

[54] CONSTRUCTION SYSTEM

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[22] Filed: **Dec. 8, 1972**

[21] Appl. No.: **313,549**

[52] U.S. Cl. **52/127; 52/250; 52/334;
52/632; 249/19**

[51] Int. Cl. **E04b 1/16**

[58] Field of Search **52/127, 250, 252, 321,
52/334, 491, 632, 326, 340; 249/19, 23, 25**

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[57]

ABSTRACT

A plurality of horizontally disposed rolled steel girders and beams are secured to vertical columns to form a plurality of frames and bays. A plurality of end-notched, pre-cast concrete joists are supported by and transversely extend between the girders to provide lateral stability therefor. At selected lateral intervals along the girders, lines of these joists are connected together over the compression flanges of the supporting girders to form continuous tension or compression ties across the structure. Preferably the tension or compression ties will terminate at points along a girder which have been braced against lateral displacement by either horizontal trusses or guy wires. The combined action of the end-notched concrete joists, the compression or tension ties, and either the truss members or the guys substantially prevents any lateral displacement or buckling of the girders across the entire structure under construction loads. A plurality of reusable, longitudinally adjustable, readily removable, support members are secured in openings provided at spaced locations in the joists and extend transversely between the joists to act as supports for concrete forms into which concrete is ultimately placed to produce slab flooring.

1 Claim, 5 Drawing Figures

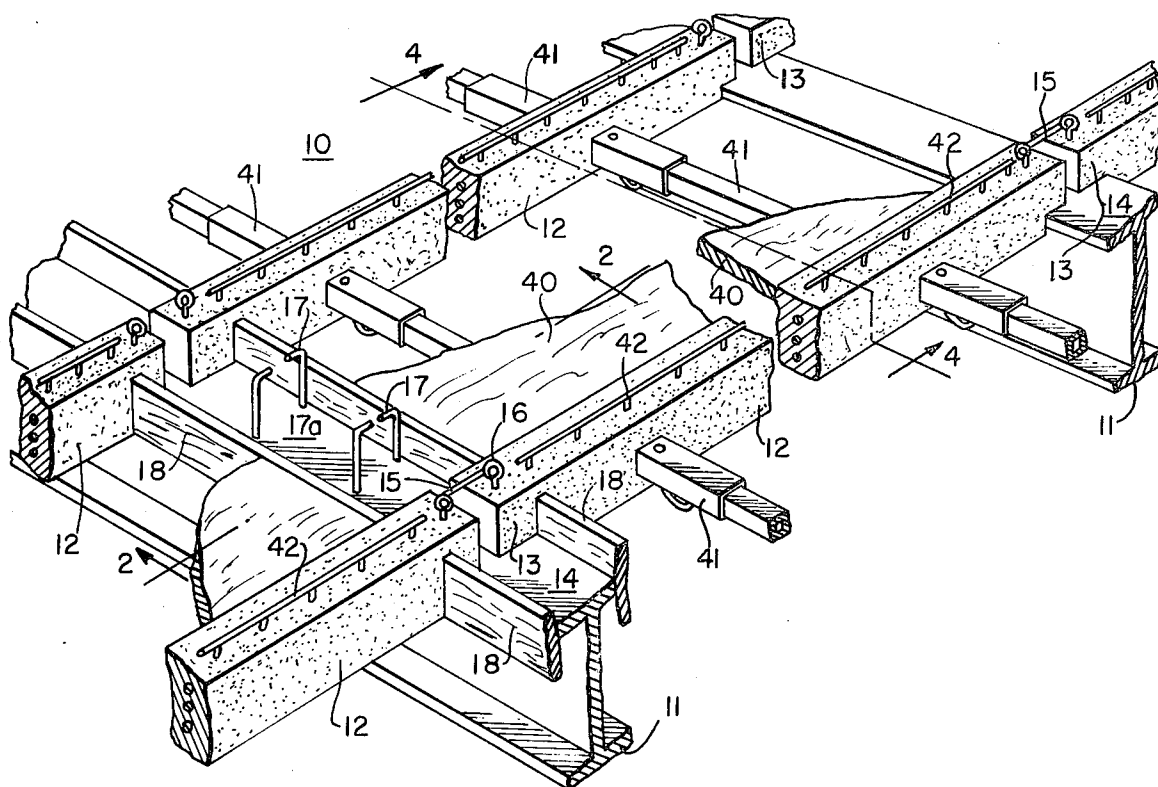


FIG. 1.

