

[Document Type] Specification

[Title of the Invention] BEAM TO COLUMN CONNECTION AND STEEL
REINFORCED CONCRETE COLUMN

[Technical Field of the Invention]

[0001]

The present invention relates to a beam to column connection and a steel reinforced concrete column.

Priority is claimed on Japanese Patent Application No. 2016-071540, filed on March 31, 2016, the content of which is incorporated herein by reference.

[Related Art]

[0002]

In the related art, as a joining structure of a steel frame column, which is constituted of a steel H-shape used as a column of an SRC structure, and a steel beam, a joining structure taking a burden of a seismic load into consideration has been proposed.

[0003]

For example, Patent Document 1 discloses a column-beam joint portion using a steel H-shape, as a column member of a steel framed structure or a steel framed reinforced concrete structure, in which a plate thickness of a web is greater than a plate thickness of a flange, thereby not requiring a horizontal stiffener and a doubler plate which are required in column-beam joint portions having an earthquake-resistant structure.

Incidentally, the invention disclosed in Patent Document 1 is a technology for performing rigid-joint of a column-beam joint portion against a seismic force, in which both upper and lower flanges of a beam having a steel framed structure are welded to flanges of a column having a steel framed structure.

[0004]

In addition, Patent Document 2 discloses a beam to column connection of a steel framed reinforced concrete structure column and a steel beam. In the beam to column connection, a plate thickness of a web of a column steel frame is formed to be greater than a plate thickness of flanges such that the steel beam in a strong axis direction of the column steel frame can be subjected to rigid-joint without using a diaphragm. In the steel beam in a weak axis direction of the column steel frame, only the web is joined to the column steel frame. The embedded length of the steel beam in concrete of the column is set to a length such that the steel beam can be subjected to rigid-joint.

Incidentally, the invention disclosed in Patent Document 2 is also a technology for performing rigid-joint of a column-beam joint portion against a seismic force. In the technology, a steel beam is subjected to rigid-joint in the weak axis direction of a column steel frame. In the weak axis direction of the column steel frame, the embedded length of the steel beam is increased by increasing the cross-sectional shape of a column having an SRC structure.

[0005]

In addition, Patent Document 3 discloses an outer shell structure, in which rigid-joint is performed by welding a beam end of an inner beam to a core steel in an outer circumferential column. Without directly joining a web of an outer circumferential beam to a web of the core steel in a structure, rigid-joint rigid-joint is performed by settling an end portion of the outer circumferential beam in coated concrete of the outer circumferential column. A shearing reinforcing bar and a width fixing reinforcement are subjected to densely intensive shearing reinforcement at

positions in the vicinity of an upper portion and a lower portion of the outer circumferential beam.

Incidentally, the invention disclosed in Patent Document 3 is also a technology for performing rigid-joint of a bi-directional column-beam joint portion against a seismic force, in which the embedded length of an outer circumferential beam is ensured by causing a column having an SRC structure to have a rectangular shape.

[Prior Art Document]

[Patent Document]

[0006]

[Patent Document 1] Japanese Unexamined Patent Application, First Publication No. 2001-214514

[Patent Document 2] Japanese Unexamined Patent Application, First Publication No. 2007-100396

[Patent Document 3] Japanese Unexamined Patent Application, First Publication No. 2013-245442

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0007]

Meanwhile, recently, in building structures, a vibration damping mechanism such as a vibration damping apparatus or an earthquake-resistant brace provided in a location other than structure members bears a seismic load. In such building structures, there is no need for the structure members to bear a seismic load. That is, in building structures equipped with a vibration damping mechanism, only a load in a vertical direction is taken into consideration for the structure members.

Incidentally, all of the inventions in Patent Documents 1 to 3 disclose a joining structure requiring reinforcement postulating a seismic load, and the structures are not specialized in supporting a load acting on a beam in the vertical direction. Particularly, in a case of bearing a seismic load by performing welding in a joint portion of a column and a beam, if a high strength steel is used as the column or the beam, it becomes difficult to perform welding work, thereby resulting in a problem that a high strength steel frame column or a high strength steel beam cannot be used.

