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 (2013.01)

(57) **ABSTRACT**

Provided is a rigid connection structure including: a lower PC column having column concrete, a lower column plate disposed on top of the column concrete, and a plurality of lower column reinforcing bars buriedly arranged vertically in the interior of the column concrete and having upper ends penetrated into the lower column plate in such a manner as to be exposed to the outside; and an upper PC column having column concrete, an upper column plate disposed on top of the column concrete, and a plurality of upper column reinforcing bars buriedly arranged vertically in the interior of the column concrete and having lower ends penetrated into the upper column plate in such a manner as to be exposed to the outside.

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Provided is a rigid connection structure including: a lower PC column having column concrete, a lower column plate disposed on top of the column concrete, and a plurality of lower column reinforcing bars buriedly arranged vertically in the interior of the column concrete and having upper ends penetrated into the lower column plate in such a manner as to be exposed to the outside; and an upper PC column having column concrete, an upper column plate disposed on top of the column concrete, and a plurality of upper column reinforcing bars buriedly arranged vertically in the interior of the column concrete and having lower ends penetrated into the upper column plate in such a manner as to be exposed to the outside.

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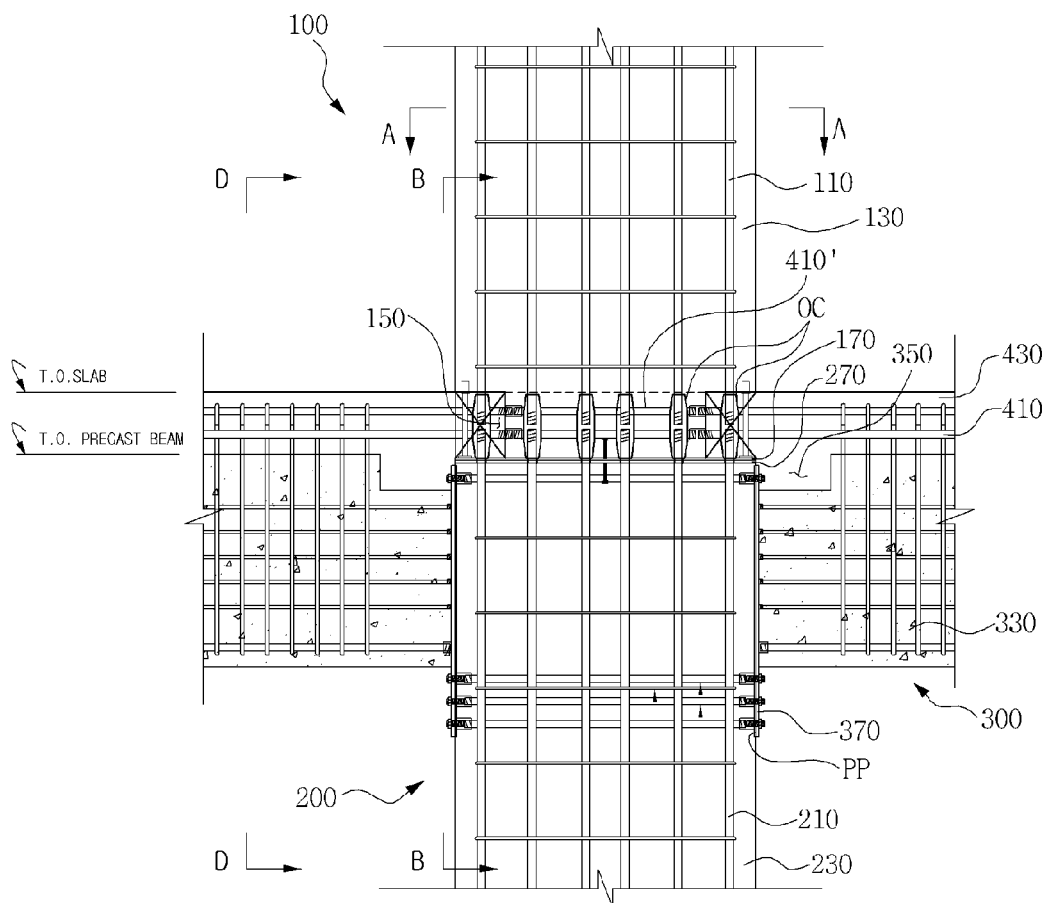