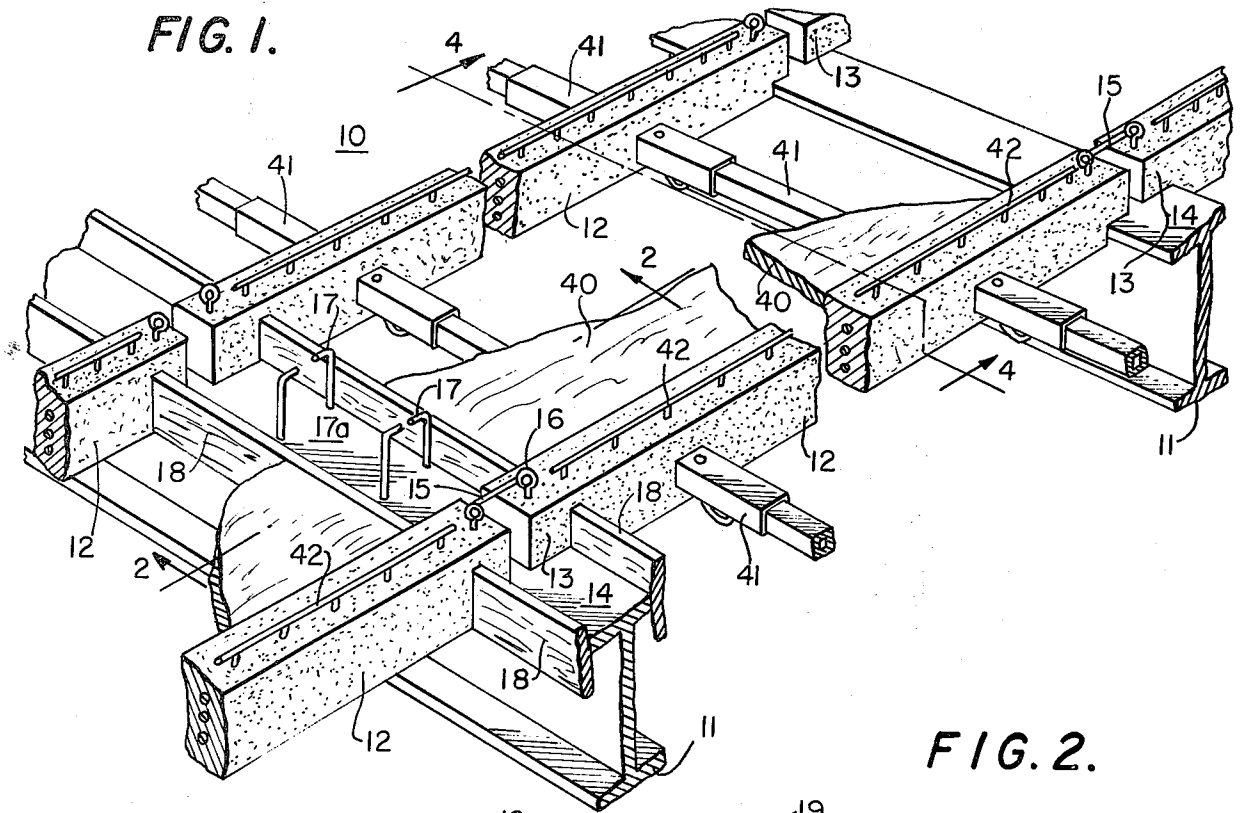


FIG. 2.