[0008]

The present invention solves the foregoing problems, and an object thereof is to provide a beam to column connection and a steel reinforced concrete column which require no complicated reinforcement, have excellent workability and safety, and are specialized in supporting a vertical load.

[Means for Solving the Problem]

[0009]

The following is the outline of the present invention.

[0010]

(1) According to a first aspect of the present invention, there is provided a beam to column connection of a steel frame column around which concrete is placed and a steel beam which is disposed on a side of the steel frame column. The beam to column connection includes a beam mounting member which is provided in a side portion of the steel frame column and supports the steel beam to be movable in a horizontal direction; and a locking unit which is disposed on an upper surface of the steel beam and is locked in the concrete. The locking unit is one of or both a stud erected on the upper surface of the steel beam and a dowel penetration hole formed on the upper surface of the steel beam.

(2) In the beam to column connection according to (1), the locking unit may be the stud, and a diameter-increasing head portion may be formed on an upper end side of the stud.

(3) In the beam to column connection according to (1), the locking unit may be the dowel penetration hole, and the beam to column connection may further include a dowel steel rod which is inserted through the dowel penetration hole.

(4) In the beam to column connection according to (3), a ratio $S1/S2$ of a cross-sectional area $S1$ of a cross section perpendicular to a material axis direction of the dowel steel rod to a cross-sectional area $S2$ of a cross section perpendicular to a penetration direction of the dowel penetration hole may range from 0.5 to 0.8.

(5) In the beam to column connection according to any one of (1) to (4), a yield strength of the steel frame column may be 400 MPa or higher.

(6) In the beam to column connection according to any one of (1) to (5), the steel frame column may be a steel H-shape, and an end surface of the steel beam may be provided to face a web of the steel H-shape.

(7) In the beam to column connection according to any one of (1) to (6), the beam mounting member may be an angle including a perpendicular surface attached to the side portion of the steel frame column, and a horizontal surface extending in the horizontal direction from an upper end of the perpendicular portion.

(8) In the beam to column connection according to any one of (1) to (7), an end surface of the steel beam may be not fixed to the side portion of the steel frame column.

(9) In the beam to column connection according to any one of (1) to (8), the steel beam and the steel frame column may be not joined to each other by welding.

(10) According to a second aspect of the present invention, there is provided a steel reinforced concrete column including the beam to column connection according to

any one of (1) to (9); and reinforced concrete which is placed around the beam to column connection.

[Effects of the Invention]

[0011]

According to the aspects of the present invention, in the beam to column connection of a steel frame column and a steel beam used in a steel reinforced concrete column, the steel beam is supported by the beam mounting member to be movable in the horizontal direction. Therefore, the steel beam is not directly joined to the steel frame column by welding or the like, so that a beam to column connection can be easily and promptly established without performing complicated reinforcement.

Particularly, since welding between a steel frame column and a steel beam is omitted, it is possible to use a high strength column member that is difficult to be subjected to welding construction. Therefore, it is possible to obtain a beam to column connection and a steel reinforced concrete column that are highly safe.

Moreover, since at least one of the stud and the dowel penetration hole is provided as the locking unit on the upper surface of the steel beam, after concrete is placed and cured, the steel beam is restrained from moving in a length direction of the steel beam. Therefore, the steel beam can be prevented from falling off the steel reinforced concrete column, and it is possible to ensure high safety.

Therefore, it is possible to provide a beam to column connection and a steel reinforced concrete column having both high workability and high safety.

[Brief Description of the Drawings]

[0012]

FIG. 1 is a perspective view of a steel reinforced concrete column including a beam to column connection according to a first embodiment of the present invention.

