

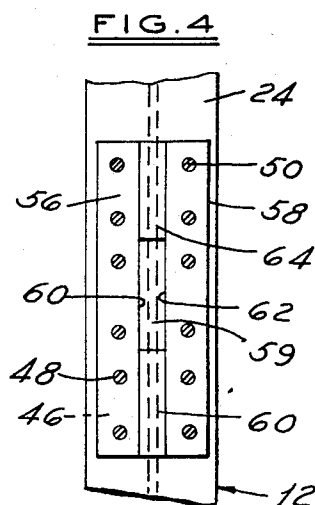
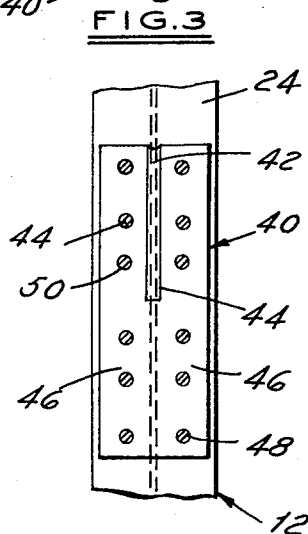
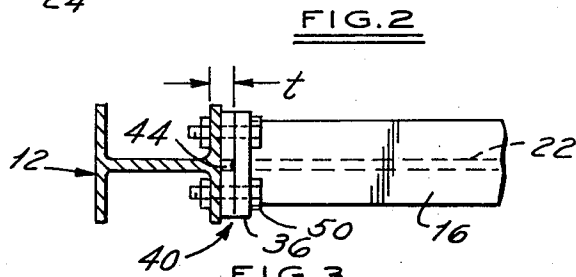
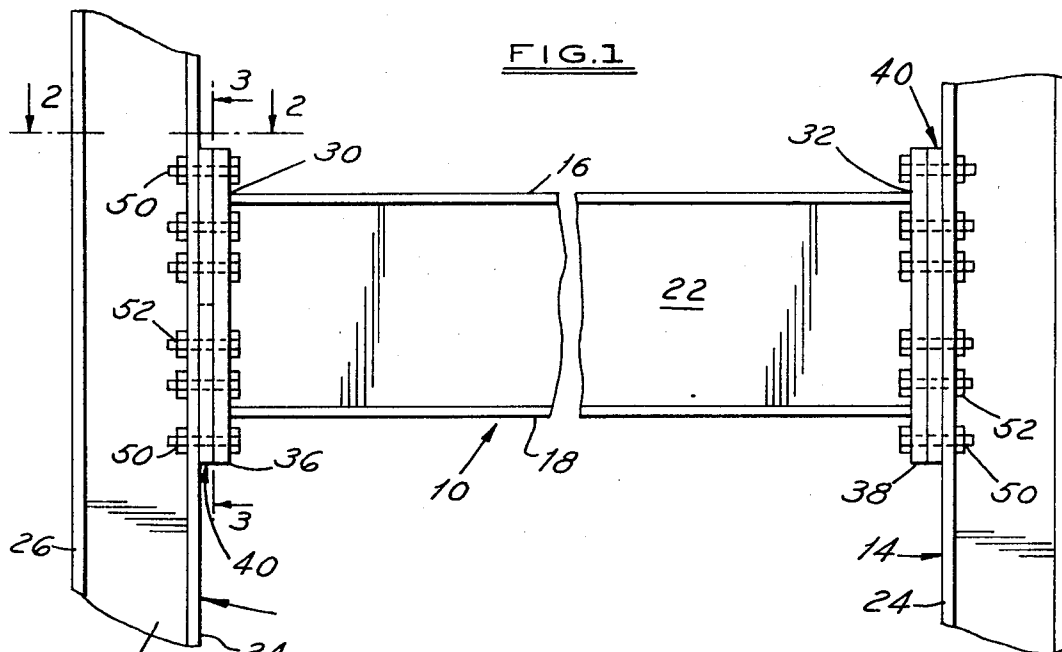
Feb. 20, 1973