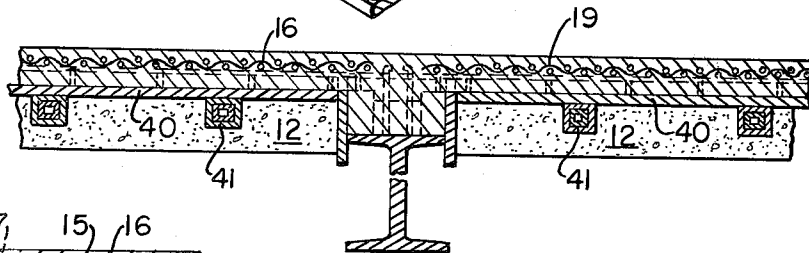


FIG. 3.

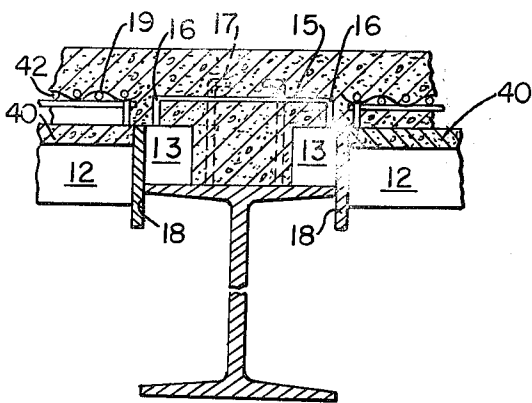


FIG. 4.

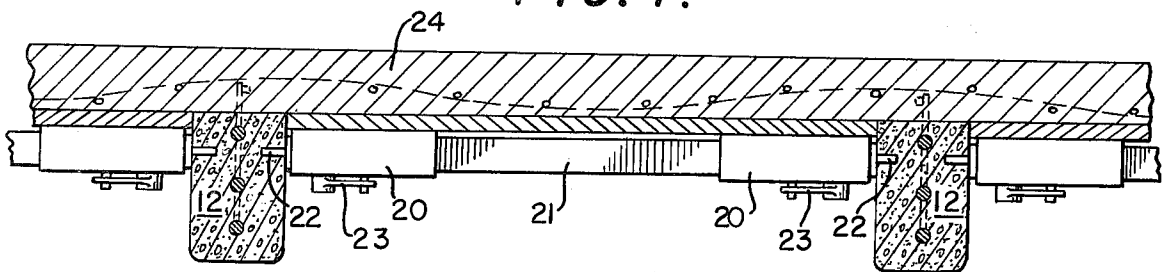
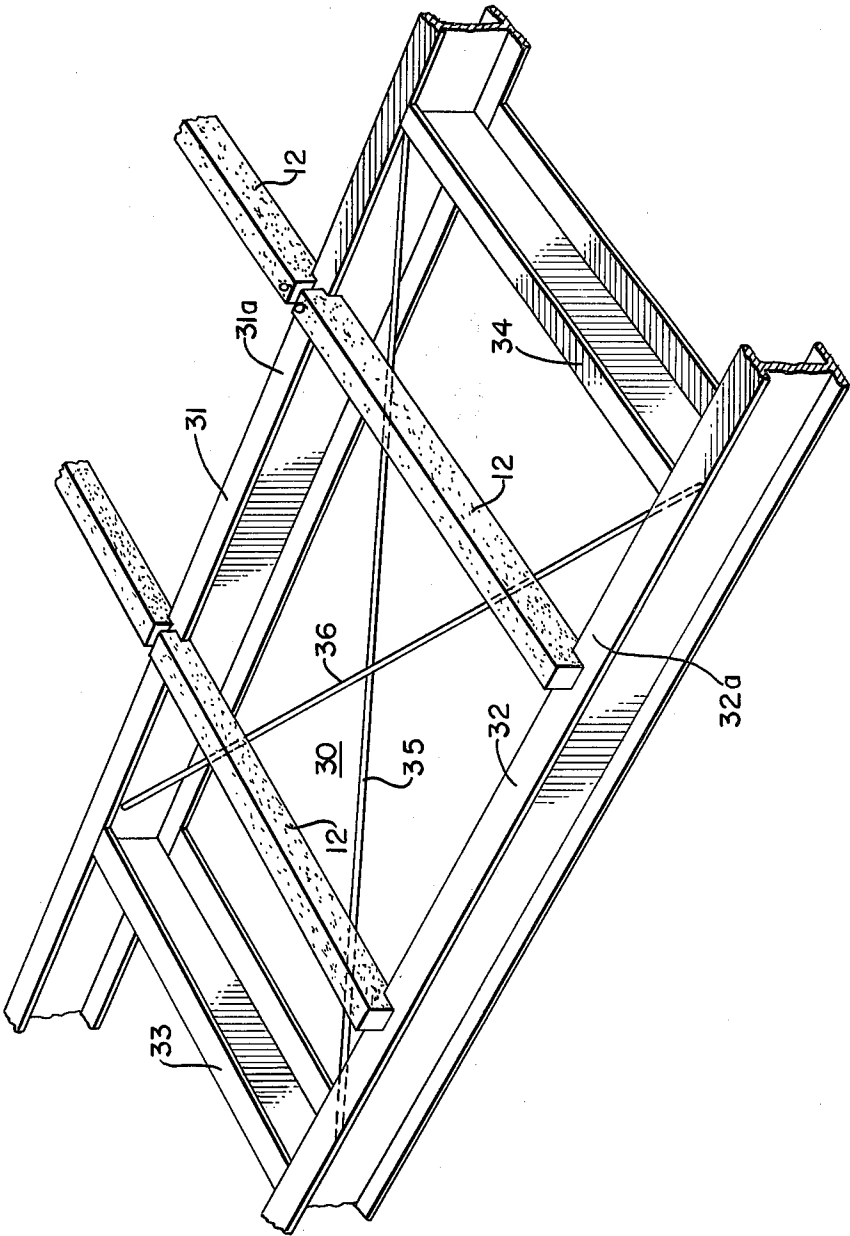