FIG. 1

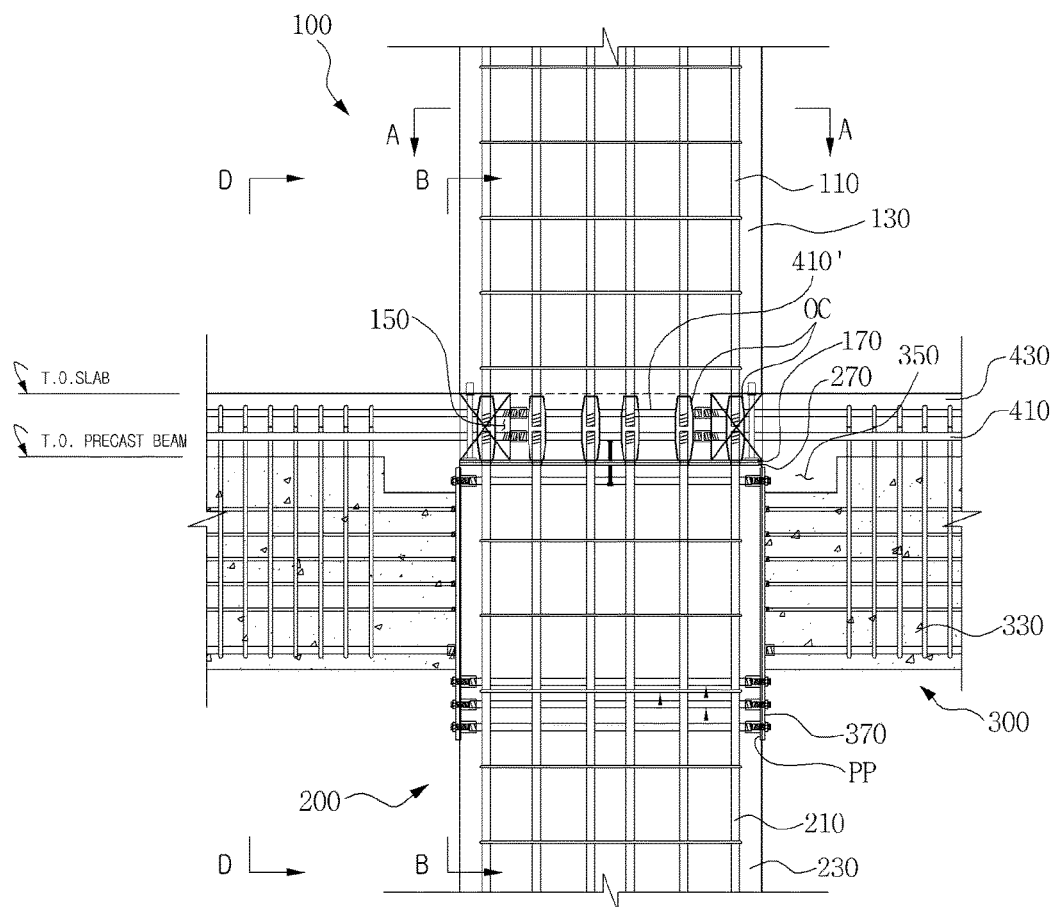


FIG. 2

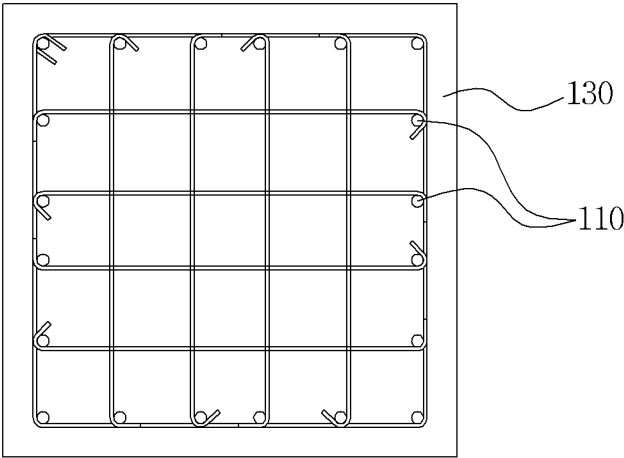


FIG. 3

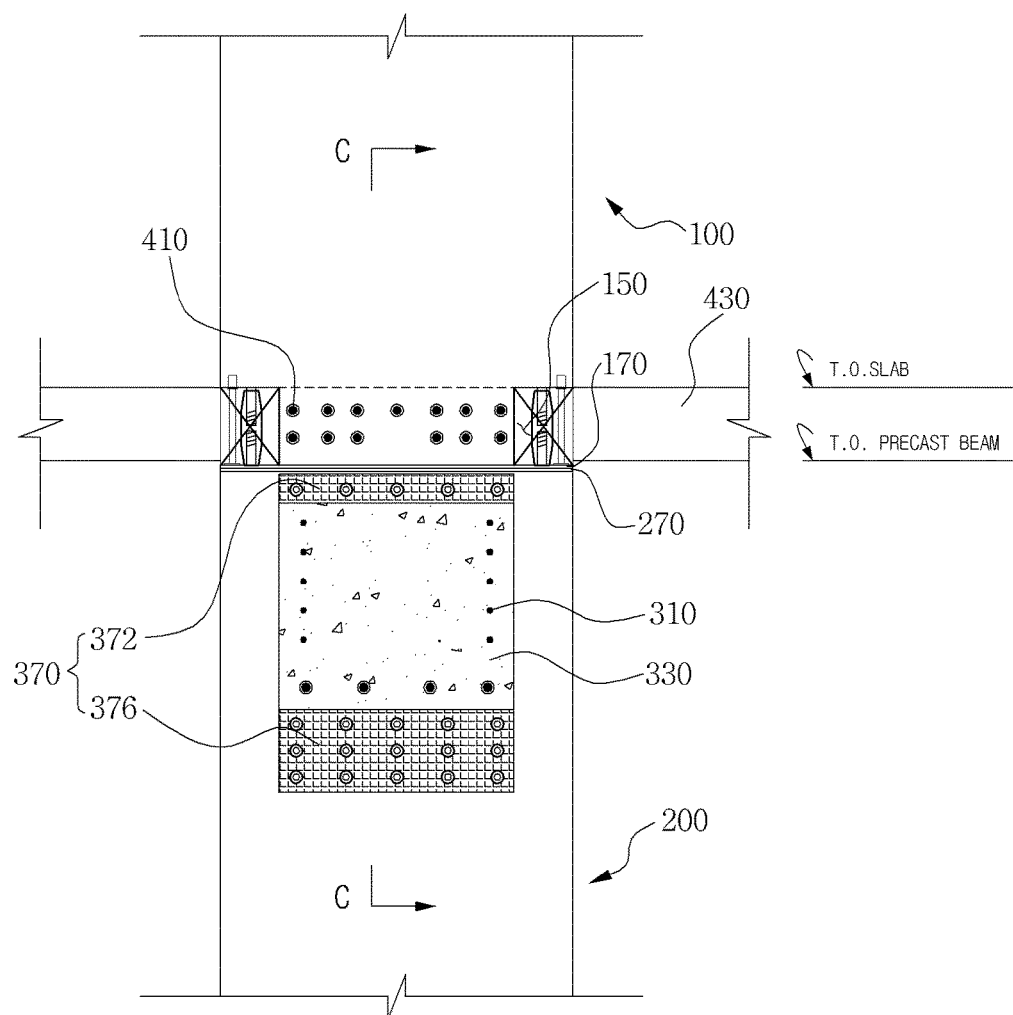


FIG. 4

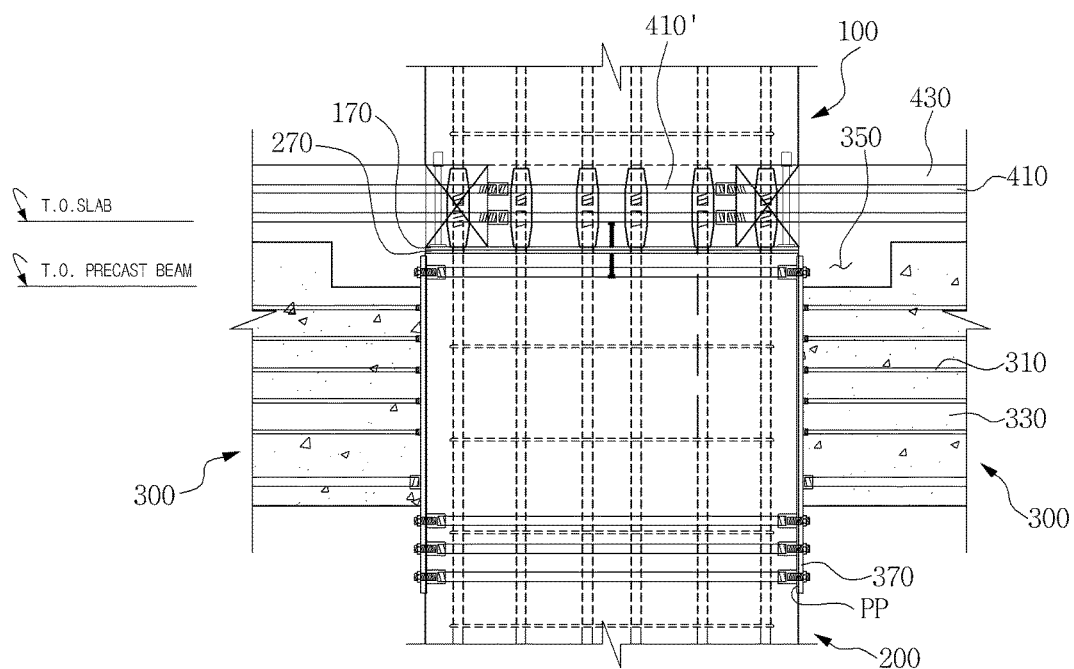


FIG. 5

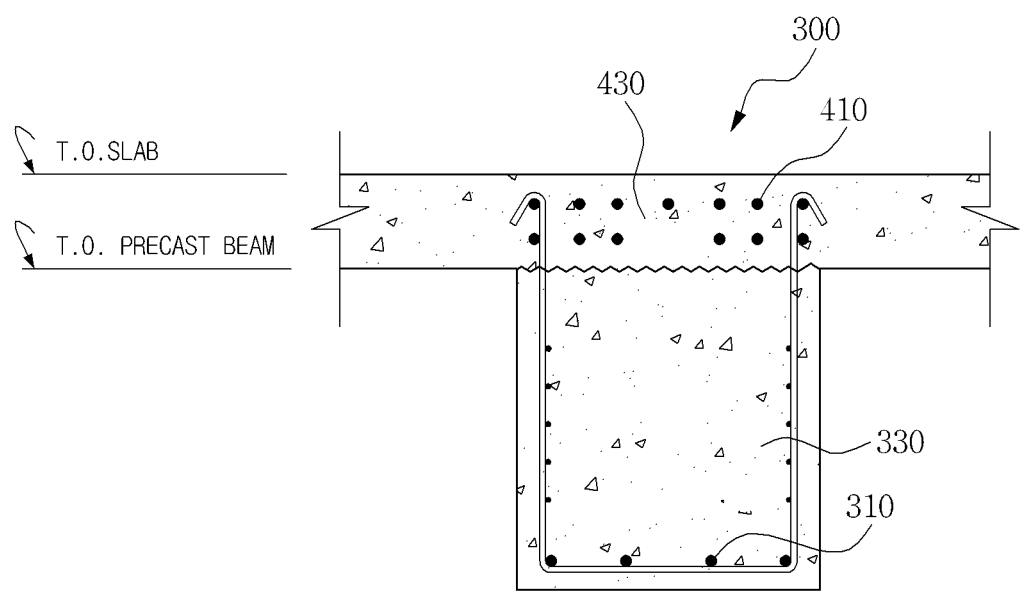