FIG. 2 shows the beam to column connection according to the same embodiment. FIG. 2(a) is a plan view, FIG. 2(b) is a longitudinal cross-sectional view seen along line A1-A1 in FIG. 2(a), and FIG. 2(c) is a longitudinal cross-sectional view seen along line B1-B1 in FIG. 2(a).

FIG. 3 shows a beam to column connection according to a second embodiment of the present invention. FIG. 3(a) is a plan view, FIG. 3(b) is a longitudinal cross-sectional view seen along line A2-A2 in FIG. 3(a), and FIG. 3(c) is a longitudinal cross-sectional view seen along line B2-B2 in FIG. 3(a).

FIG. 4 shows a beam to column connection according to a third embodiment of the present invention. FIG. 4(a) is a plan view, FIG. 4(b) is a longitudinal cross-sectional view seen along line A3-A3 in FIG. 4(a), and FIG. 4(c) is a longitudinal cross-sectional view seen along line B3-B3 in FIG. 4(a).

FIG. 5 shows a beam to column connection according to a fourth embodiment of the present invention. FIG. 5(a) is a plan view, FIG. 5(b) is a longitudinal cross-sectional view seen along line A4-A4 in FIG. 5(a), and FIG. 5(c) is a longitudinal cross-sectional view seen along line B4-B4 in FIG. 5(a).

[Embodiments of the Invention]

[0013]

The inventors have ascertained that a beam to column connection and a steel reinforced concrete column having excellent workability and safety can be provided by (a) having a structure in which a joining spot of a steel frame column and a steel beam does not bear a seismic load and the steel frame column and the steel beam are not subjected to rigid-joint by welding or the like, and (b) by providing a locking unit which prevents a deviation of a steel beam in a longitudinal direction after concrete is placed on an upper surface of the steel beam.

[0014]

Hereinafter, beam to column connections according to a first embodiment to a fourth embodiment of the present invention provided based on the knowledge described above will be described with reference to the drawings.

In this specification and the drawings, the same reference signs are applied to elements having substantially the same functional configuration, and duplicated description will be omitted.

In addition, terms in this specification will be described below.

A strong axis direction X denotes a direction in which a cross-sectional secondary moment is maximized on a cross section perpendicular to a material axis direction Z of a column. In a case where a column is a steel H-shape, an extension direction of a web on a cross section perpendicular to the material axis direction Z of the steel H-shape becomes the strong axis direction.

A weak axis direction Y denotes a direction in which the cross-sectional secondary moment is minimized on a cross section perpendicular to the material axis direction Z of a column. In a case where a column is a steel H-shape, an extension direction of the flange on a cross section perpendicular to the material axis direction Z of the steel H-shape becomes the weak axis direction.

[0015]

(First Embodiment)

FIG. 1 shows a steel reinforced concrete column 10 having a beam to column connection 1A (SRC structure) according to the first embodiment of the present invention.

As shown in FIG. 1, the beam to column connection 1A is a structure for joining a steel frame column 2 which is erected along a vertical direction Z, and a steel

beam 3 which is disposed such that its end surface faces a side surface of the steel frame column 2.

[0016]

The steel frame column 2 is constituted of a steel H-shape having a web 21 and a pair of flanges 22.

The steel beam 3 is constituted of a steel H-shape having a web 31 and a pair of an upper flange 32a and a lower flange 32b on upper and lower sides. The steel beam 3 is disposed to extend along the weak axis direction Y of the steel frame column 2. That is, the steel beam 3 is disposed such that its end surface faces a side portion of the web 21 of the steel frame column 2.

In a technology in the related art performing welding for joining a column and a beam, in consideration of weldability, there has been limitation on material design for using a high strength steel. However, in the beam to column connection 1A according to the present embodiment, welding for joining a column and a beam is not performed. Therefore, for example, it is possible to use a high strength steel having a yield strength of 400 MPa or higher, preferably 460 MPa or higher.

