

**【DESCRIPTION】****【Invention Title】**

CONNECTION STRUCTURE FOR SHAPED STEEL MEMBER OF COLUMN

**【Technical Field】**

5           The present invention relates to a connection structure for shaped steel members of a column that is capable of allowing coupling plates coupled to ends of the shaped steel members adjacent up and down to each other to be coupled to each other, in a prefabricated steel structure for building a steel-concrete composite column, and thus allowing a lower member and an upper member to be connected to each other, so that a stress of the column is transferred through bearing and conventional complicated connection through connection plates is simplified, thereby ensuring high constructability and economical efficiency.

**【Background Art】**

Many studies on a method for building a reinforced concrete column as a steel structure have been made so as to maintain efficiency of reinforced concrete, to simplify construction processes, and to reduce an amount of work in construction site.

One of such methods is a PRC (Prefabricated Reinforced Concrete Column) method in which steel bars constituting a reinforced concrete column are prefabricated to a form of a steel structure in a factory and is delivered and constructed in a construction site (which is disclosed in Korean Patent No.10-1050956). Further, another method is a PSRC (Prefabricated Steel Reinforced Concrete Column) method in which steel bars of a large stress and scale column in the PRC method are replaced with 'L'-shaped steel members (which is disclosed in Korean Patent No.10-1233693).

The PSRC method includes the steps of locating 'L'-shaped steel members at corners of a column, binding tie bars along the shaped steel members to build a prefabricated column having high rigidity, and locating column main bars  
5 between the adjacent shaped steel members to build a prefabricated steel structure in such a manner as to be composite with concrete, thereby constructing a steel-concrete composite column.

In the conventional prefabricated steel structure,  
10 connection plates are generally used to connect a lower member and an upper member. In detail, as shown in FIG.1, shaped steel members 10a and 10b of a lower member and an upper member, which are adjacent up and down to each other, are connected to each other in such a manner as to weld  
15 connection plates 20 onto the outsides thereof or to fasten the connection plates 20 thereto by means of bolts (which is disclosed in Korean Patent Application Laid-open No.10-2014-137999).

In this case, however, a large number of connection  
20 plates 20 are required, and long time for fastening the connection plates 20 to the shaped steel members 10a and 10b is consumed, thereby undesirably causing a period of construction to be extended.

Besides, the connection plates 20 or the bolts are  
25 located outward from the shaped steel members 10a and 10b, which is not advantageous in guaranteeing a covering depth.

If the connection plates 20 are fastened to the shaped steel members 10a and 10b by means of the bolts, further, bolt coupling holes have to be in advance machined on the  
30 connection plates 20 and the shaped steel members 10a and 10b. Generally, machining costs for the bolt coupling holes are determined upon weights of the members machined, but even if

the bolt coupling holes are machined only on end portions of the shaped steel members 10a and 10b, the machining costs thereof are very expensive due to the weights of the shaped steel members 10a and 10b.

5 Furthermore, section losses on the shaped steel members 10a and 10b occur due to the formation of the bolt coupling holes, thereby causing a structural weakness, and also, it is hard to install traverse support members around a connected portion between the shaped steel members 10a and 10b due to  
10 the interference of the connection plates 20, thereby undesirably causing buckling around the connected portion.

【Disclosure】

【Technical Problem】

Accordingly, the present invention has been made in view  
15 of the above-mentioned problems occurring in the related art, and it is an object of the present invention to provide a connection structure for shaped steel members of a column that is configured to simplify complicated connection between a lower member and an upper member through connection plates,  
20 in a prefabricated steel structure for building a steel-concrete composite column, thereby ensuring high constructability and economical efficiency.

It is another object of the present invention to provide a connection structure for shaped steel members of a column  
25 that is configured to allow a covering depth to be formed from the outer surfaces of the shaped steel members, thereby advantageously ensuring covering depths of a lower member and an upper member.

It is yet another object of the present invention to  
30 provide a connection structure for shaped steel members of a column that is configured to have no bolt coupling holes on the shaped steel members constituting a lower member and an

upper member, thereby causing no section losses of the lower member and the upper member and saving machining costs for the bolt coupling holes.