FIG. 6

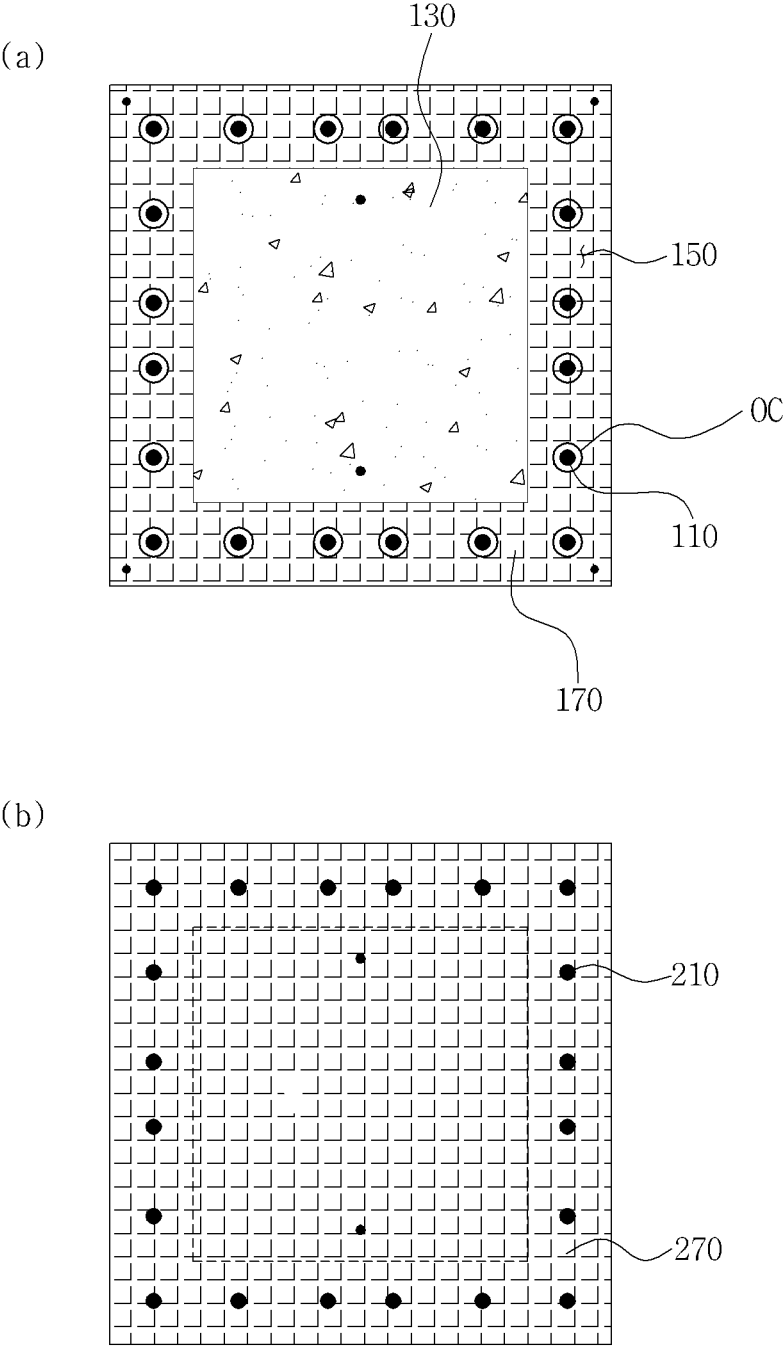


FIG. 7

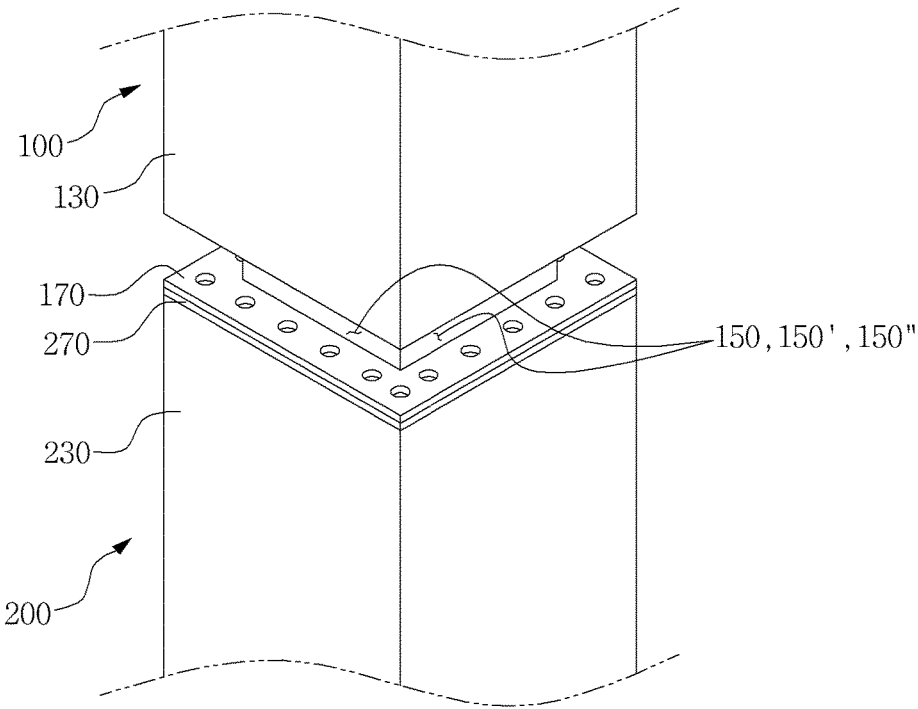


FIG. 8

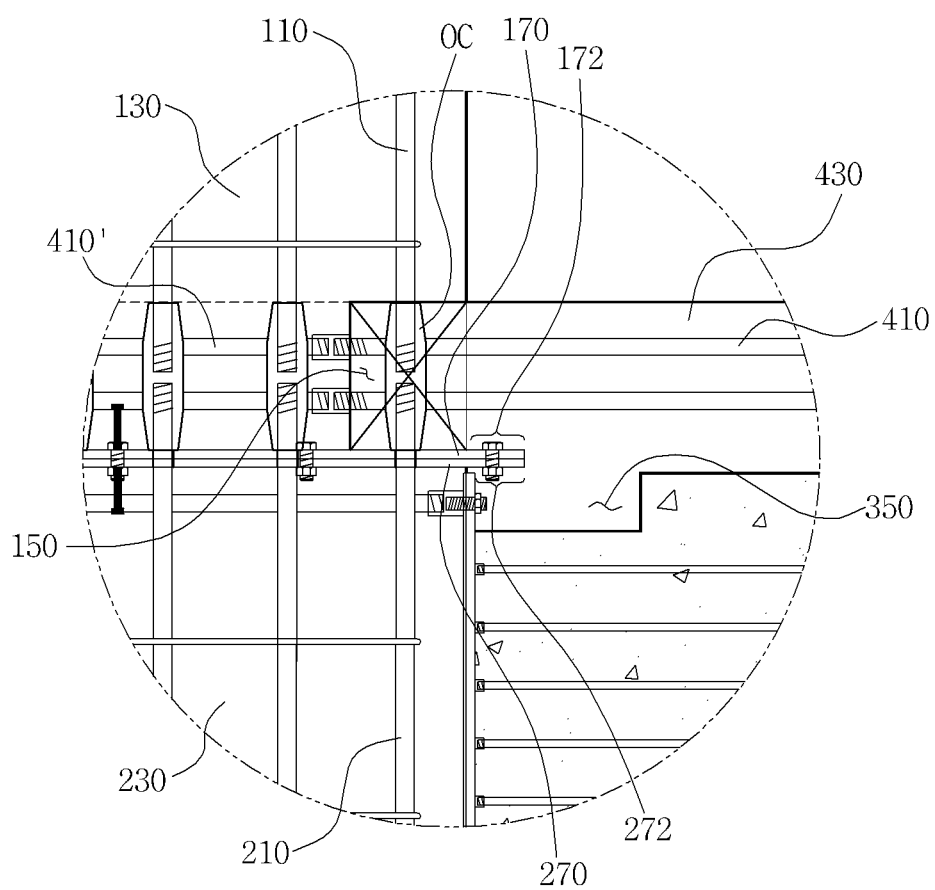


FIG. 9

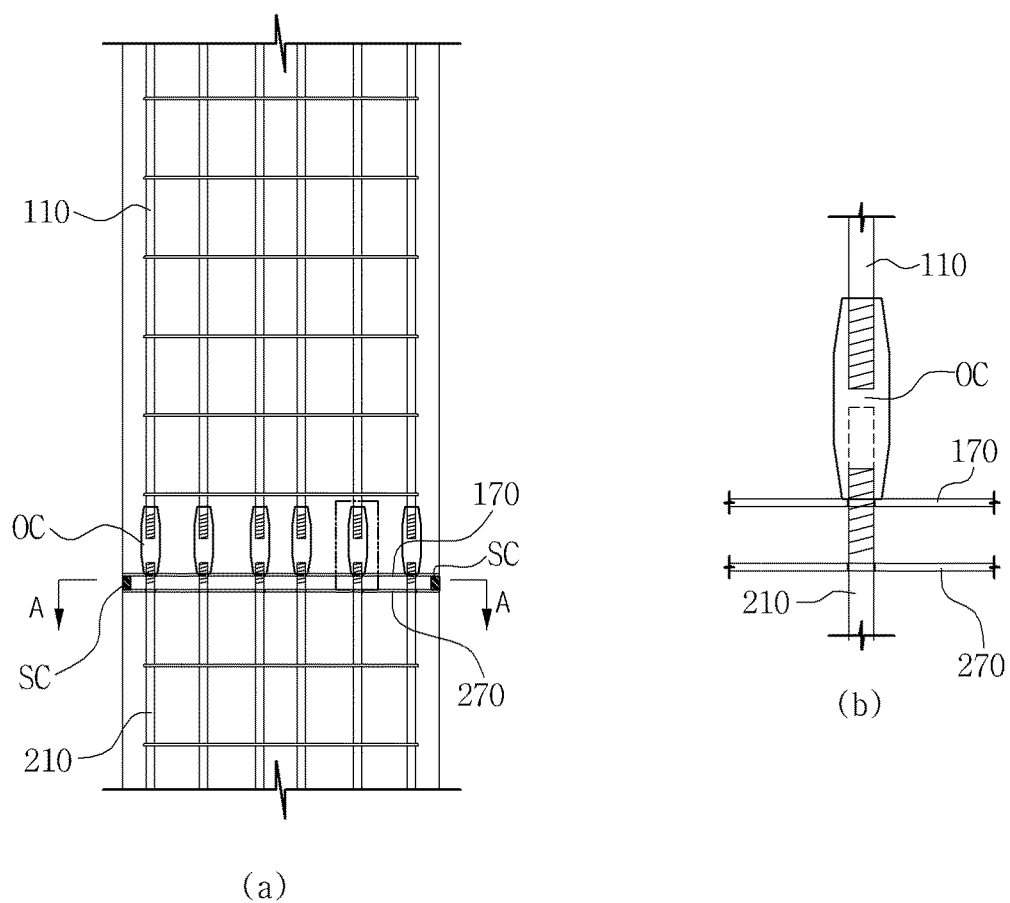


FIG. 10

