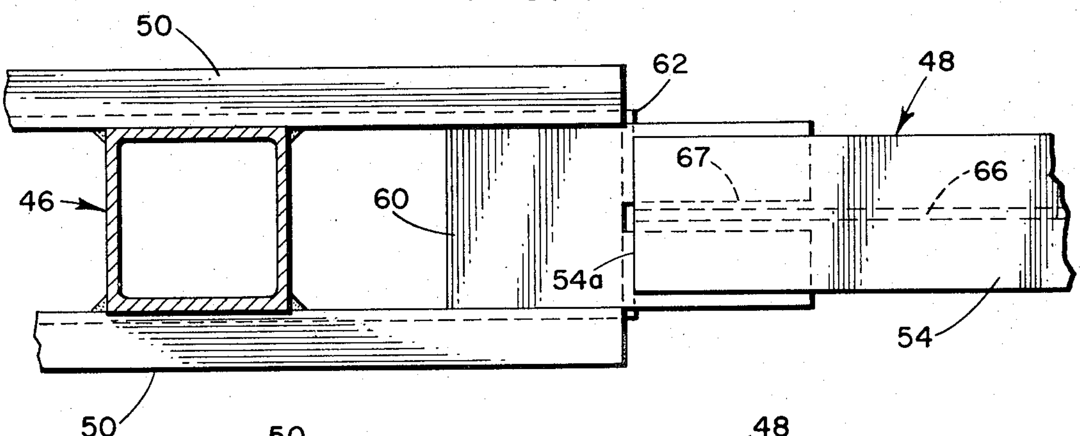


FIG. 9



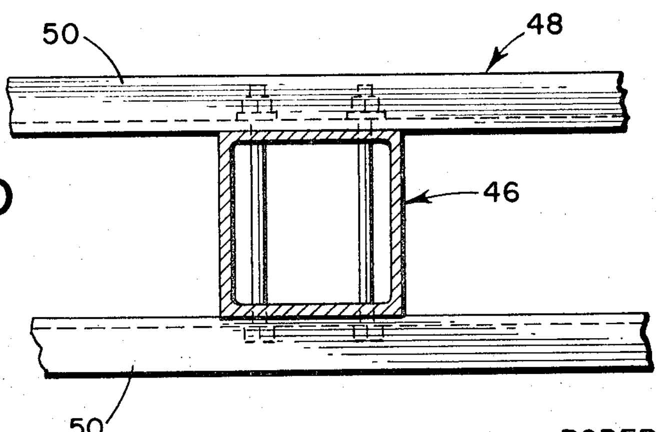


FIG. 10

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FIG. 3