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3,716,957

COLUMN FLANGE AND STIFFENER PLATE CONSTRUCTION

Filed Oct. 23. 1970



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1

3,716,957

COLUMN FLANGE AND STIFFENER PLATE CONSTRUCTION

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Filed Oct. 23, 1970, Ser. No. 83,328

Int. Cl. E04b 1/18; F16b 9/02

U.S. Cl. 52-633

3 Claims

ABSTRACT OF THE DISCLOSURE

A beam is provided with an end construction for rigid connection to a vertical column. One end of the beam is provided with a rigidly connected vertically extending support plate. A stiffener plate provided with a centrally located, vertically extending elongated slot is interposed between one flange of the column and the support plate, with one side of the stiffener plate in surface to surface contact with the adjacent column flange. The stiffener plate is welded to the column flange, with weld material completely occupying the elongated vertical slot to thereby rigidly connect the stiffener plate to the opposing flange of the column and thereby increase the effective thickness of the column flange. The support plate abuts the opposite side of the stiffener plate. A plurality of high strength bolts extend through the support plate, stiffener plate and column flange to provide a rigid connection, with the bolts being located and arranged in rows on opposite sides of the welded slot-joint so that the force applied to the column flange is rotated 90° and distributed throughout the web of the column.

BACKGROUND OF THE INVENTION

A rigid connection between a beam and column has received acceptance in the building industry in connection with the erection of multi-story steel building frames. With the advent of high strength bolts, the end plate on the beam has proved to be an effective way of developing a fixed end connection. With later specifications of the American Institute of Steel Construction, Inc., (as an example, set forth in its Manual of Steel Construction, sixth edition, 1965) and the use of plastic design it has become necessary to provide column flange stiffener plates to transfer the forces developed at the end connections where large moments occur.

In the past, using present design techniques, a rigid connection of an H-shaped beam to a vertical column has been accomplished by interposing a stiffener plate between the column flange and the support plate of the horizontal beam. High strength bolts are inserted through the support plate, stiffener plate and column flanges. The bolts are usually arranged in two vertically extending rows on opposite sides of the column web. It has been found that the portion of the column flange intermediate the rows of bolts pulls away or defects from the stiffener plate thereby decreasing the bolt efficiency. In addition the web and flange of the column are overstressed and the advantages of using a stiffener plate are not achieved. This prying action or separation of the column flange from the stiffener plate has prevented the complete or full development of fixed end connections.

The present invention has overcome the problem stated. The stiffener plate used in the present invention is fabricated in the shop and is provided with an elongated slot. The stiffener plate, as an example, is welded to the column flange in the shop; increases the effective thickness of the column flange; and eliminates the aforesaid prying action of the prior art.

SUMMARY OF THE INVENTION

A fixed end construction for an H-shaped beam having a rigid connection to a vertical column is provided. A

2

support plate is rigidly secured by welding to one end of the beam. A stiffener plate having a slot therein has one side abutting one flange of the column. The support plate is welded to the column flange, with the weld material completely occupying and filling the slot and rigidly connecting the stiffener plate to the column flange in surface to surface engagement. The stiffener plate when welded to the column flange increases the effective thickness of the flange. The support plate on the beam abuts the stiffener plate and is fastened to the column by a plurality of high strength bolts which extend through the stiffener and support plates and flange. With such a construction the bolts are located and arranged so that the force applied to the column flange is rotated at 90° and distributed throughout the web of the column without overstressing same.

In the drawing:

FIG. 1 is a side elevational view of a beam and column assembly in accordance with the present invention;

FIG. 2 is a sectional view taken substantially along the line 2—2 of FIG. 1 looking in the direction of the arrows;

FIG. 3 is a sectional view taken substantially along the line 3—3 of FIG. 1 looking in the direction of the arrows; and

FIG. 4 is a further embodiment of the present invention.