[0017]

A horizontal reinforcing rod insertion hole 33 is formed in the web 31 of the steel beam 3. A perpendicular reinforcing rod 5a is installed around the steel frame column 2 in a manner parallel to the material axis direction of the steel frame column 2, a horizontal reinforcing rod 5b is assembled with respect to the perpendicular reinforcing rod 5a inserted through the horizontal reinforcing rod insertion hole 33. Then, concrete C is placed in a region indicated by a dotted line in FIG. 1 such that the perpendicular reinforcing rod 5a and the horizontal reinforcing rod 5b are embedded around the steel frame column 2. In this manner, reinforced concrete covers an area

around the steel frame column 2 and the beam to column connection 1A, and the steel reinforced concrete column 10 is thereby established.

As shown in FIG. 1, in accordance with an installation position of the steel reinforced concrete column 10, a steel beam 3' may also be disposed in a side portion of the flanges 22 of the steel frame column 2.

[0018]

The steel reinforced concrete column 10 in this embodiment is a column having a substantial square shape in a cross section but may be a column having a substantially rectangular shape in cross section.

[0019]

FIG. 2 shows the beam to column connection 1A according to the present embodiment. FIG. 2(a) is a plan view, FIG. 2(b) is a longitudinal cross-sectional view seen along line A1-A1 in FIG. 2(a), and FIG. 2(c) is a longitudinal cross-sectional view seen along line B1-B1 in FIG. 2(a).

As shown in FIG. 2(b) and FIG. 2(c), beam mounting members 6 are joined to both side portions of the web 21 of the steel frame column 2.

The beam mounting member 6 is constituted of an angle (angle steel) having a perpendicular surface 61 attached to the side surface of the web 21 of the steel frame column 2, and a horizontal surface 62 extending in a horizontal direction from an upper end of the perpendicular surface 61.

In the beam to column connection 1A according to the present embodiment, a bolt 63a is inserted through a hole penetrating the web 21 and the beam mounting members 6 provided on both side surfaces and is screwed into a nut 63b, and then the beam mounting members 6 are respectively provided on the side surfaces of the steel frame column 2.

Then, on the upper surfaces of the horizontal surfaces 62 of the beam mounting members 6, the lower flange 32b of the steel beam 3 is mounted in a form of being movable in the horizontal direction.

Here, a form of being movable in the horizontal direction denotes a form in which the steel beam 3 is not fixed to the steel frame column 2 or the beam mounting member 6 by welding or a bolt and is slidable in the longitudinal direction and a short direction before the concrete C is cured.

[0020]

The size of the beam mounting member 6 only needs to be big enough to be able to support a load during construction while the placed concrete C is cured. Since a load during construction acting on the steel beam 3 is a vertically downward force, basically, it is favorable for the steel beam 3 to be able to be mounted on the beam mounting members 6. However, in order to bear a force (arrow f1 in FIG. 2(b)) generated due to accurate positioning of the steel beam 3 or the dead weight and the like of the steel beam 3 in the vicinity of the lower flange 32b of the steel beam 3 in a direction of pressing the steel beam 3 against the web 21 of the steel frame column 2, the steel beam 3 and the perpendicular surfaces 61 of the beam mounting members 6 may be joined to each other in temporarily tacked manner by bearing bolts or the like. For example, the steel beam 3 may maintain a horizontally movable state by inserting a bearing bolt through a bolt hole having a clearance in the horizontal direction, and fixing the bearing bolt in a state where no torque is applied.

[0021]

Meanwhile, in the vicinity of the upper flange 32a of the steel beam 3, due to bending moment acting on the steel beam 3, a force (arrow f2 in FIG. 2(b)) in a direction separated from the web 21 of the steel frame column 2 is generated. In order

to prevent a deviation caused by this force, in the beam to column connection 1A according to the present embodiment, a plurality of studs 41 are installed on the upper surface of the upper flange 32a of the steel beam 3.