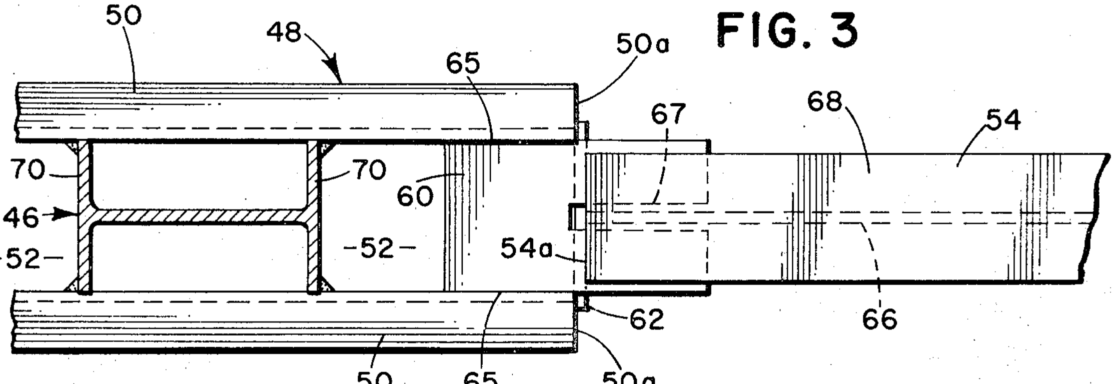


FIG. 4

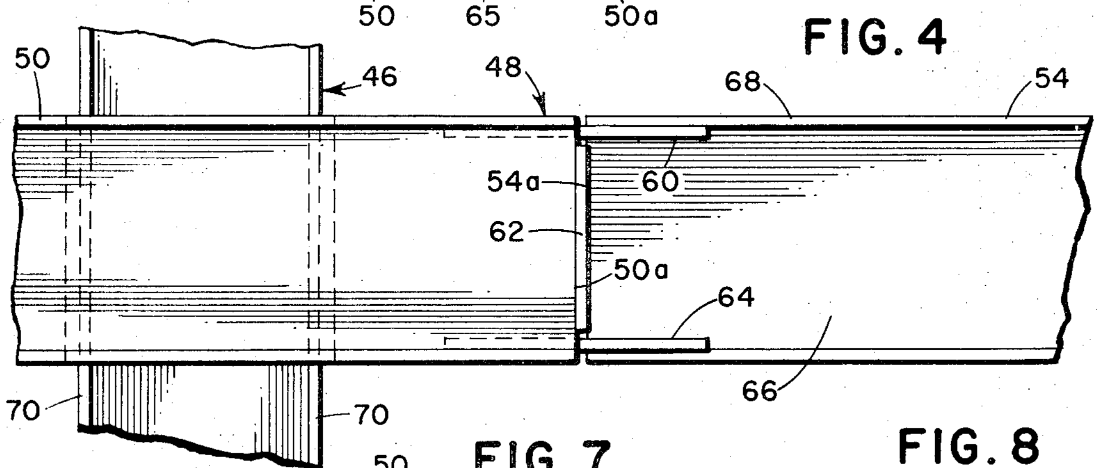


FIG. 7

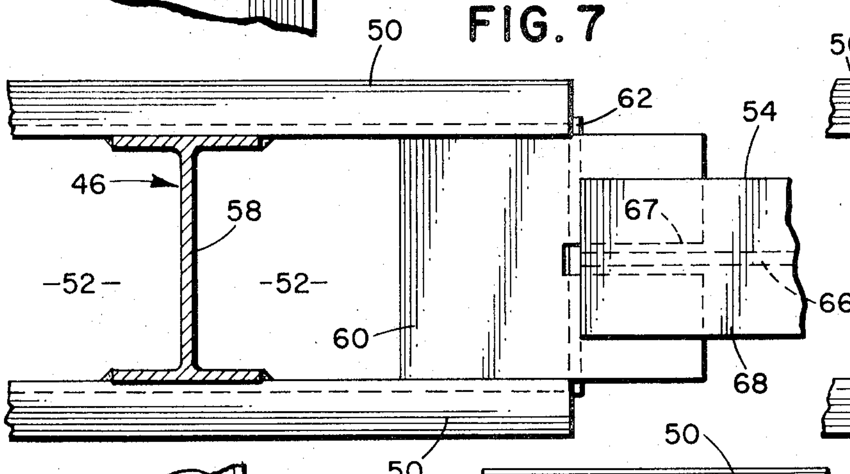
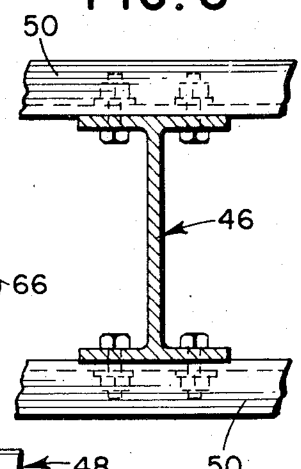