FIG. 5.



CONSTRUCTION SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to general construction. More particularly, this invention relates to an improved system for erecting steel and concrete structures utilizing pre-cast concrete joists. Still more particularly, this invention relates to a simple, inexpensive rigid system for forming monolithic concrete slabs in building construction.

In the construction arts and particularly in the construction of low-rise or high-rise buildings, a number of methods and apparatuses are known for constructing concrete floors. It is an aim in these arts to fabricate and ship materials and forms for such construction at comparatively low costs and to reuse the forms readily and simply in erected framework. In such construction, the frameworks and forms previously utilized have varied from relatively simple to quite complex.

In certain building construction, in which the floor slabs in the building construction are integrated with the structural supporting network to provide the required structural strength, a plurality of concrete girders is used to form a structural grid work with a plurality of pre-cast concrete joists. The girders and joists are securely connected to become part of the building structure and are standard structural units. Such a construction requires numerous temporary support shores under the forms, joists, and girders requiring a great deal of field labor which adds to the expense of construction. In addition, the building frame is heavy requiring additional foundation support.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a relatively inexpensive system for the construction of monolithic concrete slabs in steel frame structures which does not require temporary shoring.

It is a further object of the present invention to provide a building construction utilizing pre-cast concrete joists and steel girders either with or without composite action with concrete slabs.

It is a further object of the present invention to preclude lateral buckling of steel girders during construction by using notched pre-cast joists connected to each other at common bearing points on the girders to form continuous tension or compression ties at intervals across the structure that may terminate in horizontal trusses at end bays of a floor.

It is a further object of the present invention to provide an economical building construction system utilizing form support members which are capable of being readily secured and easily released from the construction system.