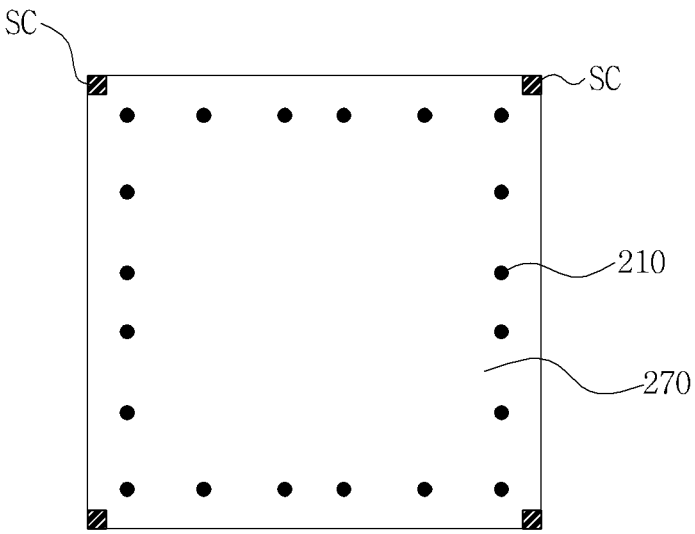


FIG. 11

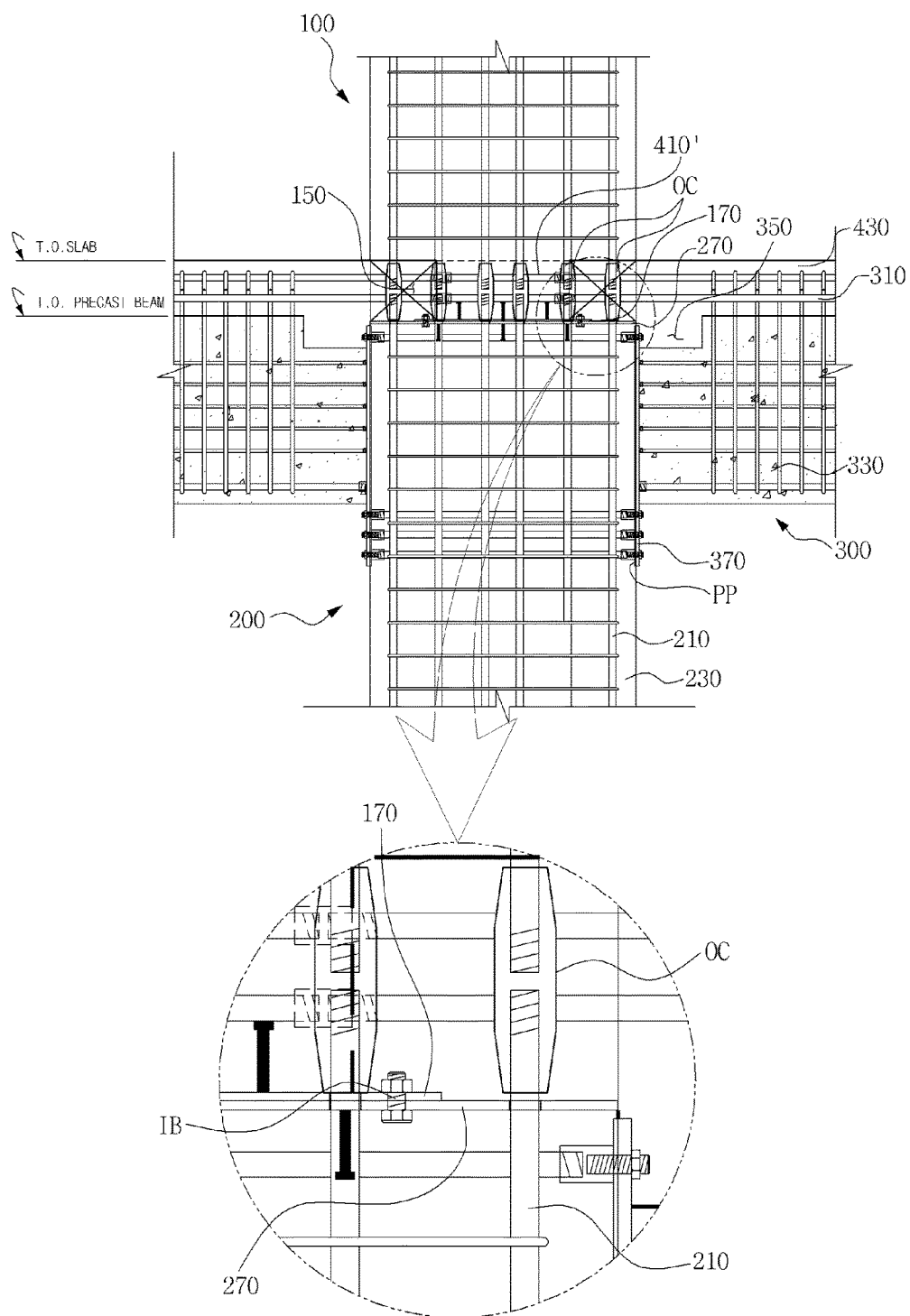


FIG. 12

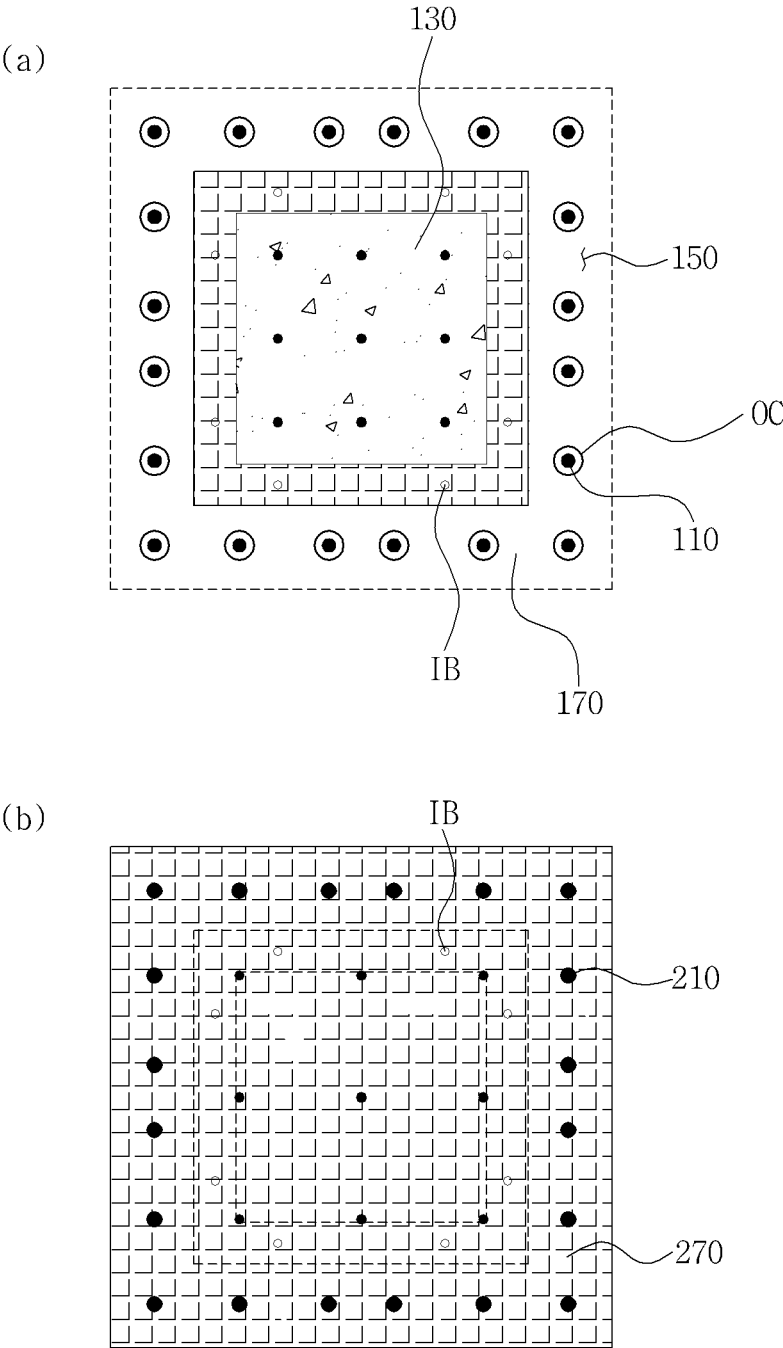


FIG. 13

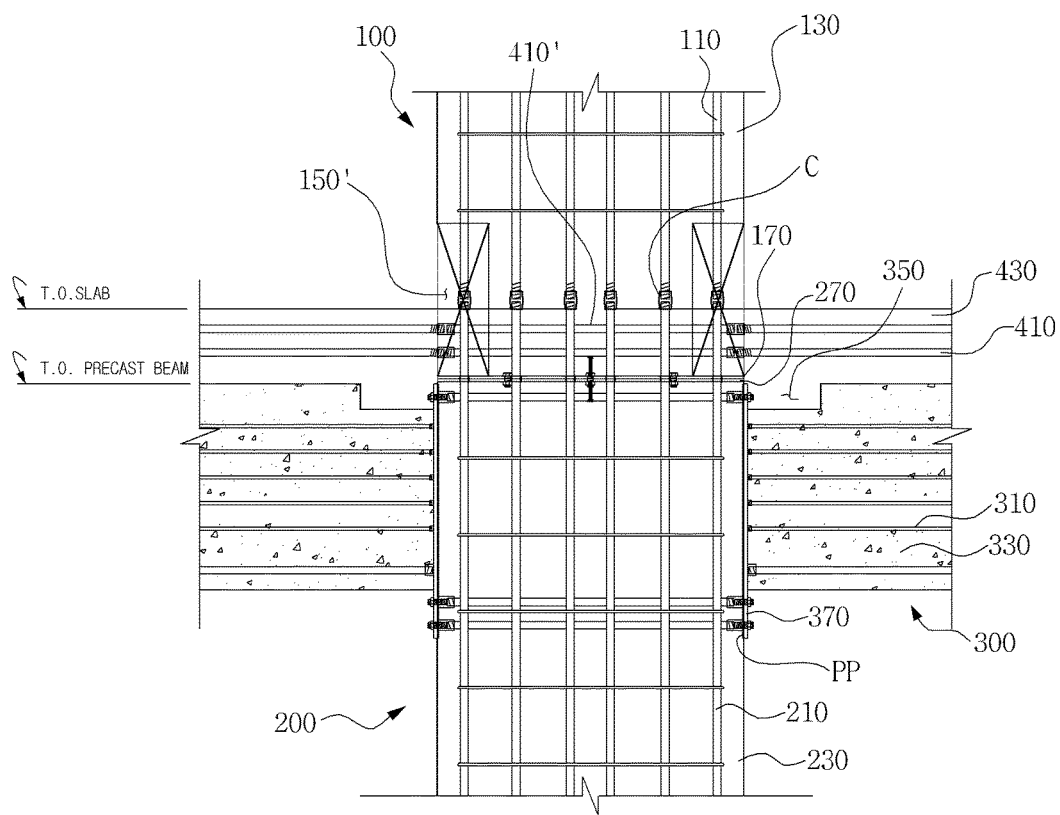


FIG. 14

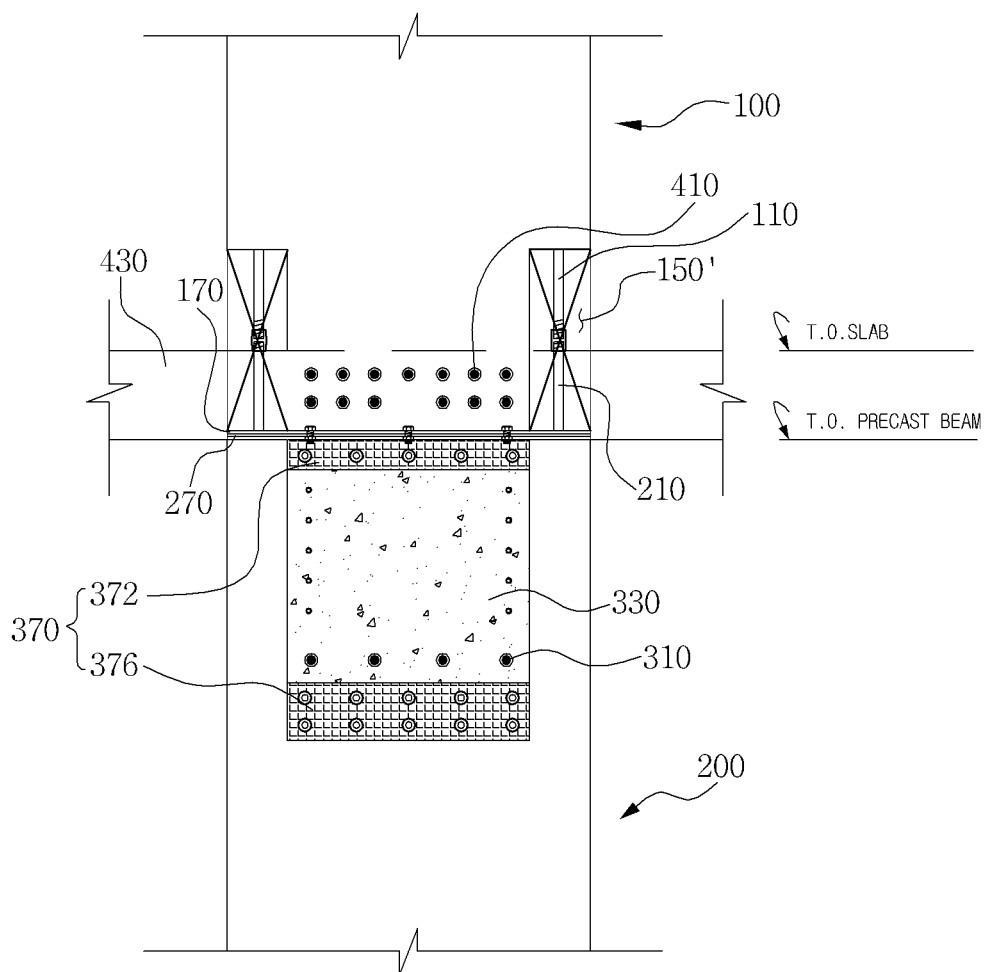


FIG. 15