FIG. 8



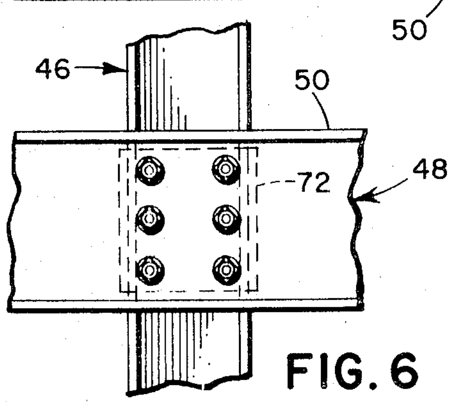


FIG. 6

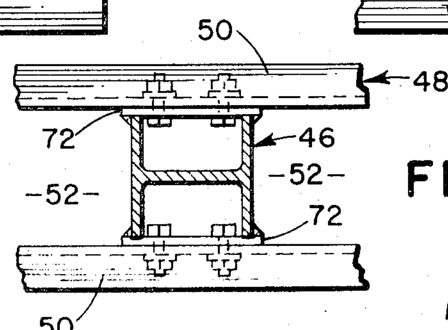


FIG. 5

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FIG. 11

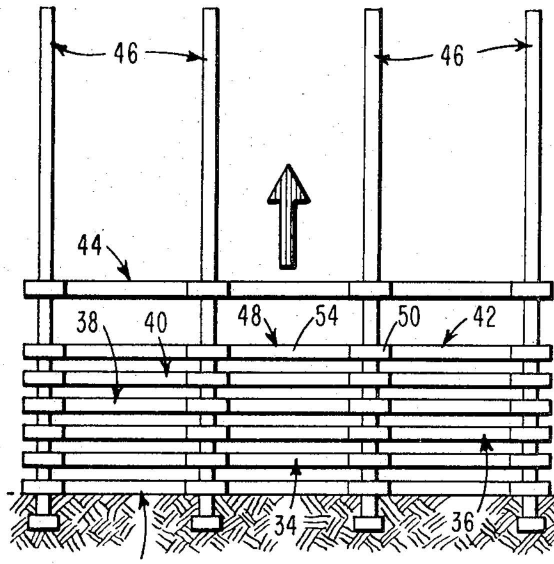

FIG. 12

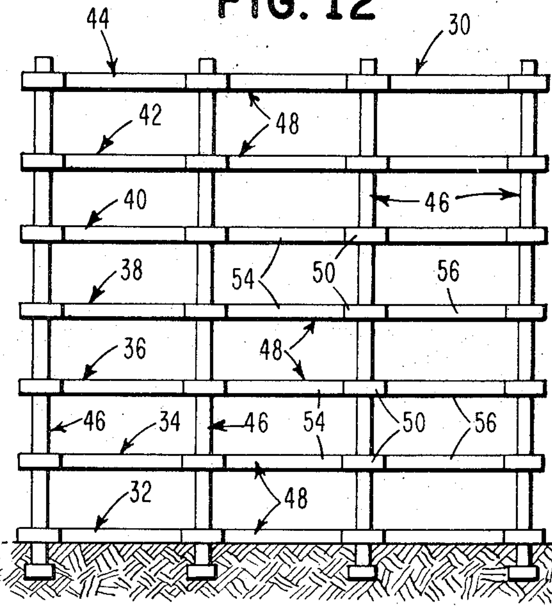

FIG. 13

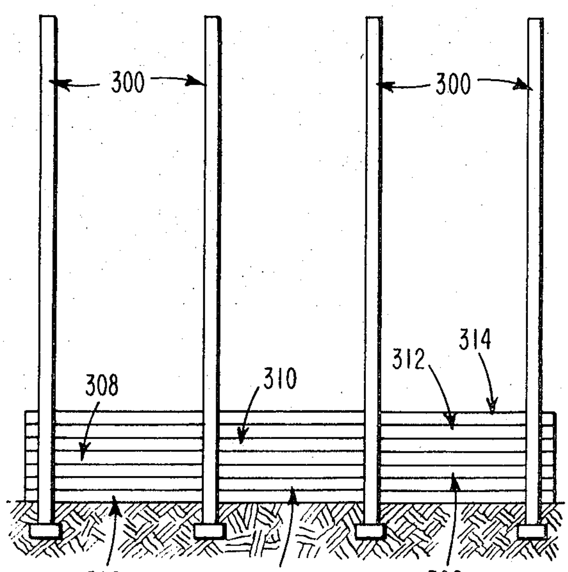

FIG. 14

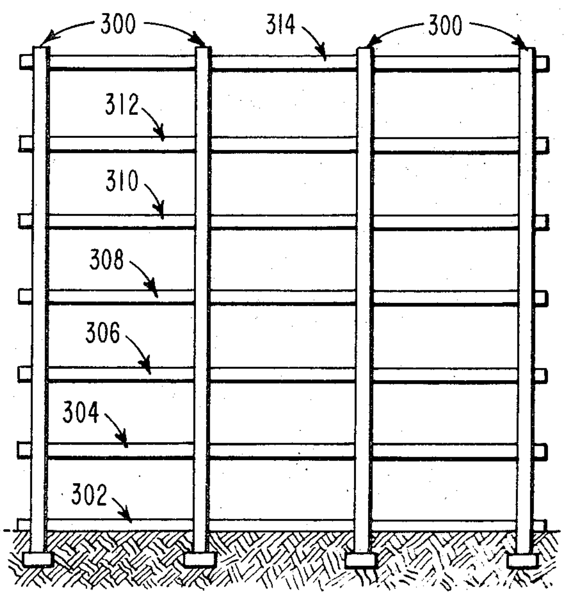

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FIG. 15

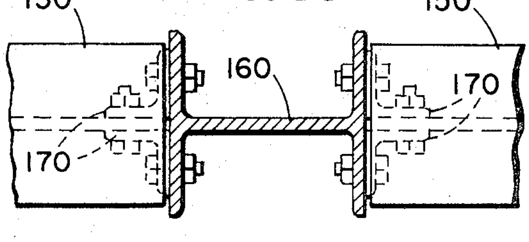


FIG. 17

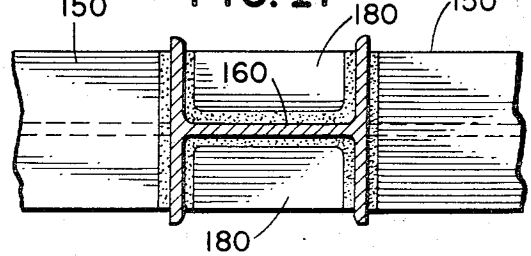


FIG. 16