In accordance with the present invention, a construction system comprises a plurality of horizontally disposed structural members, such as rolled steel girders and beams which are secured to vertical columns to form a plurality of frames and bays and a plurality of end notched pre-cast concrete joists supported by and transversely extending between the girders to provide lateral stability therefor. When the joists are in place, a plurality of reusable, longitudinally adjustable, readily removably support members are secured in openings provided at spaced locations in the joists and extend transversely therebetween the act as supports for forms into which concrete is ultimately placed to

produce slab flooring. At selected intervals along the supporting girders, lines of the joists are connected to each other over the compression flanges of the girders, so as to form continuous tension or compression ties to the girders across the structure. Preferably at least a portion of the girders are braced against lateral displacement by either horizontal trusses or guy wires. The horizontal trusses may be formed by at least one truss member extending diagonally across each of the bays, preferably at the end of the building construction.

Thus, a stable, economical construction system is provided, the combined action of the end notched joists, the tension or compression ties and either the truss members or the guys substantially preventing any lateral displacement or buckling of the girders across the entire structure under construction loads and the reusable form supports supplying a convenient inexpensive means for supporting concrete forms.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a representative portion of a building construction according to this invention showing the connection of the notched concrete joists over the compression flanges of the girders;

FIG. 2 is a view taken along line 2—2 of FIG. 1 of the construction system according to the invention showing the support members secured in openings in adjacent concrete joists, the joists being end notched and tied across the compression flange of a supporting girder;

FIG. 3 is a detailed view of the end notched and tied joists of FIG. 2;

FIG. 4 is a view taken along line 4—4 of FIG. 1 with a more detailed showing of the support members transversely secured between the joists; and

FIG. 5 is a perspective view of a representative horizontal truss formed in a bay according to this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 a representative portion of a building construction is designated generally by the reference numeral 10. The construction 10 comprises a pair of girders 11 spanning suitable structural members (not shown) and secured to a base support (also not shown) in a manner well known to the art. The girders 11 may be made of any conventional structural element, but are shown in FIG. 1, for purposes of illustration, as I-beams.

A plurality of joists 12 is secured to the girders 11 and traverse the structure at spaced intervals in a position substantially transverse to the girders 11. The joists 12 are notched at each end to form shoulder portions 13 which fit securely over the compression flanges 14 of the girders 11.

At selected intervals end portions of one joist are tied to adjacent notched pre-cast joists at common bearing points on the girders for example by tie units 15 and lifting loops 16. This tying of joists is repeated across the structure so that continuous tension for compression ties are formed which may terminate in the horizontal trusses such as shown in FIG. 5. It is not necessary to tie every line of joists across the structure in this fashion. An alternate manner of forming the continuous ties includes securing metal plates to the bottom end portions of concrete joists and welding or otherwise securing the plates to the top flange of the girders.

Since it is desired to place concrete in the space between and over the structural members to form a slab, a concrete form, for example a plywood sheet, is shown partially cut away as reference numeral 40.

In order to support the concrete forms 40, a plurality of reusable, longitudinally extensible and retractable support members designated generally by the reference numeral 41, is removably secured transversely to the joists 12. While the support members 41 act primarily to support the weight of the concrete slab forms 40 and the concrete above, they also act as bracing bars between the joists 12 to retain the joists 12 in a secure position during the placing and curing of the concrete.

A series of chairs 42 are shown embedded in the tops of the joists 12. These chairs serve to support reinforcing material which may be conventional wire mesh, such as shown in section in FIG. 2, or bars. The reinforcing material is placed across the joists prior to placing the concrete. It should be understood, however, that such chairs are not essential to this invention since other means are conventionally used for supporting or otherwise properly placing the reinforcing material.

A plurality of anchor members or studs 17 is shown projecting from the top flange 17a of one of the girders. These studs may be secured by any convenient means such as, for example, automatic welding. The studs 17 serve to promote a composite relationship between the girders and concrete slabs.