The beam 10 of the present invention is fabricated for interconnection between adjacent columns 12, 14 forming part of a frame complex, generally a multi-story frame of a building. The columns 12, 14 are vertically oriented while the beam 10 is horizontally oriented as is standard.

Each beam 10 is generally H-shaped and includes parallel horizontally oriented flanges 16, 18 interconnected at substantially the midpoint thereof by a longitudinally extending vertically oriented web 22 which is normal to the plane of the flanges. Each H-shaped column 12, 14 includes parallel vertically extending flanges 24, 26 interconnected at substantially the midpoint thereof by a longitudinally extending vertically oriented web 28 which is normal to the plane of the flanges.

The invention is particularly applicable to beams and columns of the type referred to as wide flange beams utilized for heavy duty frame construction purposes. It will, of course, be appreciated that generally H-shaped beams of other designs, such as junior beams and light weight beams may be modified in accordance with the invention for structural purposes where such beams and columns are utilized. Additionally, the invention may be utilized in connection with both regular series beams and special series beams, the difference in these designations relating only to the degree of demand for particular structural shapes. The only basic limitation on the beams is that they have a generally H-shaped cross-section. The H-shape may be interpreted to include what are referred to as I-beams which also include a pair of narrower spaced apart parallel flanges interconnected by a central web which is normal to the plane of the flanges.

The beam 10 is adapted at each end 30, 32 for rigid connection to the columns 12, 14. Support plates 36, 38 of rectangular configuration are welded to the ends 30, 32 respectively of the beam 10. The support plates 36, 38 abut the ends of the beam 10. Welds are provided between the abutting ends of the webs 22 and the abutting edges of the upper and lower flanges 16, 18. Thus the support plates 36, 38 are rigidly connected to the beam 10. The welds connecting the support plates 36, 38 to the beam 10 are designed in accordance with acceptable welding design standards to withstand the shear forces encountered under load.

Each column 12, 14 is provided with a stiffener or

helper plate 40, each stiffener plate 40 being of identical construction. The stiffener plate 40 is elongated and of rectangular configuration as best illustrated in FIG. 3 and is provided with a centrally located, vertically extending slot 42. The length of the slot 42 is substantially greater than the width of the slot 42 as illustrated in FIG. 3. The slot 42 is located along the longitudinal center line of the stiffener plate 40. Stiffener plate 40 is welded to the column flange 24 by a weld joint 44 which completely fills the slot 42 and rigidly connects the stiffener plate 40 to the column flange 24. The specific length and width of the slot 42 and the area of the weld joint 44 is dependent upon the end moment to be encountered at the point of connection.

Two vertical rows 46 of bolt openings 48 are provided in the stiffener plate 40, with one row 46 on each side of the slot 42 as illustrated in FIG. 3. Each row 46 contains a plurality of openings 48 dependent, of course, upon the number of high strength bolts 50 required for the specific end connection.

Each support plate 36, 38 and column flange 24 have a pair of rows of bolt openings. Such rows and the openings in each row are spaced apart the same identical distance as in the support plate 40. After the beam 10 has been erected in the field high strength bolts 50 are inserted through the aligned openings provided in the support plate 36, 38, stiffener plate 40 and column flange 24 and nuts 52 secured thereto properly torqued.

The column flange stiffener plate 40 enables the forces encountered under load to be distributed at the end connection without overstressing the column flange 24 and the web 28 of the column. It should be noted that the stiffener plate 40 is welded to the column flange 24 by the establishment of the weld joint 44 in the slot 42. The vertical weld joint 44 ties the stiffener plate 40 and column flange 24 together so that when the end or support plate 36, 38 of the beam 10 is clamped against the stiffener plate 40 there is no relative movement between the column flange 24 and the stiffener plate 40. With such a welded construction the prying action or separation of the intermediate portion of the column flange between the rows of bolts from the stiffener plate is eliminated as is now encountered in the art.