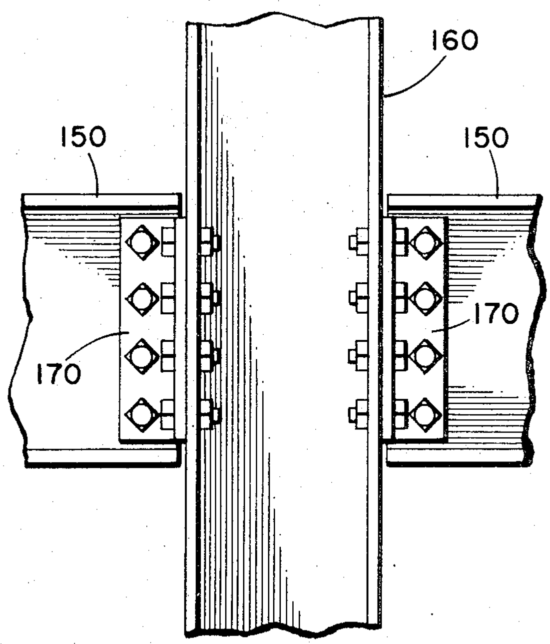


FIG. 18

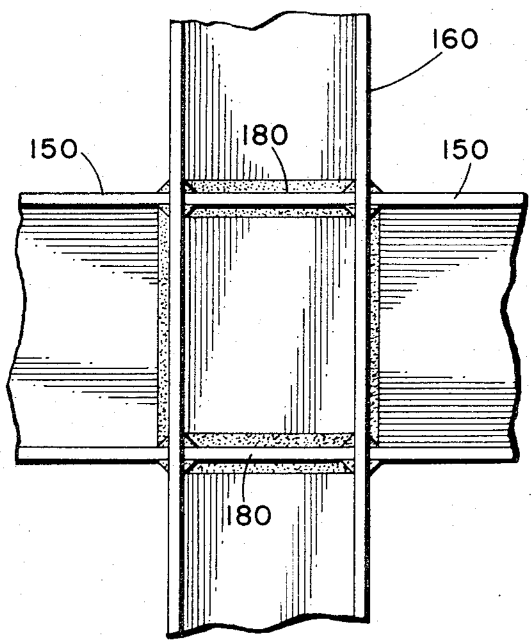


FIG. 19

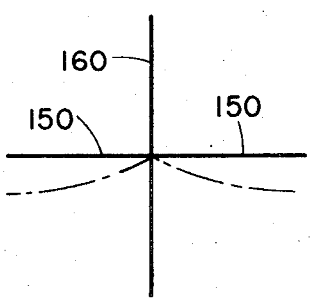


FIG. 20

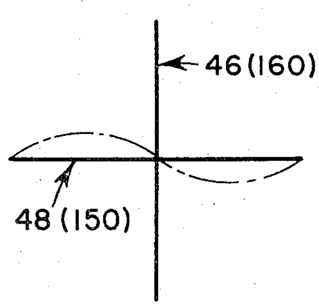
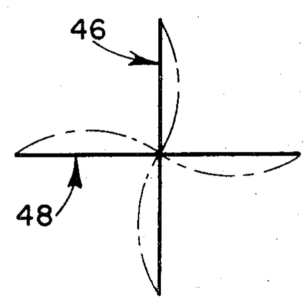


FIG. 21



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METHOD OF BUILDING CONSTRUCTION

RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 829,541, filed June 2, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of building construction and more particularly to lift-slab type construction for multi-story structures.