It is still another object of the present invention to provide a connection structure for shaped steel members of a column that is configured to allow traverse support members to be freely disposed on connection portions between a lower member and an upper member, thereby preventing buckling from being generated around the connection portions.

#### 10   【Technical Solution】

To accomplish the above-mentioned objects, according to the present invention, there is provided a connection structure for shaped steel members of a column to connect a lower member and an upper member, which respectively comprises a plurality of shaped steel members disposed on outer edges of the column and traverse support members for connecting the shaped steel members to each other, to build a steel-concrete composite column, wherein first coupling plates and second coupling plates are fixed to tops of the shaped steel members of the lower member and undersides of the shaped steel members of the upper member respectively, and the first coupling plates and the second coupling plates are coupled to each other to connect the upper member and the lower member with each other.

25       According to the present invention, desirably, the first coupling plates and the second coupling plates are coupled to each other by means of fastening bolts and nuts.

      According to the present invention, desirably, the shaped steel members are 'L'-shaped steel members, and the fastening bolts and the nuts are coupled to the first coupling plates and the second coupling plates on the insides of both legs of the shaped steel members.

According to the present invention, desirably, each fastening bolt includes a head and a body and the body has a tool insertion groove formed on an end portion thereof or a rotation tail part protruding from the end portion thereof in  
5 such a manner as to be fastened to a tool to rotate the fastening bolt.

According to the present invention, desirably, each fastening bolt includes a head and a body and the head has a tool insertion groove formed at the center of top thereof in  
10 such a manner as to be fastened to a tool to rotate the fastening bolt.

#### **【Advantageous Effects】**

The connection structure for shaped steel members of a column according to the present invention has the following  
15 advantages.

Firstly, the coupling plates coupled to the ends of the shaped steel members adjacent up and down to each other are coupled to each other, in the prefabricated steel structure for building the steel-concrete composite column, to allow  
20 the lower member and the upper member to be connected to each other, so that a stress of the column can be transferred through bearing and such conventional complicated connection through the connection plates coupled to the outer surfaces of the shaped steel members can be simplified, thereby  
25 ensuring high constructability and economical efficiency.

Secondly, since there are no connection plates coupled to the outer surfaces of the shaped steel members, the covering depth is formed from the outer surfaces of the shaped steel members, thereby advantageously ensuring the  
30 covering depths of the lower member and the upper member.

Thirdly, since there is no need to form the bolt coupling holes on the shaped steel members constituting the

lower member and the upper member, thereby causing no section losses of the lower member and the upper member and saving machining costs for the bolt coupling holes.

5 Lastly, since there is no member protruding outward from connection portions between the lower member and the upper member, the traverse support members can be freely disposed on the connection portions, thereby preventing buckling from being generated around the connection portions.

**【Description of Drawings】**

10 FIG.1 is a perspective view showing upper and lower connected portions of shaped steel members of a column in a conventional practice.

FIG.2 is a perspective view showing a connection structure for shaped steel members of a column according to  
15 the present invention.

FIG.3 is an enlarged perspective view showing connection portions of upper and lower shaped steel members in the connection structure according to the present invention.

FIG.4 is an exploded perspective view of FIG.3.

20 FIGS.5A and 5B are perspective views showing stress transfer relation between the connection portions of the upper and lower shaped steel members in the connection structure according to the present invention.

FIG.6 is a perspective view showing an example of a  
25 fastening bolt adopted in the present invention.

FIG.7 is a perspective view showing a method for fastening the fastening bolt of FIG.6.

FIG.8 is a perspective view showing another example of the fastening bolt adopted in the present invention.

30 FIG.9 is a perspective view showing yet another example of the fastening bolt adopted in the present invention.

**【Best Mode for Invention】**

To accomplish the above-mentioned objects, according to the present invention, there is provided a connection structure for shaped steel members of a column to connect a lower member and an upper member, which respectively  
5 comprises a plurality of shaped steel members disposed on outer edges of the column and traverse support members for connecting the shaped steel members to each other, to build a steel-concrete composite column, wherein first coupling plates and second coupling plates are fixed to tops of the  
10 shaped steel members of the lower member and undersides of the shaped steel members of the upper member respectively, and the first coupling plates and the second coupling plates are coupled to each other to connect the upper member and the lower member with each other.