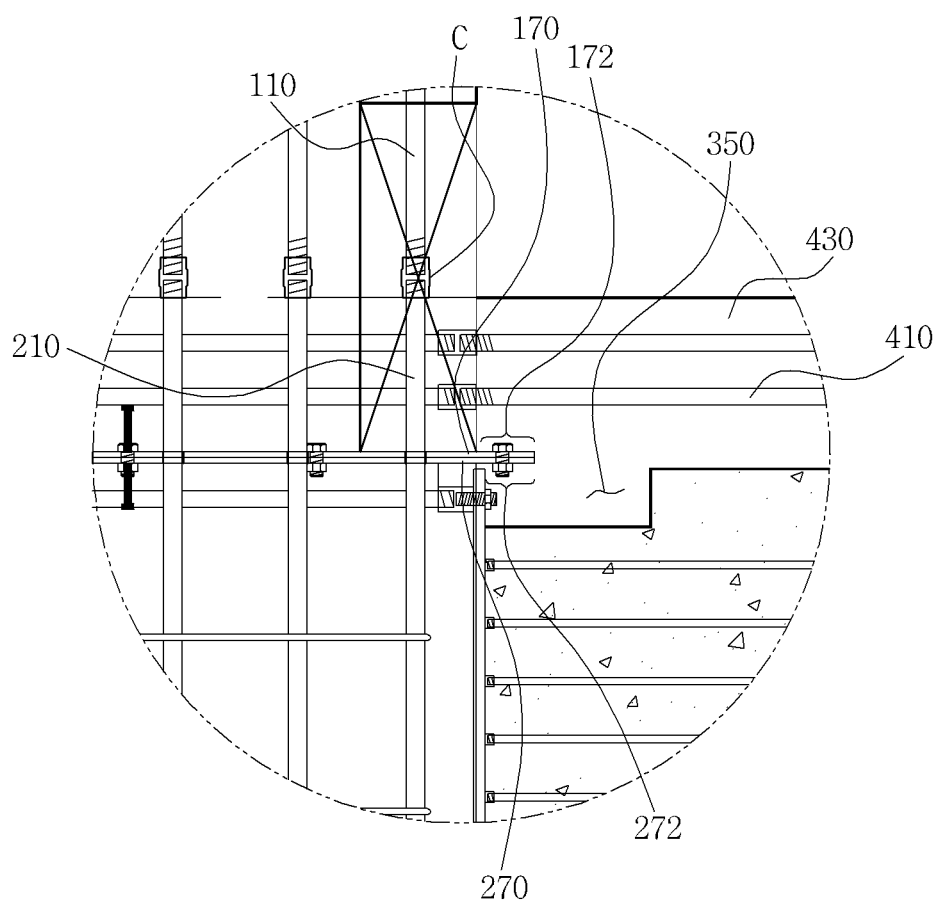


FIG. 16

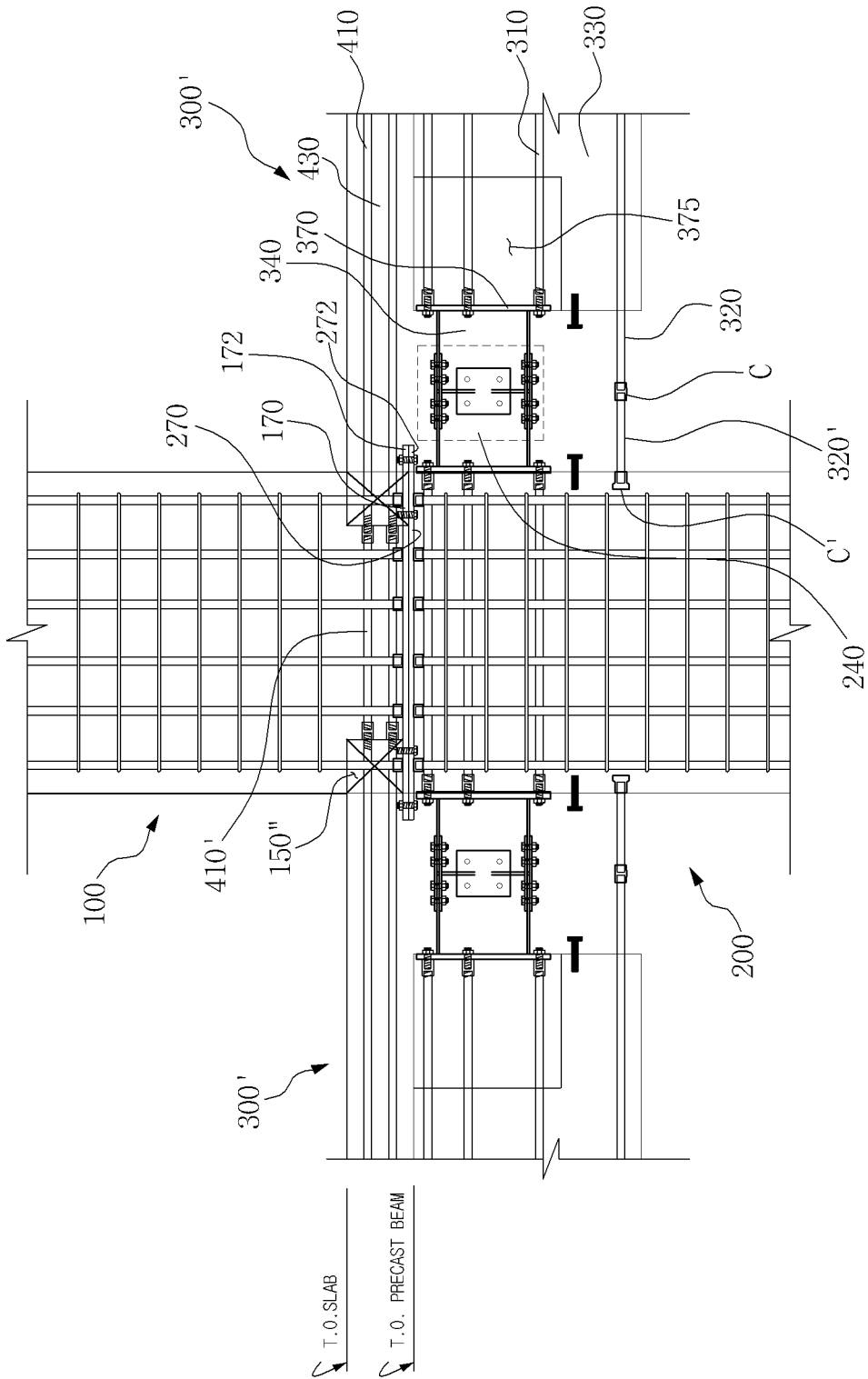


FIG. 17

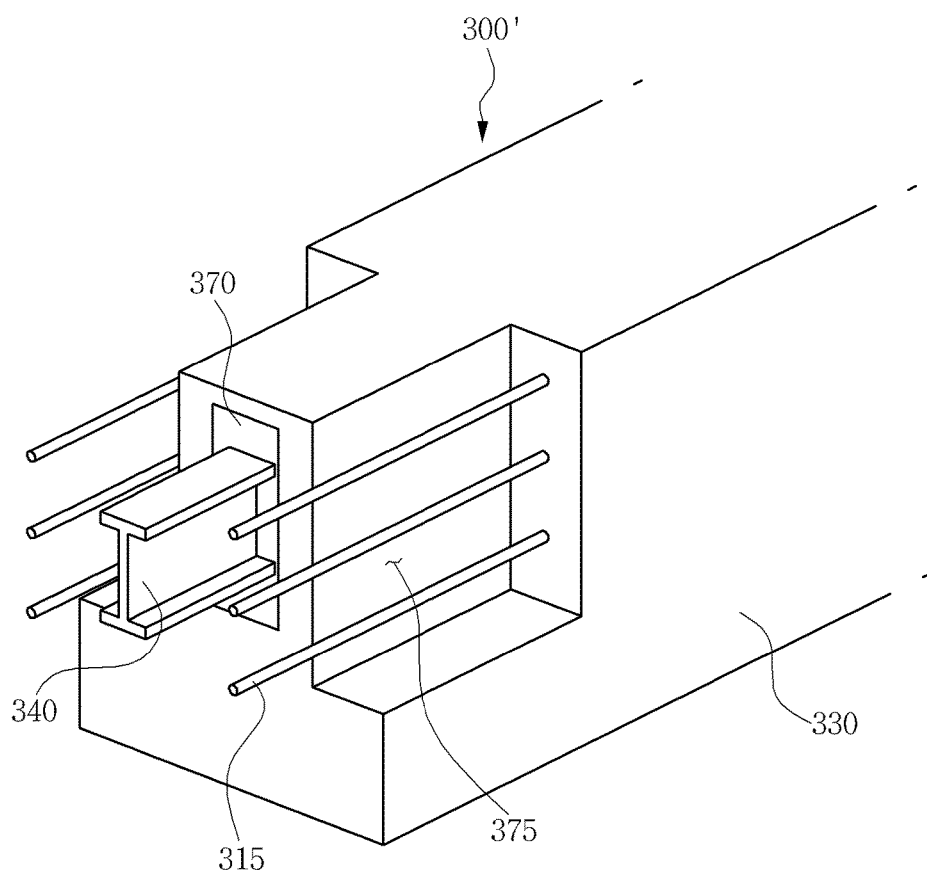


FIG. 18

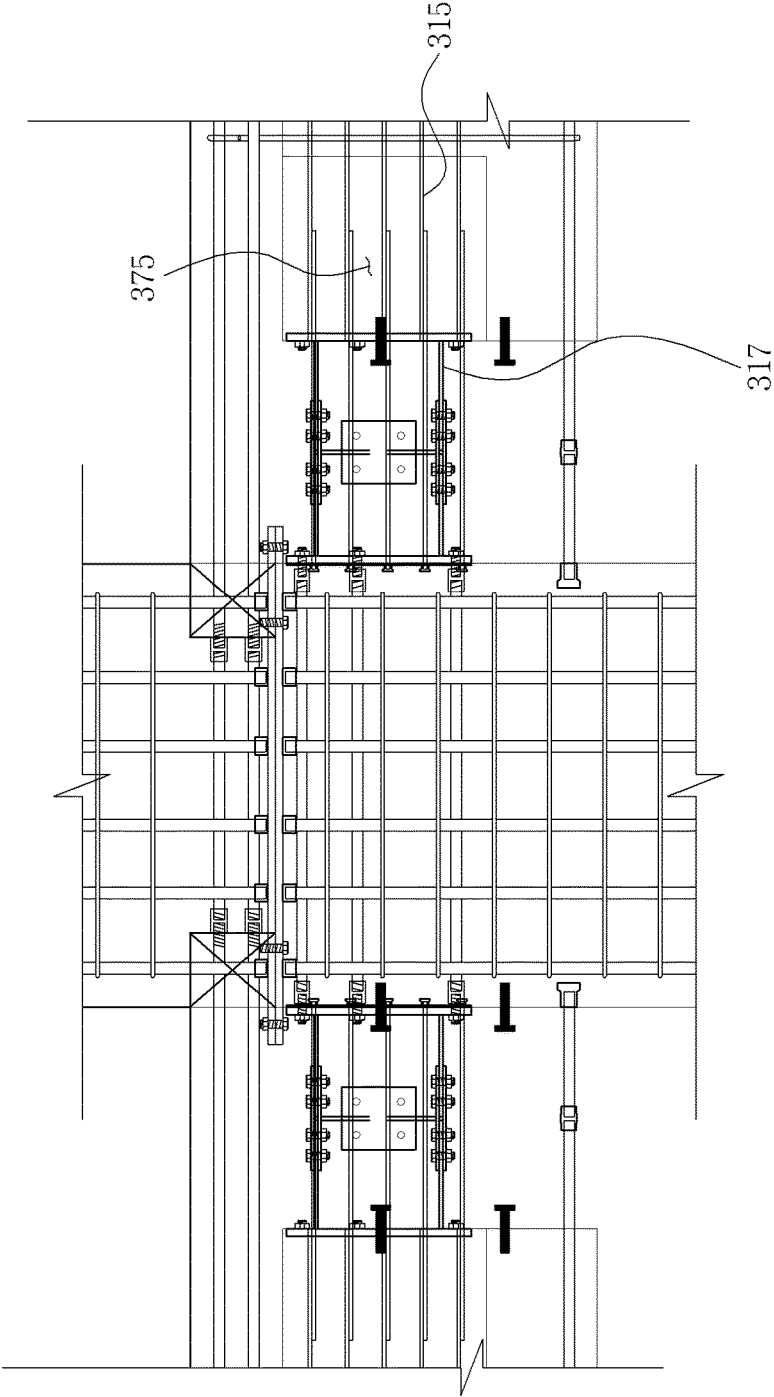
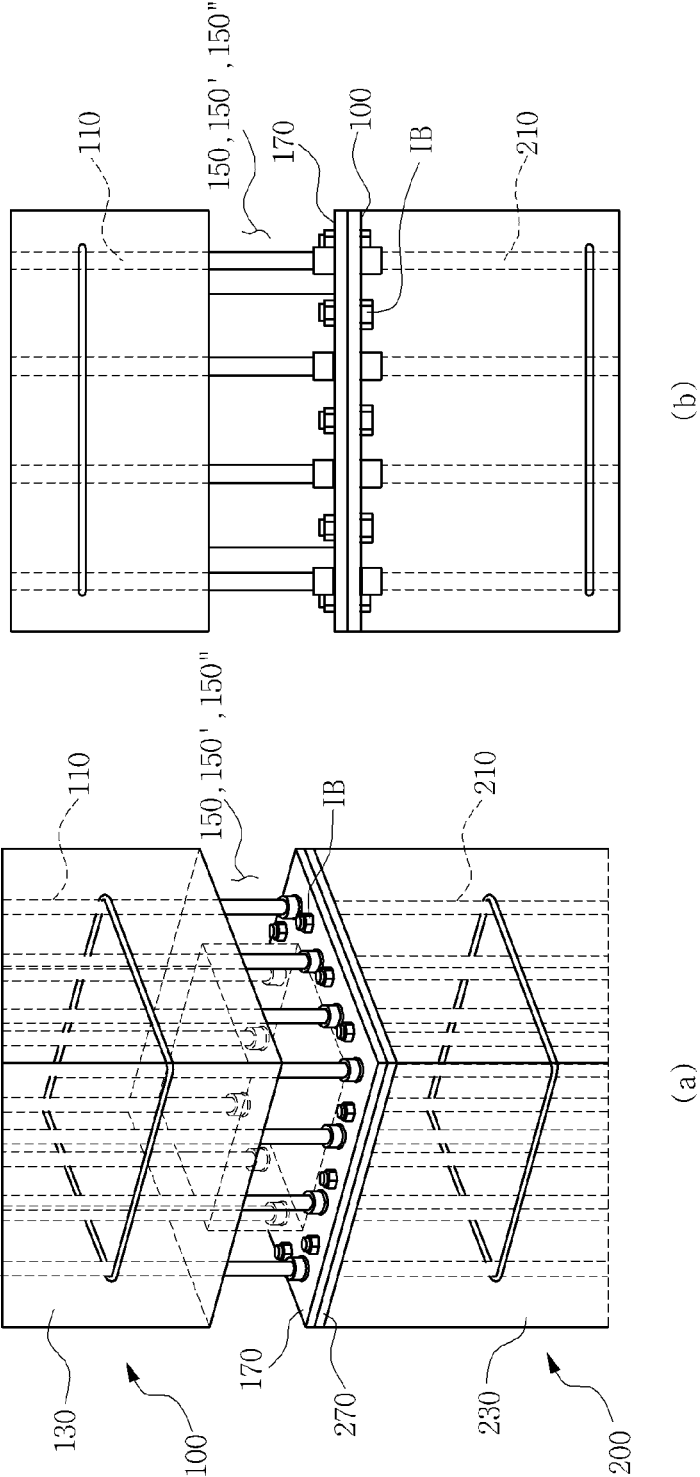