Since the studs 41 are installed at positions where the concrete C is placed, it is possible to prevent a positional deviation of the steel beam 3 in its length direction due to a shearing reinforcement effect realized by being embedded in the concrete C of the steel reinforced concrete column 10. Therefore, even in a case where the steel reinforced concrete column 10 has a small exterior shape and an embedded length of the steel beam 3 in the steel reinforced concrete column 10 is small, a deviation of the steel beam 3 in the length direction is prevented, so that the steel beam 3 can be prevented from falling off the steel reinforced concrete column 10.

[0022]

As shown in FIGS. 2(b) and 2(c), it is preferable that the stud 41 has a body portion 41a and a diameter-increasing head portion 41b which is formed on an upper end side of the body portion 41a and is further increased in diameter than the body portion 41a. In a case of using such a stud, a locking force is also generated in the vertical direction. Therefore, the above-described effect of preventing falling-off can be further enhanced.

[0023]

The studs 41 need only be installed before the concrete C is placed, and the studs 41 can be easily and promptly installed by using a stud welding gun or the like.

[0024]

In the beam to column connection 1A according to the present embodiment, welding (rigid-joint) between the web 21 of the steel frame column 2 and the end surface of the steel beam 3 in the longitudinal direction is not performed in order to

resist a seismic force as in a technology in the related art. Therefore, compared to a case of performing welding for earthquake-resistant reinforcement, construction is facilitated, so that the beam to column connection 1A can be established in a short construction period. In addition, since welding between a column and a beam does not have to be taken into consideration, it is possible to use a high strength steel, for example, a steel having a yield strength of 400 MPa or higher, preferably 460 MPa or higher. Therefore, it is possible to reduce the weight or the size of a steel required in strength design.

Moreover, in the beam to column connection 1A according to the present embodiment, since the steel beam 3 is mounted on the upper surfaces of the beam mounting members 6 in a form of being movable in the horizontal direction, position alignment of the steel beam can be easily performed, so that workability is enhanced.

[0025]

In addition, in the beam to column connection 1A according to the present embodiment, a vertical load acting on the steel beam 3 through a floor system of a building or the dead weight of the steel beam 3 is transmitted to the concrete C placed in a column, as a bearing force of the lower flange 32b of the steel beam 3 of a part embedded in the steel reinforced concrete column 10.

That is, the beam mounting members 6 on which the steel beam 3 is mounted need only support a load during construction until the concrete C is cured.

On the other hand, since the studs 41 (locking units) prevent a positional deviation of the steel beam 3 in the length direction, the steel beam 3 is prevented from escaping from the steel reinforced concrete column 10.

As a result, the beam to column connection 1A can be easily and promptly established without providing complicated reinforcement as in the related art.

Since the steel frame column 2 and the steel beam 3 are not subjected to welding having a high joining strength as in rigid-joint to be capable of enduring a seismic load, it is possible to easily use even a steel H-shape or the like which is difficult to be subjected to welding construction, such as an ultra thick steel H-shape having a high strength of which the yield strength is 400 MPa or higher, or 460 MPa or higher.

As the steel beam 3, a rolled steel H-shape made of steel, or a welding-assembled H-shaped cross-sectional member.

[0026]

In a case where a vibration damping mechanism is provided in an earthquake zone, the vibration damping mechanism is provided in a location other than a structure member of a building, instead of the beam to column connection 1A, so that the beam to column connection 1A does not bear a seismic load.

[0027]

Moreover, according to the beam to column connection 1A of the present embodiment, since a steel beam can be reliably joined to the steel reinforced concrete column, a concrete floor slab and a steel reinforced concrete column may be separated from each other in the structure. That is, there is no need for reinforcing rods of a concrete floor slab to be settled in the steel reinforced concrete column. Accordingly, concrete can be separately placed in a concrete floor slab and a steel reinforced concrete column, so that construction is facilitated.

