

STRUCTURAL FRAMEWORK

This invention relates to a girder framework for civil engineering and building structures.

5 A high-strength bolt tensile junction using a T-shaped bracket for forming a column and beam of a framed construction has been appreciated hitherto in respect of labour saving for frame shop working and better efficiency for site execution. However, in such a frame the number of tension bolts is limited by the size of the girder and brackets and the
10 weakness caused by the bolt-holes.

An object of this invention is to make the most of the advantages of the high-strength bolt tensile junction, thereby solving problems of yield strength, and also to increase the degrees of freedom in
15 planning of buildings, thereby improving workability.

The invention is set out in claim 1 of the claims of this specification.

Examples of the invention will now be described with reference to the accompanying drawings, in which:

20 Fig. 1 is a perspective view of a framework given in one embodiment of this invention;

Fig. 2, Fig. 3 and Fig. 4 are a front view, a longitudinal sectional view and a transverse sectional view, respectively, of the embodiment
25 given in Fig. 1;

Fig. 5 is a perspective view representing a variant;

Fig. 6, Fig. 7, Fig. 8 and Fig. 9 are a longitudinal sectional view, a transverse sectional view, a longitudinal sectional view and a perspective view, respectively, representing another embodiment of the invention;

Fig. 10, Fig. 11, Fig. 12 and Fig. 13 are a schematic transverse sectional view when applied to a multi-storey dwelling house, a longitudinal sectional view of beam and floor, a longitudinal sectional view of column and beam and a transverse sectional view thereof;

Fig. 14 is a vertical sectional view of a different embodiment;

Fig. 15 is a cross-sectional view of the embodiment shown in Fig. 14;

Fig. 16 is a vertical sectional view taken at the position of the outer column;

Fig. 17 is a vertical sectional view in the assembled state of the frame;

Fig. 18 and Fig. 19 are transverse sectional views representing a variant of built-up column section;

Fig. 20 and Fig. 21 are longitudinal sectional views of built-up beam section;

Fig. 22 to Fig. 26 are front views representing variants of the junction of built-up column and built-up beam; and

Fig. 27 to Fig. 30 are longitudinal sectional

views of beam and slab variants.

Figure 1 illustrates part of a framework including a built-up column 1 and a beam 2 connected to each other by connecting brackets 5. The built-up column 1 is an I- or H-steel sectional girder consisting of flanges and a web. The column may be a latticed column as shown in Fig. 5. The webs of the girders are parallel to each other, with a gap provided between the flanges, and the flanges are coupled with a joint member 3 of flat steel. The joint member 3 then works as a reinforcement for the column flange at the same time. In this embodiment, in one direction, the beam 2 is constructed as a built-up beam 2. The built-up beam has girders of H-section disposed in parallel at the same spacing as the built-up column 1 and the flanges are coupled by a joint member 4.

For joining the built-up column 1 and the built-up beam 2, split tee brackets with high-strength bolts are used. Various examples of joints are given in Fig. 22 to Fig.26 . In the case of Fig. 22, bolt holes are perforated beforehand in the stem of a T-shaped bracket 5 and the flange of the built-up column 1, and the bracket 5 is fixed on the built-up column 1 by means of high- strength bolts through the holes. The cross-piece of the bracket 5 is welded directly on the flange of the built-up beam 2. As shown in Fig. 23, the stem of the bracket can be placed upon the flange

of the built-up beam 2 and then joined with high-strength bolts. A reinforcing rib 7 can be provided on the bracket 5 as illustrated in Fig 24 to Fig 26.

5 Fig 27 to Fig 30 illustrate a case wherein a reinforced concrete slab 8 is cast in situ on the built-up beam 2. A deck plate 9 or a thin pre-cast concrete panel 10 is used to support an open-sided slab portion. A shear connector 11 can be fixed on
10 the flange of the built-up beam 2. Piping 12 or wiring can be arranged in a space of the built-up beam 2.

As shown in Fig 1 a horizontal stiffener 14 is welded to the H-section girder web for joining a
15 beam 13 transversely of the built-up column 1, which is joined with high-strength bolts by means of joint plates 15. Alternatively, the horizontal stiffener 14 can be welded directly to a flange of the beam 13.

When the built-up column and the built-up beam
20 are assembled with the T-shaped brackets, it is necessary that the high-strength bolts be inserted from inside the column flange. A suitable size of gap will have to be made between columns of the built-up column. However, when the frame is subjected
25 to a horizontal force with the gap existing as above, there is a greater chance of

deformation, which is problematical.

The embodiments of Fig. 6 to Fig. 9 are designed to improve a rigidity of the structure, thereby minimizing deformation in the steel frame.

5 The built-up column 1 and the built-up beam 2 both have H-shaped members formed together at suitable intervals, and the built-up column 1 and the built-up beam 2 are joined together through bolting and welding by the T-shaped brackets 5.