FIG. 19



**RIGID CONNECTION STRUCTURE
BETWEEN UPPER PRECAST CONCRETE
COLUMN AND LOWER PRECAST
CONCRETE COLUMN AND RIGID
CONNECTION STRUCTURE OF PRECAST
CONCRETE BEAM USING THE SAME**

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a rigid connection structure between an upper precast concrete column and a lower precast concrete column and a rigid connection structure of a precast concrete beam using the same that improve a column-column connection and a column-beam connection, while performing moment connection, that is, rigid connection, in a dry construction method, thereby enhancing the constructability thereof to allow the rigid connection to be achieved only by the connection of reinforcing bars before concrete is cast on the connections.

Background of the Related Art

[0002] So as to ensure good constructability and reduce a construction period, recently, a precast concrete (hereinafter, referred to as "PC") method has been increasingly adopted.

[0003] Examples of the conventional PC method include a method for simply mounting a PC beam onto a PC column and a method for unitarily casting a PC column and a PC beam.

[0004] The method for simply mounting the PC beam onto the PC column is one of methods widely used currently, which is capable of somewhat reducing the construction period, but since a column and beam connection in the method is made through simple jointing, a moment cannot be transferred in this method when a lateral force like an earthquake is applied. Accordingly, lateral force reinforcing means like shear walls, braces and so on should be additionally located, thereby failing to provide the advantages of the PC method planned for reducing the construction period and unavoidably increasing construction cost and period.

[0005] When the PC beam is simply mounted on the PC column, further, the escape of the column-beam connection may be generated to cause safety accidents. Accordingly, the structural instability in the column-beam connection may be undesirably generated, so that the method for simply mounting the PC beam onto the PC column is limited in the use in high-rise buildings.

[0006] In case of the method for unitarily casting the PC column and the PC beam, concrete is cast on a column-beam connection, so that the construction period may be delayed by concrete curing and the structural instability in the column-beam connection may be caused during the concrete curing, thereby being limited in the use in high-rise buildings.

[0007] So as to solve the above-mentioned disadvantages of the conventional PC method, recently, many studies on a PC method with moment connection have been made, but such PC method has complicated construction details, a low economic efficiency, and bad constructability, so that it is really hard to apply the PC method to high-rise buildings.

[0008] Accordingly, the inventor has proposed a moment resisting frame in a dry construction method, while remov-

ing the installation of additional lateral force reinforcing means such as shear walls (forms and wet construction method), braces and so on.

[0009] The present invention relates to a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same wherein precast frame construction can be performed, thereby achieving the construction period and constructability similar to those required in steel frame construction, and only if even unskilled workers know a manual, safe and rapid construction can be ensured.

SUMMARY OF THE INVENTION

[0010] Accordingly, the present invention has been made in view of the above-mentioned problems occurring in the prior art, and it is an object of the present invention to provide to a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same that improve a column-column connection and a column-beam connection, while performing moment connection, that is, rigid connection, in a dry construction method, thereby enhancing the constructability thereof to allow the rigid connection to be achieved only by the connection of reinforcing bars before concrete is cast on the connections.

[0011] To accomplish the above-mentioned object, according to a first aspect of the present invention, there is provided a rigid connection structure between an upper PC column and a lower PC column, including: the lower PC column having lower column concrete, a lower column plate disposed on top of the lower column concrete, and a plurality of lower column reinforcing bars buriedly arranged vertically in the interior of the lower column concrete to maintain the cover thickness of concrete and having upper ends penetrated into the lower column plate in such a manner as to be exposed to the outside; and the upper PC column having upper column concrete, an upper column plate disposed on top of the upper column concrete, and a plurality of upper column reinforcing bars buriedly arranged vertically in the interior of the upper column concrete to maintain the cover thickness of concrete and having lower ends penetrated into the upper column plate in such a manner as to be exposed to the outside, wherein the upper column concrete on a portion where the upper column reinforcing bars are exposed forms a box out, without having any contact with the upper column plate, and if the upper ends of the lower column reinforcing bars are penetrated into the upper column plate and are exposed to the outside, the upper column reinforcing bars and the lower column reinforcing bars are connected to each other in the box out.

[0012] To accomplish the above-mentioned object, according to a second aspect of the present invention, there is provided a rigid connection structure between an upper PC column and a lower PC column, including: the lower PC column having lower column concrete, a lower column plate disposed on top of the lower column concrete, and a plurality of lower column reinforcing bars buriedly arranged vertically in the interior of the lower column concrete to maintain the cover thickness of concrete and having upper ends penetrated into the lower column plate in such a manner as to be exposed to the outside; and the upper PC column having upper column concrete, an upper column plate disposed on top of the upper column concrete, and a plurality of upper column reinforcing bars buriedly arranged

vertically in the interior of the upper column concrete to maintain the cover thickness of concrete and having lower ends penetrated into the upper column plate in such a manner as to be exposed to the outside, wherein the upper column concrete on a portion where the upper column reinforcing bars are exposed forms a box out, the lengths of the sides of the upper column plate are shorter than the lengths of the sides of the lower column plate, and the upper column plate and the lower column plate are coupled to each other by means of internal bolts, so that if the upper ends of the lower column reinforcing bars are penetrated into the lower column plate and then exposed to the outside, the upper column reinforcing bars and the lower column reinforcing bars are connected to each other in the box out.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of the preferred embodiments of the invention in conjunction with the accompanying drawings, in which:

[0014] FIG. 1 is a front sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a first embodiment of the present invention;

[0015] FIG. 2 is a sectional view taken along the line A-A of FIG. 1;

[0016] FIG. 3 is a sectional view taken along the line B-B of FIG. 1;

[0017] FIG. 4 is an enlarged view of FIG. 1;

[0018] FIG. 5 is a sectional view taken along the line D-D of FIG. 1;

[0019] FIG. 6 is top views showing an upper column plate and a lower column plate of FIG. 1;

[0020] FIG. 7 is a perspective view of FIG. 1;

[0021] FIG. 8 is an enlarged sectional view showing another example of FIG. 1;

[0022] FIG. 9 is sectional views showing the construction example using support chips in FIG. 1;

[0023] FIG. 10 is a sectional view taken along the line A-A of (a) of FIG. 9;

[0024] FIG. 11 is an enlarged front sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a second embodiment of the present invention;

[0025] FIG. 12 is top views showing an upper column plate and a lower column plate of FIG. 11;

[0026] FIG. 13 is a front sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a third embodiment of the present invention;

[0027] FIG. 14 is a side sectional view of FIG. 13;

[0028] FIG. 15 is a sectional view showing another example of FIG. 13;

[0029] FIG. 16 is a sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a fourth embodiment of the present invention;

[0030] FIG. 17 is a perspective view showing the PC beam of FIG. 16;

[0031] FIG. 18 is an enlarged view of FIG. 16; and

[0032] FIG. 19 is perspective and sectional views showing the use examples of internal bolts in the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] Hereinafter, an explanation on a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to the present invention will be in detail given with reference to the attached drawing.

[0034] I. Rigid Connection Structure Between an Upper PC Column and a Lower PC Column and Rigid Connection Structure of a PC Beam Using the Same

[0035] FIG. 1 is a front sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a first embodiment of the present invention, FIG. 2 is a sectional view taken along the line A-A of FIG. 1, and FIG. 3 is a sectional view taken along the line B-B of FIG. 1.

[0036] FIG. 4 is an enlarged view of FIG. 1, FIG. 5 is a sectional view taken along the line D-D of FIG. 1, and (a) and (b) of FIG. 6 are top views showing an upper column plate and a lower column plate of FIG. 1.

[0037] FIG. 7 is a perspective view of FIG. 1.

[0038] A rigid connection structure between an upper PC column 100 and a lower PC column 200 according to a first embodiment of the present invention includes: the lower PC column 200 having column concrete 230, a lower column plate 270 disposed on top of the column concrete 230, and a plurality of lower column reinforcing bars 210 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having upper ends penetrated into the lower column plate 270 in such a manner as to be exposed to the outside; and the upper PC column 100 having column concrete 130, an upper column plate 170 disposed on top of the column concrete 130, and a plurality of upper column reinforcing bars 110 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having lower ends penetrated into the upper column plate 170 in such a manner as to be exposed to the outside, wherein the column concrete 130 on a portion where the upper column reinforcing bars 110 are exposed forms a box out 150, without having any contact with the upper column plate 170, and if the upper ends of the lower column reinforcing bars 210 are penetrated into the upper column plate 170 and are exposed to the outside, the upper column reinforcing bars 110 and the lower column reinforcing bars 210 are connected to each other in the box out 150.

[0039] Further, as shown in FIG. 1, the lower ends of the upper column reinforcing bars 110 are coupled to the upper ends of one touch couplers OC performing one touch fastening only by means of the insertion of reinforcing bars thereinto, unlike typical couplers, and the upper ends of the lower column reinforcing bars 210 exposed to the outside after penetrated into the upper column plate 170 are coupled to the lower ends of the one touch couplers OC, so that the upper column reinforcing bars 110 and the lower column reinforcing bars 210 are connected to each other.

[0040] (a) and (b) of FIG. 9 are sectional views showing the construction example using support chips in FIG. 1, and FIG. 10 is a sectional view taken along the line A-A of (a) of FIG. 9.