It will be appreciated that in the design of the end connection the stiffener plate 40 which is fixedly and rigidly held against the flange 24 of the column in effect develops a new flange thickness "t." The stiffener plate 40 works in unison with the column flange 24 and serves a triple function. It will be appreciated that the efficiency of the bolts is increased due to the elimination of the aforementioned prying action. In addition, the stress of the column flange is reduced due to the increase of the effective flange thickness "t." Finally, the bolts securing the end or support plate to the column are so located and arranged that the force applied to the flange of the column may be rotated 90° and fanned out or distributed throughout the web without overstressing same. The fixed end connection is designed whereby the stress in the web "S_w" equals the stress in the flange "S_f."

The stiffener plate 40 may be fabricated in one piece or of unitary construction as described in connection with the embodiment in FIGS. 1-3 inclusive or fabricated from two elongated elements which are welded together at the opposing longitudinal edges thereof and to the column flange as illustrated in FIG. 4.

In the modified embodiment of FIG. 4 the column 12 is provided with a pair of elongated plates or elements 56 and 58 which are spaced apart from the longitudinal center line of the column flange 24 to form the elongated slot or space 59. The opposing longitudinal edges 60 and 62 of the plates 56 and 58 respectively are welded together and to the column flange 24. An upper weld joint 64 completely fills the upper part of the space or slot 59 provided between the plates 56 and 58 thereby tying the plates together and to the column flange 24. A lower weld joint 60 completely occupies the lower portion of

the space or slot 59 and ties the opposing edges of the plates 56 and 58 together and to the column flange 24 as illustrated. The longitudinal spacing between the plates 56 and 58 and the areas of the weld joints 58 and 60 is dependent upon the end moment to be encountered at the point of connection. The portion of the slot 59 intermediate the weld portions 58 and 60 is open as illustrated.

The welding of the plates 56 and 58 together and to the column flange 24 takes place in the shop. With such a construction the elements 56 and 58 and column flange 24 act as a unit. In addition, the two vertical rows 46 of bolt openings 48 are also fabricated in the shop as are the openings provided in the column flange 24 and in the support plate 36. The high strength bolts 50 are inserted in the field through the aligned bolt openings as described previously.

What is claimed is:

1. A rigid framing structure comprising a vertical column of H-shaped cross-section having parallel, vertical first and second flanges interconnected by a web arranged perpendicular thereto, a horizontal beam of H-shaped cross-section extending at right angles from said column and having parallel, horizontal top and bottom flanges interconnected by a web arranged perpendicular thereto, a flat, elongated, vertical support plate having one side abutting one end of said beam in surface-to-surface relation, the ends of the flanges and web of said beam being welded to said support plate, a flat, elongated, vertical stiffener plate having one side abutting the outer side of said first flange of said column in surface-to-surface relation, said stiffener plate having a vertical weld slot on the longitudinal center line thereof, a weld joint in said weld slot rigidly securing said stiffener plate to said first flange of said column to thereby increase the effective thickness of said first flange, said support plate abutting said stiffener plate in surface-to-surface relation, vertical rows of aligned openings in said support plate, stiffener plate and first flange on opposite sides of said slot, and high strength bolts extending through said aligned openings to secure said column and beam together, said bolts as thus positioned being located and arranged so that the force applied to said first flange is rotated 90° and distributed throughout the web of said column without overstressing same whereby the stresses in said first flange and web of said column are essentially equal.

2. The rigid frame structure defined in claim 1, wherein said stiffener plate is of unitary construction.

3. The rigid framing structure defined in claim 1, wherein said stiffener plate comprises two vertical elongated elements having the adjacent longitudinal edges spaced apart to define said slot, said weld joint including an upper weld portion in the upper part of said slot and a lower weld portion in the lower portion of said slot, the portion of said slot between said weld portions being open.

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U.S. Cl. X.R.

52—729; 287—189.36 B