15 **【Mode for Invention】**

Hereinafter, an explanation on a connection structure for shaped steel members of a column according to the present invention will be in detail given with reference to the attached drawings.

20 FIG.2 is a perspective view showing a connection structure for shaped steel members of a column according to the present invention and FIG.3 is an enlarged perspective view showing connection portions of upper and lower shaped steel members in the connection structure according to the  
25 present invention.

As shown in FIGS.2 and 3, a connection structure for shaped steel members of a column according to the present invention is configured to connect a lower member 1a and an upper member 1b, which respectively comprises a plurality of  
30 shaped steel members 11a and 11b disposed on outer edges of a column and traverse support members 12a and 12b for connecting the shaped steel members 11a and 11b to each other,

to build a steel-concrete composite column, wherein first coupling plates 13a and second coupling plates 13b are fixed to tops of the shaped steel members 11a of the lower member 1a and undersides of the shaped steel members 11b of the upper member 1b respectively, and the first coupling plates 13a and the second coupling plates 13b are coupled to each other to connect the upper member 1b and the lower member 1a with each other.

The lower member 1a and the upper member 1b have the shaped steel members 11a and 11b disposed on the corners of the column and the traverse support members 12a and 12b for connecting the adjacent shaped steel members 11a and 11b.

The traverse support members 12a and 12b are spaced apart from each other in longitudinal directions of the shaped steel members 11a and 11b.

The traverse support members 12a and 12b are coupled to the shaped steel members 11a and 11b by means of bolts or welding.

Other shaped steel members are disposed between the shaped steel members 11a and 11b arranged on the corners of the column.

The lower member 1a and the upper member 1b are prefabricated in a factory and are then moved and built in a construction site.

The first coupling plates 13a and the second coupling plates 13b are coupled to coupled ends of the shaped steel members 11a and 11b of the lower member 1a and the upper member 1b coupled to each other.

In detail, the first coupling plates 13a are coupled to tops of the shaped steel members 11a of the lower member 1a, and the second coupling plates 13b are coupled to undersides of the shaped steel members 11b of the upper member 1b.

The first coupling plates 13a and the second coupling plates 13b are coupled to the ends of the shaped steel members 11a and 11b by means of welding.

5 The lower member 1a and the upper member 1b are connected up and down to each other by means of coupling between the first coupling plates 13a and the second coupling plates 13b.

10 The first coupling plates 13a and the second coupling plates 13b are coupled to each other by means of fastening means like fastening bolts 21 and nuts 22, and otherwise, the fastening means may be replaced with various methods inclusive of welding.

15 Accordingly, compression forces of the shaped steel members 11a and 11b are transferred through bearing of the first coupling plates 13a and the second coupling plates 13b against the ends of the shaped steel members 11a and 11b.

20 According to the present invention, as a result, the conventional complicate connection structure, in which the upper shaped steel members 11a and the lower shaped steel members 11b are connected to each other by means of the connection plates, becomes simplified to ensure high constructability and economical efficiency.

25 Moreover, no separate connection plates are located on the connection portions between the shaped steel members 11a and the shaped steel members 11b, thereby easily coupling the traverse support members 12a and 12b to the shaped steel members 11a and the shaped steel members 11b, and a covering depth is formed from the outer surfaces of the shaped steel members 11a and 11b, thereby advantageously ensuring covering  
30 depths of the traverse support members 12a and 12b.

FIG.4 is an exploded perspective view of FIG.3, and FIGS.5A and 5B are perspective views showing stress transfer

relation between the connection portions of the upper and lower shaped steel members in the connection structure according to the present invention.

As shown in FIG.4, the first coupling plate 13a and the second coupling plate 13b are coupled to each other by means of the fastening bolt 21 and the nut 22.

To do this, the first coupling plate 13a and the second coupling plate 13b have fastening holes 131 formed thereon to pass the fastening bolt 21 therethrough.

The first coupling plate 13a and the second coupling plate 13b may be coupled to each other by means of welding, but if the fastening bolt 21 and the nut 22 are used, welding in the construction site can be minimized, so that the coupling work can be easily and rapidly carried out.

As shown in FIG.5A, the compression forces of the shaped steel members 11a and 11b are transferred through bearing of the first coupling plate 13a and the second coupling plate 13b.