[0041] According to the present invention, as shown in FIGS. 9 and 10, when the upper PC column 100 is lifted and disposed on top of the lower PC column 200, support chips SC are previously mounted on top of the lower column plate 270, so that after the lower column reinforcing bars 210 are penetrated into the upper column plate 170, the underside of the upper column plate 170 is mounted onto tops of the support chips SC, and after it is checked that the center lines of the lower column reinforcing bars 210 correspond to the center lines of the upper column reinforcing bars 110, the upper PC column 100 is descended, while the support chips SC are being removed.

[0042] FIG. 8 is an enlarged view showing another example of FIG. 1.

[0043] As shown in FIG. 8, the lower column plate 270 and the upper column plate 170 have protruding portions 272 and 172 extended from the side surfaces thereof, so that the protruding portions 272 of the lower column plate 270 are coupled to the protruding portions 172 of the upper column plate 170 by means of bolts and nuts.

[0044] (a) and (b) of FIG. 19 are perspective and sectional views showing the use examples of internal bolts in the present invention.

[0045] As shown in (a) and (b) of FIG. 19, the lower column plate 270 has internal bolts IB protruding from top thereof in such a manner as to be penetrated into the upper column plate 170 and then fastened in the box out 150.

[0046] As shown in FIG. 1, a rigid connection structure of a PC beam 300 using the rigid connection structure between the upper PC column 100 and the lower PC column 200 according to the first embodiment of the present invention includes: the PC beam 300 having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, and a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 thereinto, wherein the beam plate 370 is coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0047] Further, as shown in FIG. 4, when the beam upper reinforcing bars 410 are coupled to the side of the column concrete 130, the column concrete 130 has connection reinforcing bars 410' in advance buried thereinto in such a manner as to be coupled to couplers, so that the beam upper reinforcing bars 410 are coupled to the couplers coupled to the connection reinforcing bars 410'.

[0048] As shown in FIG. 3, a level down portion 350 is formed on the upper end of the beam concrete 350 coming into contact with the beam plate 370, so that the upper end of the beam plate 370 is exposed to form an exposed upper plate 372, and the lower end of the beam plate 370 is extended downwardly from the lower end of the beam concrete 330 to form an exposed lower plate 376, so that the

exposed upper plate 372 and the exposed lower plate 376 are coupled to the column concrete 230 by means of bolts.

[0049] FIG. 16 is a sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a fourth embodiment of the present invention, FIG. 17 is a perspective view showing the PC beam of FIG. 16, and FIG. 18 is an enlarged view of FIG. 16.

[0050] Referring analogically to the PC beam of FIG. 16, a rigid connection structure of a PC beam 300' using the rigid connection structure between the upper PC column 100 and the lower PC column 200 according to the present invention includes: the PC beam 300' having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370, and a beam bracket 340 having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300'; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 thereinto, wherein the beam bracket 340 is coupled to a column bracket 240 coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0051] Further, as shown in FIG. 17, the beam plate 370 is located on the center of the side surface of the beam concrete 330, and the beam concrete 330 on both sides of the beam plate 370 forms a setback portion 375.

[0052] Furthermore, as shown in FIG. 18, beam protruding reinforcing bars 315 protrude from the beam concrete 330 toward the setback portion 375 in such a manner as to be lap-spliced with column connection reinforcing bars 317 disposed on the lower PC column 200.

[0053] Moreover, as shown in FIG. 16, a beam lower reinforcing bar 320 protrudes from the side of the lower portion of the beam concrete 330 in such a manner as to be connected to a connection reinforcing bar 320' disposed on the side of the lower PC column 200, and the connection reinforcing bar 320' has one end coupled to the side of the column concrete 230 by means of a buried coupler C' and the other end coupled to the beam lower reinforcing bar 320 by means of a coupler C.

[0054] FIG. 11 is an enlarged front sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a second embodiment of the present invention, and (a) and (b) of FIG. 12 are top views showing an upper column plate and a lower column plate of FIG. 11.

[0055] As shown in FIG. 11, a rigid connection structure between an upper PC column 100 and a lower PC column 200 according to the second embodiment of the present invention includes: the lower PC column 200 having column concrete 230, a lower column plate 270 disposed on top of the column concrete 230, and a plurality of lower column reinforcing bars 210 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having upper ends penetrated into the lower column plate 270 in such a manner as to be

exposed to the outside; and the upper PC column 100 having column concrete 130, an upper column plate 170 disposed on top of the column concrete 130, and a plurality of upper column reinforcing bars 110 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having lower ends penetrated into the upper column plate 170 in such a manner as to be exposed to the outside, wherein the column concrete 130 on a portion where the upper column reinforcing bars 110 are exposed forms a box out 150, the lengths of the sides of the upper column plate 170 are shorter than those of the lower column plate 270, and the upper column plate 170 and the lower column plate 270 are coupled to each other by means of internal bolts IB, so that if the upper ends of the lower column reinforcing bars 210 are penetrated into the lower column plate 270 and then exposed to the outside, the upper column reinforcing bars 110 and the lower column reinforcing bars 210 are connected to each other in the box out 150.

[0056] Further, the lower ends of the upper column reinforcing bars 110 are coupled to the upper ends of one touch couplers OC, and the upper ends of the lower column reinforcing bars 210 are coupled to the lower ends of the one touch couplers OC, so that the upper column reinforcing bars 110 and the lower column reinforcing bars 210 are connected to each other.

[0057] Referring analogically to FIGS. 9 and 10, when the upper PC column 100 is lifted and disposed on top of the lower PC column 200, the support chips SC are previously mounted on top of the lower column plate 270, so that the underside of the upper column plate 170 is mounted onto tops of the support chips SC, and after it is checked that the center lines of the lower column reinforcing bars 210 correspond to the center lines of the upper column reinforcing bars 110, the upper PC column 100 is descended, while the support chips SC are being removed.

[0058] According to the second embodiment of the present invention, a rigid connection structure of a PC beam 300 using the rigid connection structure between the upper PC column 100 and the lower PC column 200 includes: the PC beam 300 having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, and a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 therein, wherein the beam plate 370 is coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0059] Further, when the beam upper reinforcing bars 410 are coupled to the side of the column concrete 130, the column concrete 130 has connection reinforcing bars 410' in advance buried therein in such a manner as to be coupled to couplers, so that the beam upper reinforcing bars 410 are coupled to the couplers coupled to the connection reinforcing bars 410'.

[0060] According to the second embodiment of the present invention, a level down portion 350 is formed on the upper end of the beam concrete 350 coming into contact with the beam plate 370, so that the upper end of the beam plate 370

is exposed to form an exposed upper plate 372, and the lower end of the beam plate 370 is extended downwardly from the lower end of the beam concrete 330 to form an exposed lower plate 376, so that the exposed upper plate 372 and the exposed lower plate 376 are coupled to the column concrete 230 by means of bolts.

[0061] Referring analogically to FIG. 16, the rigid connection structure of the PC beam 300 using the rigid connection structure between the upper PC column 100 and the lower PC column 200 according to the present invention includes: the PC beam 300' having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370, and a beam bracket 340 having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300'; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 therein, wherein the beam bracket 340 is coupled to the column bracket 240 coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0062] Referring analogically to FIG. 17, the beam plate 370 is located on the center of the side surface of the beam concrete 330, and the beam concrete 330 on both sides of the beam plate 370 forms the setback portion 375.

[0063] Referring analogically to FIG. 18, beam protruding reinforcing bars 315 protrude from the beam concrete 330 toward the setback portion 375 in such a manner as to be lap-spliced with column connection reinforcing bars 317 disposed on the lower PC column 200.

[0064] Moreover, a beam lower reinforcing bar 320 protrudes from the side of the lower portion of the beam concrete 330 in such a manner as to be connected to a connection reinforcing bar 320' disposed on the side of the lower PC column 200, and the connection reinforcing bar 320' has one end coupled to the side of the column concrete 230 by means of a buried coupler C' and the other end coupled to the beam lower reinforcing bar 320 by means of a coupler C.

[0065] II. Rigid Connection Structure Between an Upper PC Column and a Lower PC Column and Rigid Connection Structure of a PC Beam Using the Same

[0066] FIG. 13 is a sectional view showing a rigid connection structure between an upper PC column and a lower PC column and a rigid connection structure of a PC beam using the same according to a third embodiment of the present invention, FIG. 14 is a side sectional view of FIG. 13, and FIG. 15 is a sectional view showing another example of FIG. 13.

[0067] A rigid connection structure between an upper PC column 100 and a lower PC column 200 according to a third embodiment of the present invention includes: the lower PC column 200 having column concrete 230, a lower column plate 270 disposed on top of the column concrete 230, and a plurality of lower column reinforcing bars 210 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having upper ends penetrated into the lower column plate 270 in such a manner as to be exposed to the outside; and the upper PC

column 100 having column concrete 130, an upper column plate 170 disposed on top of the column concrete 130, and a plurality of upper column reinforcing bars 110 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having lower ends penetrated into the upper column plate 170 in such a manner as to be exposed to the outside, wherein the column concrete 130 on a portion where the upper column reinforcing bars 110 are exposed forms a box out 150', without having any contact with the upper column plate 170, and if the upper ends of the lower column reinforcing bars 210 are penetrated into the upper column plate 170 and are then exposed to the outside, the upper ends of couplers C are coupled to the lower ends of the upper column reinforcing bars 110 in the box out 150', while the upper ends of the lower column reinforcing bars 210 exposed to the outside after penetrated into the upper column plate 170 are coupled to the lower ends of the couplers C, thereby connecting the upper column reinforcing bars 110 and the lower column reinforcing bars 210 to each other.

[0068] Referring analogically to FIGS. 9 and 10, when the upper PC column 100 is lifted and disposed on top of the lower PC column 200, support chips SC are previously mounted on top of the lower column plate 270, so that after the lower column reinforcing bars 210 are penetrated into the upper column plate 170, the underside of the upper column plate 170 is mounted onto tops of the support chips SC, and after it is checked that the center lines of the lower column reinforcing bars 210 correspond to the center lines of the upper column reinforcing bars 110, the upper PC column 100 is descended, while the support chips SC are being removed.

[0069] Referring analogically to (a) and (b) of FIG. 19, the lower column plate 270 has internal bolts IB protruding from top thereof in such a manner as to be penetrated into the upper column plate 170 and then fastened in the box out 150'.

[0070] A rigid connection structure of a PC beam 300 using the rigid connection structure between the upper PC column 100 and the lower PC column 200 according to the third embodiment of the present invention includes: the PC beam 300 having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, and a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 therein, wherein the beam plate 370 is coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150' and is then coupled to the side of the column concrete 130.

[0071] Further, when the beam upper reinforcing bars 410 are coupled to the side of the column concrete 130, the column concrete 130 has connection reinforcing bars 410' in advance buried therein in such a manner as to be coupled to couplers, so that the beam upper reinforcing bars 410 are coupled to the couplers coupled to the connection reinforcing bars 410'.

[0072] Furthermore, a level down portion 350 is formed on the upper end of the beam concrete 350 coming into

contact with the beam plate 370, so that the upper end of the beam plate 370 is exposed to form an exposed upper plate 372, and the lower end of the beam plate 370 is extended downwardly from the lower end of the beam concrete 330 to form an exposed lower plate 376, so that the exposed upper plate 372 and the exposed lower plate 376 are coupled to the column concrete 230 by means of bolts.