2. Description of the Prior Art

In the past, lift-slab type building construction has been conducted by first erecting a number of support columns and then constructing a stack of floors adjacent the columns. The floors were subsequently lifted to their final positions. During its construction, each floor was supported by the floor directly therebelow. Often, this required at least the lowest floor to be structurally capable of supporting a load many times greater than the load it would be called upon to support after construction was completed.

It has not been commonplace to utilize structural steel frameworks in lift-slab type construction in the past. On the other hand, conventional construction methods have utilized structural steel frameworks for individual floors, by assembling the steel members at succeeding story heights above ground level. The complexity of total assembly of the components at each succeeding higher elevation is apparent. Generally speaking, this type of construction has utilized beams which are discontinuous at the columns, the beams being merely bolted to the column flanges to act as a shear type connection. If the design of the structure required a moment type connection utilizing a continuously acting beam, rather than a shear type connection, the beam ends were welded to the column flanges and fillers were provided to extend between the column flanges such that after the fillers were welded in place, the joint would cause rotation of the column in response to rotation of the beam. Thus, the constructional requirements for a moment type connection were vastly different than the structural requirements for a shear type connection.

SUMMARY OF THE INVENTION

The instant invention is aimed at alleviating the above stated problems. In this regard, it is an object of the invention to provide a method of construction for a multi-story building wherein none of the floors need be constructed to support a load greater than required for the service conditions existing after the construction of the building. It is an important object of the invention to provide a method of building construction wherein each floor provides access to the next higher floor, but at a closer proximity to each previously completed floor, thereby facilitating the construction of the latter. In addition, it is a very important aim of the invention to provide a structurally stable floor element having a supporting frame construction including a continuous beam structure permitting vertical movement of the floor element relative to the vertical columns after the floor element has been constructed. In this connection, one of the objects of the invention is to provide a beam

construction which facilitates either shear or moment type connections between the beam and the support columns.

The invention is not restricted to any particular type of floor construction but requires only that each floor be a structurally stable unit that can be elevated from its initial position to a final position in the manner of conventional lift slab construction. Typical floor constructions utilizes a steel beam frame upon which a wooden or metal floor is placed, or a steel beam frame having a concrete floor poured on or within the confines thereof in the manner presently used in the art for constructing floors of non-lift slab type conventional steel frame buildings.

The above stated objects, aims and purposes are accomplished in a method for constructing a multi-story building structure which includes the steps of erecting a plurality of vertical support members and thereafter constructing a closely vertically spaced series of structurally stable floor elements, each of the floor elements being supported substantially by the support members during its construction. The elements are each initially disposed at first elevations facilitating construction of the next higher elements. After the construction of all the floor elements, each floor element is elevated to its predetermined final position.

The method of the invention is facilitated by a collar type column to beam connection construction comprising a pair, of elongated beam portions disposed in laterally spaced, generally parallel relationship presenting an elongated gap therebetween. A first elongated beam member is disposed in general parallelism to the beam portions. The first member has an extremity disposed at one end of the gap centrally of the corresponding ends of the portions. A second elongated beam member is disposed in longitudinally spaced, longitudinally aligned relationship to the first member. The second member has an extremity disposed at the opposite end of the gap centrally of the opposite ends of the portions. Means are provided for rigidly interconnecting the extremities of the beam members with the respective ends of the beam portions to present a substantially continuous beam disposed in horizontally extending relationship with the gap opening vertically and receiving a vertical column therethrough. Means are provided for rigidly interconnecting the column and the beam portions. If the column in the beam portions are welded together, a moment type joint is produced. If the beam portions are bolted to the column, a shear type connection is produced. In this latter respect, the joint detail is applicable to conventionally constructed steel buildings with the unique advantage that continuous type floor beams can be utilized which transmit no bending movements to the columns.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary top plan view of a structural steel beam constructed in accordance with the concepts and principles of the invention;

FIG. 2 is a fragmentary side elevational view of the beam of FIG. 1;

FIG. 3 is an enlarged fragmentary top plan view of the connection between the beam and a column wherein the beam is welded to an I-beam column to present a moment type connection;

FIG. 4 is a side elevational view of the structure of FIG. 3;