[0028]

The beam to column connections in the related art proposed in Patent Documents 1 to 3 aim to perform rigid-joint of a steel frame column and a steel beam constituting an SRC structure against a seismic load. In contrast, the beam to column

connection 1A according to the present embodiment is applied to a case where a seismic load acting on a structure member is reduced on the premise that a vibration damping mechanism provided in a location other than a structure member of a building bears a seismic load. Therefore, the beam to column connection 1A according to the present embodiment is provided with no special structure for resisting a seismic load as that in the related art and has a configuration in which a deviation preventing unit in a steel beam is embedded in concrete of a steel reinforced concrete column in a state where the steel beam is mounted on beam mounting members attached to a steel frame column. Accordingly, a vertical load due to the dead weight of a steel beam or a vertical load acting on a steel beam from a floor system of a building is supported, so that the beam to column connection 1A can be rationalized and can be easily and promptly established.

[0029]

(Second Embodiment)

FIG. 3 shows a beam to column connection 1B according to the second embodiment of the present invention.

The beam to column connection 1B according to the embodiment differs from the beam to column connection 1A according to the first embodiment described above in using dowel penetration holes 42 as locking units, instead of the studs 41.

That is, in the beam to column connection 1B according to the present embodiment, as shown in FIGS. 3(a), 3(b), and 3(c), in a part of the upper flange 32a of the steel beam 3 to be embedded in the concrete C of the steel reinforced concrete column 10, a plurality of dowel penetration holes 42 penetrating the upper flange 32a in a thickness direction are formed as locking units.

[0030]

In the case of the beam to column connection 1B according to the present embodiment, the surrounding area of the dowel penetration holes 42 are embedded in the concrete C when the concrete C is placed, and the concrete C enters the inside of each of the dowel penetration holes 42. Accordingly, a dowel effect, that is, a deviation preventing effect utilizing shearing resistance is exhibited. Therefore, similar to the beam to column connection 1A according to the first embodiment, it is possible to prevent a positional deviation of the steel beam 3 in the length direction.

[0031]

(Third Embodiment)

FIG. 4 shows a beam to column connection 1C according to the third embodiment of the present invention.

In the beam to column connection 1C according to the embodiment, dowel steel rods 43 are inserted through the plurality of dowel penetration holes 42 provided in a manner similar to the beam to column connection 1B according to the second embodiment, and the upper side and the lower side of the dowel steel rods 43 protrude from the upper surface and the lower surface of the upper flange 32a.

[0032]

In the case of the beam to column connection 1C according to the present embodiment, since a shearing reinforcement effect is realized as the dowel steel rods 43 are embedded in the concrete C of the steel reinforced concrete column 10, it is possible to prevent a positional deviation of the steel beam 3 in the length direction. Moreover, a dowel effect is exhibited as the concrete C also enters the insides of spaces between inner circumferential surfaces of the dowel penetration holes 42 and outer circumferential surfaces of the dowel steel rods 43, that is, spaces caused by clearances between the dowel penetration holes 42 and the dowel steel rods 43. Therefore, due to

a combined effect of a shearing reinforcement effect and a dowel effect, a deviation of the steel beam 3 in the length direction is strongly prevented, so that the steel beam 3 can be more stably prevented from falling off the steel reinforced concrete column 10.

[0033]

Moreover, since the dowel steel rods 43 inserted into the dowel penetration holes 42 can increase a shearing resistance force of the placed concrete C, it is possible to reduce the number of dowel penetration holes 42, compared to the beam to column connection 1B according to the second embodiment, in which no dowel steel rod 43 is inserted.

Therefore, even in a case where the steel reinforced concrete column 10 has a small exterior shape and the embedded length of the steel beam 3 in the concrete C is small, a positional deviation of the steel beam 3 in the length direction can be prevented, so that the steel beam 3 is prevented from escaping from the steel reinforced concrete column 10.