Further, as shown in FIG.5B, a tensile force is transferred directly through coupling between the first coupling plate 13a and the second coupling plate 13b, more specifically, through the fastening bolt 21.

Especially, the upper and lower shaped steel members 11a and 11b are connected to each other by means of only one fastening bolt 21, thereby reducing the number of bolts coupled and greatly shortening the time for forming the connection portions.

Since a main stress of a column is a compression force, a tensile force generated from the column is relatively small. Accordingly, the full sections of the shaped steel members 11a and 11b are not required so as to generate the tensile force, and also, there is no need to transfer the full

tensile strength of the sections of the shaped steel members 11a and 11b.

According to the present invention, in detail, the tensile force of the column is supported by means of the fastening bolt 21 on the connection portions of the upper shaped steel member 11a and the lower shaped steel member 11b, so that it becomes reduced, thereby decreasing P-M interaction. Generally, however, a column design strength is in a compression force control area, and accordingly, there is no problem in adoption of the fastening bolt 21.

A diameter of the fastening bolt 21 is determined according to sizes of the tensile forces or shear forces applied to the shaped steel members 11a and 11b.

If a tensile stress is excessively required even after the sizes of the tensile forces or shear forces have been analyzed, the first coupling plates 13 and the second coupling plate 13b are welded to each other.

In case of connecting the shaped steel members through bolts in the conventional practice, high tension bolts are generally used to connect the members through friction so that stress like tension and compression is transferred from the connection portion. According to the present invention, however, the compression forces on the connection portions between the upper shaped steel member 11a and the lower shaped steel member 11b are supported by means of the bearing of the first coupling plate 13a and the second coupling plate 13b, and the tensile force thereon is supported by means of the fastening bolt 21, so that there is no need to use the high tension bolt.

Moreover, the shaped steel members 11a and 11b are 'L'-shaped steel members, and the fastening bolt 21 and the nut 22 are coupled to the first coupling plate 13 and the second

coupling plate 13b on the insides of both legs of the shaped steel members 11a and 11b.

In addition to the 'L'-shaped steel members, of course, the shaped steel members 11a and 11b may have various  
5 sections such as a '□'-shaped section, and so on.

If the shaped steel members 11a and 11b are the 'L'-shaped steel members, especially, attachment to other members like beams through the coupling plates or to the traverse support members 12a and 12b is advantageously carried out. As  
10 the 'L'-shaped steel members have large radiuses of gyration, further, a buckling length becomes long to provide excellent flexural rigidity, and when the prefabricated lower member 1a or upper member 1b with the 'L'-shaped steel members is moved and coupled in the construction site, it has high rigidity so  
15 that it can be stable and ensure high straightness upon construction.

If the shaped steel members 11a and 11b are the 'L'-shaped steel members, furthermore, the fastening bolt 21 is fastened to the centers of the sections of the 'L'-shaped  
20 steel members 11a and 11b, so that the tensile force applied to the shaped steel members 11a and 11b can be effectively transferred, without any eccentricity.

FIG.6 is a perspective view showing an example of the fastening bolt adopted in the present invention, FIG.7 is a  
25 perspective view showing a method for fastening the fastening bolt of FIG.6, and FIG.8 is a perspective view showing another example of the fastening bolt adopted in the present invention.

As shown in FIGS.6 and 8, the fastening bolt 21 includes  
30 a head 211 and a body 212, and the body 212 has a tool insertion groove 213 formed on an end portion thereof or a rotation tail part 214 protruding from the end portion

thereof in such a manner as to be fastened to a tool to rotate the fastening bolt 21.

If the nut 22 is fastened to the fastening bolt 21, the nut 22 or the head 211 has to be rotated by means of another  
5 tool in a state where the head 211 of the fastening bolt 21 or the nut 22 is fixed to the tool. To do this, a given distance or more has to be ensured between the outer periphery of the head 211 of the fastening bolt 21 or the nut 22 and one surface of the shaped steel members 11a and 11b,  
10 so that the tool can be rotated.

If the fastening bolt 21 having a large diameter is used by means of the application of a relatively high tensile force, however, the given distance between the outer periphery of the head 211 of the fastening bolt 21 and one  
15 surface of the shaped steel members 11a and 11b becomes narrow so that it is hard to fasten the tool to the head 211 of the fastening bolt 21 and to thus rotate the fastening bolt 21.