FIG. 5 is a fragmentary top plan view of a connection similar to the structure of FIG. 3 except that the beam and the column are interconnected by bolt and nut means to present a shear type connection;

FIG. 6 is a side elevational view of the structure of FIG. 5;

FIG. 7 is a fragmentary top plan view of a moment type connection structure similar to the structure of FIG. 3 except that the I-beam is rotated 90°;

FIG. 8 is a fragmentary top plan view of a connection similar to the structure of FIG. 7 except that the beam is bolted to the column to present a shear-type connection;

FIGS. 9 and 10 are enlarged, fragmentary top plan views of structures similar to the connections illustrated in FIGS. 3 and 5 respectively except that a box beam is utilized for the column rather than an I-beam;

FIG. 11 is a side elevational view on reduced scale of a multi-story building construction illustrating the manner in which the individual floors are supported during the early stages of construction utilizing the method of the instant invention;

FIG. 12 is a side elevational view of the building construction after the floors have been constructed and elevated to their final positions;

FIGS. 13 and 14 are views similar to FIGS. 11 and 12 illustrating a prior art method for construction of multi-story building by the lift-slab method;

FIGS. 15 and 16 are a fragmentary top plan view and side elevational view respectively illustrating a shear type joint utilized in previously for interconnecting columns and beams;

FIGS. 17 and 18 are a fragmentary top plan view and side elevational view respectively illustrating a moment type joint utilized previously for interconnecting columns and beams;

FIG. 19 is a schematic diagram illustrating the shear type action of the connection of FIGS. 15 and 16;

FIG. 20 is a schematic diagram of the shear type action produced by the structures illustrated in FIGS. 5 and 6, 8 and 10; and

FIG. 21 is a schematic diagram of the moment type action produced by the structures illustrated in FIGS. 3 and 4, 7, 9 and 17 and 18, the dashed lines on FIGS. 19, 20 and 21 indicate the deflected positions (exaggerated) of the loaded structure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A multi-story building structure which embodies the concepts and principles of the invention and which has been constructed in accordance with the method of the invention is schematically illustrated in FIG. 12 and is broadly designated by the numeral **30**. Structure **30** includes a plurality of structurally stable floor elements **32–42** and a roof element **44**. A plurality of columns **46** are provided for supporting the floor and roof elements.

Each of the structurally stable floor elements **32–42** and the roof element **44** comprises a structural steel frame that supports a planar floor construction of types well known in the art. Each frame includes at least one elongated, horizontally extending beam **48**. The beams **48** are intersected by the columns **46** as can be seen in FIG. 12; however, beams **48** are capable of acting as a substantially continuous beam which extends outwardly on both sides of each respective column **46**.

The structure of the intersection between the beams **48** and the columns **46** is illustrated in FIGS. 1 and 2. At each column **46**, each beam **48** includes a pair of elongated beam portions **50**. Portions **50** are disposed in laterally spaced, generally parallel relationship presenting an elongated gap **52** therebetween. At each column **46**, each beam **48** also comprises a first elongated beam member **54** disposed in general parallelism to portions **50**. Member **54** has an extremity **54a** disposed at one end of gap **52**.

Each beam **48** also includes a second elongated beam member **56** at each intersection with a column **46**. The members **56** are each disposed in longitudinal aligned relationship to corresponding members **54** and each has an extremity **56a** disposed at the opposite end of gap **52** from the corresponding extremity **54a**. Each of the extremities **54a** and **56a** are disposed centrally of the corresponding ends of the portions **50**. This arrangement of portions **50**, member **54** and member **56** constructs a collar about column **46**.

Generally speaking, beam portions **50** may be constructed of channels while beam members **54** and **56** may comprise I-beams. In FIGS. 3–6 column **46** is shown as comprising an I-beam disposed with its central web **58** extending longitudinally of beam **48**.

Beam member **54** is rigidly interconnected to beam portions **50** by means comprising three plates **60**, **62** and **64** as best illustrated in FIGS. 3 and 4. Plate **60** extends transversely between channels **50** and longitudinally beyond the ends **50a** thereof. Plate **60** is preferably attached to channels **50** by welding or the like along edges **65**. A longitudinally extending slot **67** is provided in plate **60** for receiving the web **66** of I-beam **54**. The upper flange **68** of I-beam **54** is then welded to plate **60**.

Plate **62** is welded in place between extremity **54a** of beam member **54** and ends **50a** of channels **50**. The lower flanges of channels **50** and I-beams **54** are attached to plate **64** by welding or the like.