10 The T-shaped bracket 5 is joined to the built-up column 1 with bolts 16, and the built-up beam 2 is butt-welded on the T-shaped bracket 5. Then, a bearing member 17 T-shaped in section is mounted on the inside of the flange of the built-up column

15 1, an iron base plate 18 and an iron side plate 19 are mounted on the bearing member 17, and after possible bolting concrete 20 is poured into the space surrounded by the built-up column 1, the base plate 18 and the side plate 19 to give rigidity to the

20 structure. A through hole is provided on the upper part of the side plate 19 to accommodate a beam reinforcement 21 therein.

25 Since there is a gap present between girders of the built-up column 1, the T-shaped brackets 5 can be fixed in position with the high-strength bolts.

The embodiments of Fig. 10 to Fig. 13

illustrate the invention applied to a multi-storey dwelling house.

5 The built-up column 1 and the built-up beam 2 used in the building structure are those for which two girders of H-section are disposed with their webs in parallel and the necessary gap provided between the flanges and then assembled with a joint member as described above.

10 The built-up column 1 is installed on the slab concrete at the desired position. In this case, each built-up column 1 is arranged so as to have the webs of the H-steel parallel.

15 Then, the T-shaped brackets 5 are mounted on the flanges of each built-up column 1 with high-strength bolts and the built-up beam 2 is welded or joined with high-strength bolts extending parallel to the webs of the girders of the built-up column 1 by the T-shaped brackets 5 (which is the strong direction of the girders of column 1).

20 A pre-cast wall panel 22 is built in the outer wall, A cast-in-place reinforced concrete wall 23 is provided in the weak axial direction of the girder acting as an interior boundary wall. In this case, a connecting member consisting of a small frame
25 section which connects adjacent built-up columns 1 in the weak axial direction is embedded in the wall 23. A column reinforcement 24 and a beam reinforcement 25 are arranged around the built-up

column and the built-up beam, and concrete is poured to include the column in a steel-framed reinforced concrete structure and the beam in a composite beam.

5 A floor 26 is framed with a large slab of cast-in-place reinforced concrete without a binder, and a deflection of the floor is controlled by means of an unbonded steel wire 27. A fireproof coating 28 is applied on the side and lower parts
10 of the built-up beam 2.

 In a different embodiment shown in Figs. 14 to 17, only the column 1 is constructed as a built-up column 1 consisting of a pair of H-section girders while the beam 2 is constituted by a single H-section
15 girder. A bracket 29 serving as a connecting member is jointed to both girders of the built-up column 1 through high-strength bolts so as to connect the beam 2. Fig. 16 illustrates the construction at the peripheral part of the building.

20 The advantages of the invention can be seen from the following considerations:

(1) A bending strength of the column and the beam through a high-strength bolt tensile junction is governed by the number of working tension bolts.
25 The number of tension bolts is limited to 4 - 8 per H-shaped column according to the width of the flange, however, it can be increased to 8 - 16 by

arranging the present built-up column, to which may also be added a built-up beam. The bending strength can therefore be doubled.

5 (2) A single H-section girder has small resistance to buckling in the weak axial direction. However, the built-up column is very effective in increasing the resistance to buckling in the weak axial direction.

10 (3) A permissible bending stress of the beam depends on the lateral buckling of the beam, but the built-up beam is more resistant to lateral buckling, which is very effective in increasing resistance to bending stress.

15 (4) A combination of the built-up column and the built-up beam may improve the yield strength of the frame as mentioned above. Therefore, columns can be installed with larger than normal intervals between them, giving an increased degree of freedom for planning.

20 (5) The frame is composed of relatively large members, and a junction of the column and the beam is made only with the joint brackets and high-strength bolts, thus improving efficiency.

25 (6) When the built-up beam is located along the circumference of a building, a deck plate can be cantilevered from the built-up beam and

concrete is placed thereon to form an open-sided slab without using a scaffold.

- (7) The internal space of the column and the beam can be used effectively by including pipes and wiring in the space between the girders of the built-up column and the built-up beam.
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CLAIMS

1. A structural framework composed of a built-up column and a beam joined to the built-up column through a T-shaped bracket, said built-up column having a plurality of I- or H-sectioned girders with webs and flanges with their webs parallel, and then coupled with a plurality of connecting members to leave a gap provided between the flanges of adjacent girders, the cross piece of said bracket being fixed to the flange of said built-up column by means of a high-strength bolt tensile junction, and the stem of said bracket being fixed to the flange of said beam.
2. A framework as claimed in claim 1, wherein the girders are latticed or trussed.
4. A framework as claimed in claim 1 or claim 2, wherein said girders are laid such that their flanges extend horizontally with a gap left between the flanges of the adjacent girders and connected by a plurality of connecting members.
4. A framework as claimed in any one of claims 1 to 3, wherein concrete is filled into the built-up column at a junction of the built-up column and the beam.
5. A framework as claimed in any one of claims 1 to 4, wherein reinforcing bars are arranged around the built-up column, a beam reinforcement is arranged through said gap of the built-up column and concrete is poured at the junction to form a steel-framed reinforced concrete structure.



6. A structural framework substantially as herein described with reference to and as illustrated in Figures 1 to 4 or Figure 5 or Figures 6 to 9 or Figures 10 to 13, or Figures 14 to 17 alone or as
5 modified by any of Figures 18 to 30 of the accompanying drawings.