[0034]

In order to more favorably achieve this combined effect, it is preferable that a value of $S1/S2$ that is a ratio of a cross-sectional area $S1$ of a cross section perpendicular to the material axis direction of the dowel steel rod 43 to a cross-sectional area $S2$ of a cross section perpendicular to a penetration direction of the dowel penetration hole 42 ranges from 0.2 to 0.6. If the value of $S1/S2$ is 0.2 or smaller, the dowel steel rods become excessively thin and excel in bending behavior. Therefore, there are cases where a reinforcing effect may not be achieved. In addition, if the value of $S1/S2$ is 0.6 or greater, fillability of concrete deteriorates. Therefore, there are cases where a construction problem may be caused and a clearance may be generated inside a dowel hole.

In a case where the ratio of $S1/S2$ is reduced, in order to prevent the dowel steel rods 43 from falling off, dowel steel rods of which the upper end sides are bent may be used, or dowel steel rod having a substantial U-shape so as to straddle holes adjacent to each other may be used.

[0035]

(Fourth Embodiment)

FIG. 5 shows a beam to column connection 1D according to the fourth embodiment of the present invention.

The beam to column connection 1D according to the fourth embodiment has the steel beam 3 joined along the strong axis direction X of the steel frame column 2, thereby differing from the beam to column connection 1A according to the first embodiment in which the steel beam 3 is joined along the weak axis direction Y of the steel frame column 2.

[0036]

In the beam to column connection 1D according to the present embodiment, as shown in FIG. 5(b), the beam mounting member 6 is fixed by the bolt 63a and the nut 63b with respect to each of the side portions on outer sides of both the flanges 22 and 22 of the steel frame column 2.

In the example shown in FIG. 5, similar to the beam to column connection 1A according to the first embodiment, the studs 41 are used as locking units. However, similar to the beam to column connections 1B and 1C according to the second embodiment and the third embodiment, the dowel penetration holes 42 or the dowel steel rods 43 may be employed, or a combination thereof may be employed.

[0037]

However, in the beam to column connection 1D according to the present embodiment, the steel beam 3 is installed such that its end surface faces the side portion of the flanges 22 separated from a central axis of the steel frame column 2. Therefore, compared to the beam to column connections 1A to 1C according to the first embodiment to the third embodiment in which the steel beam 3 is installed such that its end surface faces the side portion of the web 21 of the steel frame column 2, the embedded length of the steel beam 3 in the steel reinforced concrete column 10 tends to be decreased.

Particularly, in a case where the steel reinforced concrete column 10 has a substantial square shape in a cross section as in the beam to column connections 1A to 1D according to the first embodiment to the fourth embodiment, compared to a case where the steel reinforced concrete column has a substantially rectangular shape in a cross section elongated in the length direction of the steel beam, the embedded length of the steel beam 3 in the steel reinforced concrete column 10 is likely to be decreased.

However, if the studs 41, the dowel penetration holes 42, the dowel steel rods 43, or the like described above are used as locking units, deviation preventing of the steel beam 3 in the length direction can be sufficiently prevented. Therefore, the steel beam 3 can be prevented from falling off the steel reinforced concrete column 10.

[0038]

Hereinabove, favorable embodiments of the present invention have been described. However, the present invention is not limited to the examples described above. It is obvious that those skilled in the art can conceive various modification examples or correction examples within the scope of the technical idea disclosed in Claims, and it is understood that those examples also belong to the technical scope of the present invention.

[0039]

For example, in the first embodiment to the fourth embodiment described above, a steel H-shape is used as a steel frame column. However, in place of the steel H-shape, a square steel or a steel I-shape may be used.

In addition, in the first embodiment to the fourth embodiment described above, a steel H-shape is used as a steel beam. However, in place of the steel H-shape, a square steel or a steel I-shape may be used.

In addition, in the second embodiment and the third embodiment described above, examples of a case where a cross section perpendicular to the penetration direction of the dowel penetration hole 42 has a circular shape are shown. However, the shape may be an elliptic shape or a polygonal shape.