Beam member **56** is attached to channels **50** at the opposite ends thereof in an identical fashion such that at each column **46**, the member **54** the channels **50** and the member **56** act together as a substantially continuous beam **48**. Beam **48** extends horizontally with the gaps **52** opening vertically. Each gap **52** receives a column **46** extending therethrough. Each column **46** is rigidly interconnected with a beam **48** so that the beam **48** may be supported by the column **46**.

Viewing FIGS. 3 and 4, it can be seen that flanges **70** of the I-beam constituting column **46** are welded to channels **50**. Thus, a moment type connection between beam **48** and column **46** is provided. That is to say, a clockwise rotation of beam **48** (FIG. 4) will cause a corresponding clockwise rotation of column **46**. This is caused by the fact that beam **48** is not free to move relative to column **46**. This moment type action is schematically illustrated in FIG. 21.

In FIGS. 5 and 6, a shear type connection between beam **48** and column **46** is illustrated where the components are substantially identical with the components of FIGS. 3 and 4. In addition, a bearing plate **72** is welded to each side of the I-beam column **46**. Plates **72** are then bolted to channels **50**. Thus, a clockwise deflection of beam **48** (FIG. **6**) does not cause a corresponding clockwise deflection of column **46** because the interconnection between the bolts and the corresponding bolt holes permits a slight amount of movement of beam **48** relative to column **46**. This shear type action is schematically illustrated in FIG. **20**.

In FIGS. **7** and **8**, the column **46** is shown as an I-beam wherein the web **58** extends transversely of beam **48**. In this embodiment also, column **46** may be welded (FIG. **7**) or bolted (FIG. *) to channels **50** to provide a moment type connection wherein column **46** rotates with beam **48** (FIG. **7** and FIG. **21**) or a shear type connection wherein deflections of beam **48** do not cause a corresponding deflection of column **46** (FIG. **8** and FIG. **20**).

FIGS. **9** and **10** illustrate another embodiment of the invention wherein column **46** comprises a box-shaped section. In FIG. **9**, column **46** is welded to channels **50** to provide a moment type connection and in FIG. **10**, column **46** is bolted to channels **50** to provide a shear type connection.

The beams **48** of the invention provide efficiency and design flexibility in the construction of multi-story buildings which has not been possible in the past. This is best illustrated by comparing the structure of this invention with the structure of the prior art as shown in FIGS. **15–18**. In the past, it was not uncommon to provide shear type connections by merely terminating the beams **150** (FIGS. **15** and **16**) at columns **160** and bolting beams **150** to columns **160** through the use of angle irons **170**. The action of this type connection is illustrated schematically in FIG. **19**. On the other hand, if a moment type connection was desired, beams **150** were welded to column **160**. Then filler plates **180** were installed in alignment with the flanges of beams **150** and were welded between the flanges of column **160**. Thus, a rotational deflection of beam **150** would cause a corresponding rotational deflection of column **160** as illustrated schematically in FIG. **21**. Manifestly, FIGS. **15–18** illustrate vividly that two different types of joint construction were required to achieve shear type or moment type connections. On the other hand, through the use of the instant invention, a single connection construction is utilized to produce a moment type connection by welding the beam to the column or a shear type connection by bolting the beam to the column.

The structure of the instant invention also facilitates lift-slab type construction. A structurally stable floor element, such as **32–42** which includes beams such as **48**, constructed at one level and then elevated to another. The collars presented by beam portions **50** and the extremities **54***a* and **56***a* of beam members **54** and **56** are moveable relative to columns **46** to facilitate this elevation.

The ease of interconnecting beams **48** and columns **46** in accordance with the instant invention has also made possible a new method for construction of multi-story buildings. This method is illustrated in FIGS. **11** and **12** and provides many advantages not obtainable through the use of prior art methods, the most important of which is illustrated in FIGS. **13** and **14**.

Viewing FIGS. **11** and **12**, a multi-story building is constructed in accordance with the instant invention by first erecting columns **46**. A structurally stable floor element **32** is then constructed at or near ground level. Thereafter, a structurally stable floor element **34** is constructed at an elevation slightly above the elevation of element **32**. Element **34** includes a plurality of beams **48** which may be preliminarily attached to columns **46** so that element **34** is supported substantially solely by columns **46** during its construction. Thus, floor element **32** may serve to provide access to floor element **34** during construction of the latter. Further, floor element **32** does not have to be of sufficient strength to support floor element **34** during the construction of the latter since floor element **34** is supported substantially solely by the columns **46**.