[0073] As shown in FIG. 15, the lower column plate 270 and the upper column plate 170 have protruding portions 272 and 172 extended from the side surfaces thereof, so that the protruding portions 272 of the lower column plate 270 are coupled to the protruding portions 172 of the upper column plate 170 by means of bolts and nuts.

[0074] Referring analogically to FIG. 16, the rigid connection structure of the PC beam 300' using the rigid connection structure between the upper PC column 100 and the lower PC column 200 according to the present invention includes: the PC beam 300' having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370, and a beam bracket 340 having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300'; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 therein, wherein the beam bracket 340 is coupled to a column bracket 240 coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0075] Referring analogically to FIG. 17, the beam plate 370 is located on the center of the side surface of the beam concrete 330, and the beam concrete 330 on both sides of the beam plate 370 forms a setback portion 375.

[0076] Referring analogically to FIG. 18, furthermore, beam protruding reinforcing bars 315 protrude from the beam concrete 330 toward the setback portion 375 in such a manner as to be lap-spliced with column connection reinforcing bars 317 disposed on the lower PC column 200.

[0077] Referring analogically to FIG. 11, the lengths of the sides of the upper column plate 170 are shorter than those of the lower column plate 270, and the upper column plate 170 and the lower column plate 270 are coupled to each other by means of internal bolts IB, so that if the upper ends of the lower column reinforcing bars 210 are penetrated into the lower column plate 270 and then exposed to the outside, the upper column reinforcing bars 110 and the lower column reinforcing bars 210 are connected to each other in the box out 150.

[0078] As mentioned above, moreover, the beam lower reinforcing bar 320 protrudes from the side of the lower portion of the beam concrete 330 in such a manner as to be connected to the connection reinforcing bar 320' disposed on the side of the lower PC column 200, and the connection reinforcing bar 320' has one end coupled to the side of the column concrete 230 by means of the buried coupler C' and the other end coupled to the beam lower reinforcing bar 320 by means of the coupler C.

[0079] FIG. 16 is a sectional view showing the rigid connection structure between an upper PC column and a lower PC column and the rigid connection structure of a PC

beam using the same according to a fourth embodiment of the present invention, FIG. 17 is a perspective view showing the PC beam of FIG. 16, and FIG. 18 is an enlarged view of FIG. 16.

[0080] (a) and (b) of FIG. 19 are perspective and sectional views showing the use examples of internal bolts in the present invention.

[0081] A rigid connection structure between an upper PC column 100 and a lower PC column 200 according to the third embodiment of the present invention includes: the lower PC column 200 having column concrete 230, a lower column plate 270 disposed on top of the column concrete 230, and a plurality of lower column reinforcing bars 210 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having upper ends penetrated into the lower column plate 270 in such a manner as to be exposed to the outside; and the upper PC column 100 having column concrete 130, an upper column plate 170 disposed on top of the column concrete 130, and a plurality of upper column reinforcing bars 110 buriedly arranged vertically in the interior of the column concrete 230 to maintain the cover thickness of concrete and having lower ends penetrated into the upper column plate 170 in such a manner as to be exposed to the outside, wherein the column concrete 130 on a portion where the upper column reinforcing bars 110 are exposed forms a box out 150", without having any contact with the upper column plate 170, and the lower column plate 270 and the upper column plate 170 have protruding portions 272 and 172 extended from the side surfaces thereof, so that the protruding portions 272 of the lower column plate 270 are coupled to the protruding portions 172 of the upper column plate 170 by means of bolts and nuts.

[0082] Referring analogically to FIGS. 9 and 10, when the upper PC column 100 is lifted and disposed on top of the lower PC column 200, support chips SC are previously mounted on top of the lower column plate 270, so that the underside of the upper column plate 170 is mounted onto tops of the support chips SC, and the upper PC column 100 is descended, while the support chips SC are being removed.

[0083] The rigid connection structure of the PC beam 300' using the rigid connection structure between the upper PC column 100 and the lower PC column 200 according to the third embodiment of the present invention includes: the PC beam 300' having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370, and a beam bracket 340 having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300'; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 thereinto, wherein the beam bracket 340 is coupled to a column bracket 240 coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0084] Further, when the beam upper reinforcing bars 410 are coupled to the side of the column concrete 130, the column concrete 130 has connection reinforcing bars 410' in advance buried thereinto in such a manner as to be coupled

to couplers, so that the beam upper reinforcing bars 410 are coupled to the couplers coupled to the connection reinforcing bars 410'.

[0085] Furthermore, a beam lower reinforcing bar 320 protrudes from the side of the lower portion of the beam concrete 330 in such a manner as to be connected to a connection reinforcing bar 320' disposed on the side of the lower PC column 200.

[0086] The connection reinforcing bar 320' has one end coupled to the side of the column concrete 230 by means of a buried coupler C' and the other end coupled to the beam lower reinforcing bar 320 by means of a coupler C.

[0087] Further, as shown in FIG. 17, the beam plate 370 is located on the center of the side surface of the beam concrete 330, and the beam concrete 330 on both sides of the beam plate 370 forms a setback portion 375.

[0088] Furthermore, as shown in FIG. 18, beam protruding reinforcing bars 315 protrude from the beam concrete 330 toward the setback portion 375 in such a manner as to be lap-spliced with column connection reinforcing bars 317 disposed on the lower PC column 200.

[0089] As shown in (a) and (b) of FIG. 19, the lower column plate 270 has internal bolts IB protruding from top thereof in such a manner as to be penetrated into the upper column plate 170 and then fastened in the box out 150.

[0090] Referring analogically to FIG. 1, the rigid connection structure of the PC beam 300 using the rigid connection structure between the upper PC column 100 and the lower PC column 200 having the plates according to the present invention includes: the PC beam 300 having beam concrete 330, a beam plate 370 disposed on the side of the beam concrete 330, and a plurality of beam reinforcing bars 310 buriedly arranged vertically in the interior of the beam concrete 330 to maintain the cover thickness of concrete and each having one end connected to the beam plate 370; beam upper reinforcing bars 410 arranged horizontally above the PC beam 300; and slab concrete 430 adapted to be cast on the beam upper reinforcing bars 410 to bury the beam upper reinforcing bars 410 thereinto, wherein the beam plate 370 is coupled to the side of the column concrete 230 of the lower PC column 200, and one end of each beam upper reinforcing bar 410 passes through the box out 150 and is then coupled to the side of the column concrete 130.

[0091] Further, when the beam upper reinforcing bars 410 are coupled to the side of the column concrete 130, the column concrete 130 has connection reinforcing bars 410' in advance buried thereinto in such a manner as to be coupled to couplers, so that the beam upper reinforcing bars 410 are coupled to the couplers coupled to the connection reinforcing bars 410', and a level down portion 350 is formed on the upper end of the beam concrete 350 coming into contact with the beam plate 370, so that the upper end of the beam plate 370 is exposed to form an exposed upper plate 372, and the lower end of the beam plate 370 is extended downwardly from the lower end of the beam concrete 330 to form an exposed lower plate 376, thereby coupling the exposed upper plate 372 and the exposed lower plate 376 to the column concrete 230 by means of bolts.

[0092] As shown in (a) and (b) of FIG. 19, the formation of the protruding portions 272 and 172 may be eliminated.

[0093] As described above, the rigid connection structure between the upper PC column and the lower PC column and the rigid connection structure of the PC beam using the same according to the present invention that improve the column-

column connection and the column-beam connection, while performing moment connection, that is, rigid connection, in a dry construction method, thereby enhancing the constructability thereof to allow the rigid connection to be achieved only by the connection of the reinforcing bars before concrete is cast on the connections.

[0094] While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

1. A rigid connection structure between an upper precast concrete column and a lower precast concrete column, comprising:

- a lower column plate disposed on an end of the lower precast concrete column,
- a plurality of lower column reinforcing bars in an interior of the lower precast concrete column and having ends penetrating through the lower column plate to be outside of the lower precast concrete column;
- an upper column plate disposed on an end of the upper precast concrete column,
- a plurality of upper column reinforcing bars in an interior of the upper precast concrete column and having ends penetrating through the upper column plate to be outside of the upper precast concrete column, and
- a box out comprising ends of the upper column reinforcing bars and in which the upper precast concrete column does not contact the upper column plate and the upper column reinforcing bars and the lower column reinforcing bars are connected to each other.

2. The rigid connection structure according to claim 1, wherein the ends of the upper column reinforcing bars are coupled to upper ends of one touch couplers, and the ends of the lower column reinforcing bars are coupled to lower ends of the one touch couplers, so that the upper column reinforcing bars and the lower column reinforcing bars are connected to each other.

3. The rigid connection structure according to claim 2, further comprising support chips between the lower column plate and an underside of the upper column plate.

4. A rigid connection structure of a precast concrete beam, comprising:

- the rigid connection structure between the upper precast concrete column and the lower precast concrete column as defined in claim 1;
- a beam plate disposed on a side of the precast concrete beam;
- a plurality of beam reinforcing bars in an interior of the precast concrete beam and each having one end connected to the beam plate;
- beam upper reinforcing bars arranged horizontally above the precast concrete beam; and

slab concrete on the beam upper reinforcing bars, the beam upper reinforcing bars being buried in the slab concrete,

wherein the beam plate is coupled to a side of the lower precast concrete column, each beam upper reinforcing bar passes through the box out, and one end of each beam upper reinforcing bar is coupled to a side of the upper precast concrete column.

5. The rigid connection structure according to claim 1, wherein the lower column plate has a protruding portion extending from a side surface of the lower column plate and the upper column plate has a protruding portion extending from a side surface of the upper column plate, and the protruding portion of the lower column plate is coupled to the protruding portion of the upper column plate by means of bolts and nuts.

6. The rigid connection structure according to claim 1, wherein the lower column plate has internal bolts protruding from a top of the lower column plate, the internal bolts penetrate through the upper column plate, and the internal bolts are fastened in the box out.

7. A rigid connection structure between an upper precast concrete column and a lower precast concrete column, comprising:

- a lower column plate disposed on an end of the lower precast concrete column,
 - a plurality of lower column reinforcing bars in an interior of the lower precast concrete column and having ends penetrating through the lower column to be outside of the lower precast concrete column;
 - an upper column plate disposed on an end of the upper precast concrete column,
 - a plurality of upper column reinforcing bars in an interior of the upper precast concrete column and having ends penetrating through the upper column plate to be outside of the upper precast concrete column, and
 - a box out comprising ends of the upper column reinforcing bars,
- wherein sides of the upper column plate are shorter than sides of the lower column plate, the upper column plate and the lower column plate are coupled to each other by means of internal bolts, and the upper column reinforcing bars and the lower column reinforcing bars are connected to each other in the box out.

8. The rigid connection structure according to claim 7, wherein the ends of the upper column reinforcing bars are coupled to upper ends of one touch couplers, and the ends of the lower column reinforcing bars are coupled to lower ends of the one touch couplers, so that the upper column reinforcing bars and the lower column reinforcing bars are connected to each other.

9. The rigid connection structure according to claim 7, further comprising support chips between the lower column plate and an underside of the upper column plate.

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