So as to rotate the fastening bolt 21, accordingly, the  
20 tool is not fastened to the head 211 of the fastening bolt 21, but fastened to the lower end periphery of the body 212 of the fastening bolt 21, and to do this, the tool insertion groove 213 or the rotation tail part 214 is formed on the lower end periphery of the body 212.

25 As shown in FIGS.6 and 7, the tool insertion groove 213 is formed on the lower end periphery of the body 212 of the fastening bolt 21, and as shown in FIG.8, the rotation tail part 214 is formed protrudingly from the lower end periphery of the body 212 of the fastening bolt 21.

30 In a state where the nut 22 is fixed through another tool 4, as shown in FIG.7, a wrench 3 is inserted into the tool insertion groove 213, and otherwise, the rotation tail

part 214 is inserted into a socket wrench, so that the wrench 3 or the rotation tail part 214 is rotated to fasten the nut 22 to the fastening bolt 21.

5 The tool insertion groove 213 or the rotation tail part 214 has a polygonal shape corresponding to the shape of the tool so that it can be fixed by means of the tool.

Moreover, a diameter of the rotation tail part 214 is less than or equal to a diameter of the body 212 so that the nut 22 is coupled to the rotation tail part 214.

10 FIG.9 is a perspective view showing yet another example of the fastening bolt adopted in the present invention.

As shown in FIG.9, the fastening bolt 21 includes a head 211 and a body 212, and further, the head 211 has a tool insertion groove 213 formed at the center of top thereof in such a manner as to be fastened to a tool to rotate the fastening bolt 21.

15 If the tool insertion groove 213 is formed at the center of top of the head 211 of the fastening bolt 21, there is no need to allow the body 212 to protrude long from the lower end periphery of the nut 22. Accordingly, the fastening bolt 21 has a relatively short length.

#### **【Industrial Applicability】**

25 The connection structure for the shaped steel members of the column according to the present invention is configured to allow the coupling plates coupled to the ends of the shaped steel members adjacent up and down to each other to be coupled to each other, in the prefabricated steel structure for building the steel-concrete composite column, and thus to allow the lower member and the upper member to be connected to each other, so that a stress of the column can be transferred through bearing and such conventional complicated connection through the connection plates coupled to the outer

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surfaces of the shaped steel members can be simplified, thereby ensuring high constructability and economical efficiency.

**【CLAIMS】****【Claim 1】**

A connection structure for shaped steel members of a column to connect a lower member 1a and an upper member 1b, which respectively comprises a plurality of shaped steel members 11a and 11b disposed on outer edges of the column and traverse support members 12a and 12b for connecting the shaped steel members 11a and 11b to each other, to build a steel-concrete composite column, wherein first coupling plates 13a and second coupling plates 13b are fixed to tops of the shaped steel members 11a of the lower member 1a and undersides of the shaped steel members 11b of the upper member 1b respectively, and the first coupling plates 13a and the second coupling plates 13b are coupled to each other to connect the upper member 1b and the lower member 1a with each other.

**【Claim 2】**

The column steel connection structure according to claim 1, wherein the first coupling plates 13a and the second coupling plates 13b are coupled to each other by means of fastening bolts 21 and nuts 22.

**【Claim 3】**

The column steel connection structure according to claim 2, wherein the shaped steel members 11a and 11b are 'L'-shaped steel members, and the fastening bolts 21 and the nuts 22 are coupled to the first coupling plates 13a and the second coupling plates 13b on the insides of both legs of the shaped steel members 11a and 11b.

**【Claim 4】**

The column steel connection structure according to claim 2, wherein each fastening bolt 21 comprises a head 211 and a body 212 and the body 212 has a tool insertion groove 213

formed on an end portion thereof or a rotation tail part 214 protruding from the end portion thereof in such a manner as to be fastened to a tool to rotate the fastening bolt 21.

**【Claim 5】**

- 5        The column steel connection structure according to claim 2, wherein each fastening bolt 21 comprises a head 211 and a body 212 and the head 211 has a tool insertion groove 213 formed at the center of top thereof in such a manner as to be fastened to a tool to rotate the fastening bolt 21.