In order to prevent leakage of concrete through the space which exists between the concrete slab forms 40 and the top flanges of the girders 11 haunch form members 18, such as the wooden forms illustrated, are tied together by any convenient means on either side of the girder so that their top edges are flush with the top surface of the concrete form. These haunch form members are removed after the concrete slabs have hardened.

FIG. 2 is a cross sectional view taken along line 2—2 of FIG. 1 illustrating the construction system after the concrete has been placed and prior to removal of the barrier members. Wire mesh 19 rests on the chairs 16 and is covered by concrete which is placed on the forms 40. The forms are supported by the support members 41 which are secured in holes in the concrete joists 12. As seen more clearly in FIG. 3, the ends of the joists are notched so that shoulder portions extend over the compression flange of the girder and are tied together by tie unit 15 and lifting loops 16. However, it should be understood that other means may be employed to connect the joists to each other across the girders such as welding end plates to the girder flanges.

FIG. 4 is a view along line 4—4 of FIG. 1 and more clearly illustrates the support members, identified generally by the numeral 41, and their placement in the concrete joists. A pair of telescoping parts 20 are slidably supported by a central tubular part 21. Support pins 22 are axially-opposed on the outer ends of the telescoping part 20 and received in openings or recesses of the adjacent concrete joists 12. The telescoping parts 20 are in an elevated position relative to the tubular part 21 and support the slab form 13. When the placed concrete 24 has hardened, actuating members 23 are rotated clockwise so that threaded members (not shown) attached thereto are retracted away from a contacting relationship with the top inside surfaces of the telescoping parts permitting their gravity withdrawal from contact with the forms 40 and convenient

removal from the joists. A more detailed description of the support members may be found in co-pending application Ser. No. 313,488 filed Dec. 8, 1972 which disclosure is incorporated herein by reference.

FIG. 5 is a perspective view of a representative portion of the construction system of this invention showing a horizontal truss which is designated generally by the reference numeral 30. The truss 30 is one of a series of bays preferably located at one end of a larger floor complex the size of which will be determined by the requirements of the installation. The truss 30 comprises a pair of generally horizontally disposed spaced, parallel girders 31 and 32 and a pair of spaced beams 33 and 34 extending transversely between the girders and connected thereto.

The girders 31 and 32 are secured to base supports or columns (not shown) in a manner well-known to the art, and may be of any conventional structural element, such as rolled-steel I-beams.

Extending transversely to the girders 31 and 32 are pre-cast concrete joists 12 which are notched at each end to form shoulder portions which fit securely over the compression flanges 31a and 32a of the girders 31 and 32, respectively.

A pair of truss members, preferably in the form of crossed cables 35 and 36 are connected to the girders 31 and 32 and extend diagonally across each unit 30 to form a horizontal truss.

The distal ends of the cables 35 and 36 are connected to the web portions 31b and 32b of the girders 31 and 32, respectively, at points approximately vertically aligned with the intersection with the beams 33 and 34. The truss members 35 and 36 may be of a conventional design such as rods, bars, or cables. A more detailed description of the lateral bracing of the girders may be found in co-pending application Ser. No. 313,490, filed Dec. 8, 1972 which disclosure is incorporated herein by reference.

The invention may be embodied in other specific forms without departing from the spirit or the essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed is:

1. A construction system comprising at least three horizontally disposed, spaced, structural members, each of said structural members being in an elevated position and secured to base supports, a plurality of horizontal trusses laterally bracing a portion of said structural members, a plurality of spaced, parallel concrete joists securely engaging and transversely extending between each pair of adjacent structural members, and means to connect adjacent end portions of said concrete joists to each other or to said structural members to form continuous tension or compression ties at selected intervals along top flanges of said structural members, said continuous ties terminating in said horizontal trusses, and a plurality of reusable, longitudinally extensible and retractable support members supported by said joists and adapted to support concrete slab forms to receive concrete thereover.

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