Each of the structurally stable floor elements **32–42** consists of a framework that supports a floor surface. By way of example, the framework may be a steel beam construction upon which is installed conventional wooden or metal flooring in a known manner. A conventional concrete floor can be constructed upon or within the confines of the framework by providing suitable forms upon or around the sides and the bottom of the framework and pouring concrete therein as is well known in the field for constructing concrete floors in non-lift slab type constructions. Openings in the floor surface are provided at each of the vertical support columns to facilitate removal of the temporary attachment means necessary for the practice of the method of this invention, slidable vertical movement of the floor elements to their final positions, and permanent attachment of the floor elements at their final position. Once the floor element is placed in final position, these openings can be closed. The concrete form is normally removed prior to moving the floor element to its final position.

Preliminary attachment of the structurally stable floor elements to the vertical support columns can be accomplished by temporary attachment means (not shown) now known in the field such as spot welding or bolting the framework directly to the vertical columns or by welding or bolting clip angle seats to the vertical columns, and supporting the framework on these seats. The temporary supports are removed prior to moving the floor element to its final position.

Movement of the floor elements to their final positions can be accomplished by any of the means now used in conventional lift-slab construction such as hoists and jacks.

The remaining floor elements **36–42** are constructed in seriatim and each is supported solely by columns **46** during the construction thereof. In each case, each floor element provides access facilitating the construction of the next higher floor element and yet, none of the floor elements must be designed to support any of the succeeding floor elements during the construction thereof. The floor elements can be constructed as close together as a few inches, or spaced apart enough to allow persons access to the underside of the upper element.

Another thing made possible through the method of the instant invention is that the roof element **44** can be constructed at an intermediate level as illustrated in FIG. **11** to provide shelter during the construction of floor elements **32–42**.

After all of the floor elements have been constructed, each is elevated in reverse order to its final elevation. Manifestly, the instant invention provides a method for constructing a multi-story building utilizing a lift-slab type procedure wherein the floor elements comprise a structurally stable unit having a steel framework.

The advantages provided by the method of the instant invention can be seen by comparing the method of the instant invention as shown in FIGS. **11** and **12** with a prior art method illustrated in FIGS. **13** and **14**. In the prior art method, the columns **300** were erected and then the floors **302–314** were constructed one after another. Floor **302** was constructed and then floor **304** was constructed and was supported by floor **302**. Thereafter floor **306** was constructed and was supported by floors **304** and **302**. Each succeeding floor was constructed on top of the floors already constructed and was supported by the lower floors. Thus, the lower floor elements had to be designed to support a load much greater than required by normal service conditions. As pointed out above, this problem is solved completely by the method of the instant invention since each of the floor elements is supported solely by the vertical columns during its construction.

I claim:

1. A method for constructing a multi-story building comprising the steps of:
   - erecting a plurality of upwardly extending vertical columns of sufficient height to accommodate a plurality of stories of the completed building spaced along the height thereof,
   - constructing a first structurally stable floor element at a first elevation on said columns,
   - constructing a second structurally stable floor element directly attached to and supported solely by said columns and removably attached to said columns at a temporary elevation on said columns spaced slightly above said first elevation,
   - elevating said second structurally stable floor element from said temporary elevation to a permanent elevation above said temporary elevation, and,
   - permanently attaching said second structurally stable floor element to said columns at said permanent elevation.

2. A method for constructing a multi-story building comprising the steps of:
   - erecting a plurality of upwardly extending vertical columns of sufficient height to accommodate a plurality of stories of the completed building spaced along the height thereof,
   - constructing a first structurally stable floor element directly attached to and supported solely by said columns and removably attached to said columns at a first temporary elevation,
   - constructing a second structurally stable floor element directly attached to and supported solely by said columns and removably attached to said columns at a second temporary elevation on said columns spaced slightly above said first temporary elevation,
   - elevating said second structurally stable floor element from said second temporary elevation to a second permanent elevation above said second temporary elevation,
   - permanently attaching said second structurally stable floor element to said columns at said second permanent elevation,
   - elevating said first structurally stable floor element from said first temporary elevation to a first permanent elevation above said first temporary elevation, and
   - permanently attaching said first structurally stable floor element to said columns at said first permanent elevation.

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