In addition, in the first embodiment to the fourth embodiment described above, an angle is used as a beam mounting member. However, the member need only be able to be installed in a side portion of a steel frame column and allow a steel beam to be mounted on its upper surface. A square steel may be used.

In addition, in the first embodiment to the fourth embodiment described above, a side portion of a steel frame column and an end portion of a steel beam are disposed in surface contact (without being joined to each other by welding, bolt fastening, or the like) with each other. However, a gap therebetween may be formed to the extent that they do not come into surface contact with each other.

The first embodiment to the fourth embodiment described above may be suitably combined. For example, studs and dowel penetration holes may be alternately disposed.

[Industrial Applicability]

[0040]

According to the present invention, it is possible to provide a beam to column connection and a steel reinforced concrete column having both high workability and high safety.

[Brief Description of the Reference Symbols]

[0041]

- 1A, 1B, 1C, 1D beam to column connection
- 10 steel reinforced concrete column
- 2 steel frame column (steel H-shape)
- 21 web
- 22 flange
- 3, 3' steel beam (steel H-shape)
- 31 web
- 32a upper flange
- 32b lower flange
- 33 horizontal reinforcing rod insertion hole
- 41 stud
- 41a body portion
- 41b head portion
- 42 dowel penetration hole
- 43 dowel steel rod
- 5a perpendicular reinforcing rod
- 5b horizontal reinforcing rod
- 6 beam mounting member (angle)
- 61 perpendicular surface
- 62 horizontal surface

63a	bolt
63b	nut
C	concrete
X	strong axis direction
Y	weak axis direction
Z	vertical direction

[Document Type]

CLAIMS

What is claimed is:

1. A beam to column connection of a steel frame column around which concrete is placed and a steel beam which is disposed on a side of the steel frame column, the beam to column connection comprising:

a beam mounting member which is provided in a side portion of the steel frame column and supports the steel beam to be movable in a horizontal direction; and

a locking unit which is disposed on an upper surface of the steel beam and is locked in the concrete,

wherein the locking unit is one of or both a stud erected on the upper surface of the steel beam and a dowel penetration hole formed on the upper surface of the steel beam.

2. The beam to column connection according to Claim 1,
wherein the locking unit is the stud, and
wherein a diameter-increasing head portion is formed on an upper end side of the stud.

3. The beam to column connection according to Claim 1,
wherein the locking unit is the dowel penetration hole, and
wherein the beam to column connection further includes

a dowel steel rod which is inserted through the dowel penetration hole.

4. The beam to column connection according to Claim 3,
wherein a ratio $S1/S2$ of a cross-sectional area $S1$ of a cross section

perpendicular to a material axis direction of the dowel steel rod to a cross-sectional area S2 of a cross section perpendicular to a penetration direction of the dowel penetration hole ranges from 0.2 to 0.6.

5. The beam to column connection according to any one of Claims 1 to 4, wherein a yield strength of the steel frame column is 400 MPa or higher.
6. The beam to column connection according to any one of Claims 1 to 5, wherein the steel frame column is a steel H-shape, and an end surface of the steel beam is provided to face a web of the steel H-shape.
7. The beam to column connection according to any one of Claims 1 to 6, wherein the beam mounting member is an angle including a perpendicular surface attached to the side portion of the steel frame column, and a horizontal surface extending in the horizontal direction from an upper end of the perpendicular portion.
8. The beam to column connection according to any one of Claims 1 to 7, wherein an end surface of the steel beam is not fixed to the side portion of the steel frame column.
9. The beam to column connection according to any one of Claims 1 to 8, wherein the steel beam and the steel frame column are not joined to each other by welding.
10. A steel reinforced concrete column comprising:

the beam to column connection according to any one of Claims 1 to 9; and
reinforced concrete which is placed around the beam to column connection.