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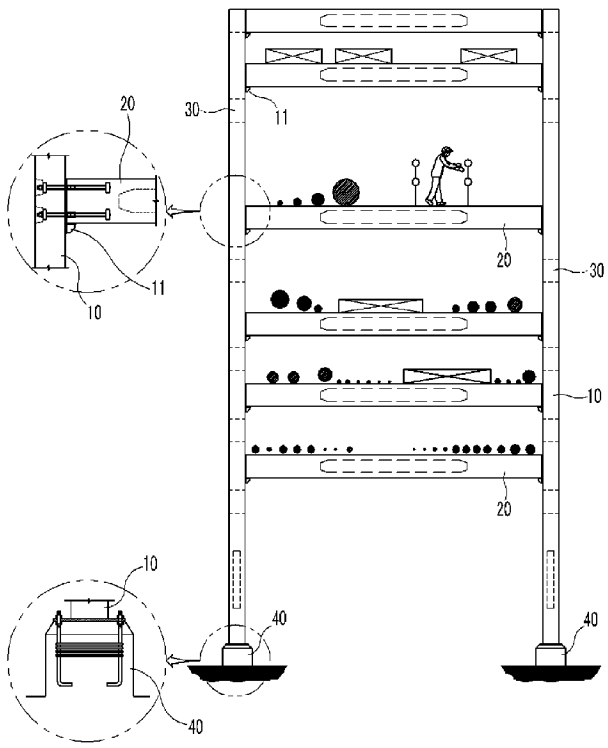
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[Continued on next page]

(54) Title: PIPE RACK AS CONSTRUCTED USING PRECAST CONCRETE MEMBERS

[Fig. 1]



(57) Abstract: A pipe rack constructed with precast concrete members. The pipe rack includes at least four columns fabricated of precast concrete, arranged in transverse and longitudinal directions, and vertically installed on a footing, a plurality of transverse beams horizontally installed between the two transverse columns, fabricated of precast concrete members to which pre-tension is applied, having a hollow zone therein, connected between the columns under post-tension in a fixed structure, and having a variety of pipes installed thereon, and a plurality of longitudinal beams horizontally installed between the two longitudinal columns arranged in the longitudinal direction, fabricated of precast concrete members to which pre-tension is applied, having a hollow zone therein, and connected between the columns in a hinged structure.

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Description

PIPE RACK AS CONSTRUCTED USING PRECAST CONCRETE MEMBERS

Technical Field

[1] The present invention relates, in general, to a pipe rack that supports pipes for transporting a variety of raw materials such as chemicals, gases in the loading docks and plants, and more particularly, to a pipe rack constructed with precast concrete members, which sharply reduces construction expenses using inexpensive concrete structures, remarkably reduces a construction period using precast concrete construction, reduces weight of precast concrete members to facilitate transportation and installation by forming the precast concrete members in a hollow structure, and applies pre-tension and post-tension in order to reinforce strength, and ensures a long lifespan.

Background Art

[2] Generally, a variety of raw materials such as chemicals, gases are transported in the loading docks and plants using pipes. These pipes have various sizes and shapes. Thus, a support structure for arranging and supporting these pipes is required. This support structure for pipes is called a pipe rack.

[3] This pipe rack is conventionally installed in a steel frame construction using H sections. This conventional pipe rack having the steel frame construction has a disadvantage in that the prices of raw materials and the costs of construction are expensive. Particularly, the prices of raw materials, for instance steel materials, have sharply risen of late. For example, in the case in which the steel frames of 700 tons per unit are required, the construction costs required for fabrication, transportation, installation, and fireproofing of the steel frames amount to about 3.5 million dollars, which correspond to 5,000 dollars per ton. This means a sharp increase in the construction costs as compared to the conventional construction costs. Furthermore, the prices or the demand and supply of the steel materials frames are expected to be unstable in the future.

[4] Further, the conventional pipe rack having the steel frame construction has a drawback in that a construction period is long. The steel frame construction process by nature cannot perform fabrication and installation at the same time, so that it is difficult to reduce the construction period. In the case in which the steel frames of 700 tons per unit are required, the construction period including purchase and fabrication of the steel frames requires a range from 4 months to 5 months in Korea. For example, in the case of the countries in the Middle East, the transportation period of 2 months and the installation period of 6 to 7 months are required. In this manner, the countries in the

Middle East experience twice the impact of the overall construction delays that Korea does. Moreover, the raw materials lately run short, and thus delay of the purchase period acts as a factor that delays the construction period.

[5] Thus, the conventional pipe rack having the steel frame construction causes problems with delay of piping work and storage of piping materials. Since the pipe rack is not installed at a proper time, the piping work is often delayed despite sufficient piping materials. Further, the steel frames for the pipe rack and the piping materials are frequently carried into a construction field at the same time. In this case, a space for storing the materials in the construction field runs short, and thus a working space runs short. This insufficient working space has an influence on other works.

[6] For this reason, complicated problems such as various unexpected problems with management of the construction field are caused to influence an overall process.

[7] The conventional pipe rack having the steel frame construction has a problem with quality and safety managements resulting from welding work. Since a main process for the installation is the welding work, it is difficult to check quality of each welded zone, and there are many fires and injuries during the welding work.

[8] Meanwhile, the pipe rack can be installed using ordinary reinforced concrete. This method has an advantage in that the construction costs are low, but has disadvantages in that the construction period is long and that the construction is complicated, because all the processes proceed in the construction field.

Disclosure of Invention

Technical Problem

[9] Accordingly, the present invention has been made in an effort to solve the problems occurring in the related art, and embodiments of the present invention provide a pipe rack constructed with precast concrete members, in which members required to fabricate the pipe rack are fabricated as the precast concrete members in separate industries, and are constructed in a construction field, thereby reducing fabrication expenses, simplifying works in the construction field, and thus providing reduction in construction period and simplification of the surroundings of the construction field.

[10] There is provided a pipe rack constructed with precast concrete members, in which weight of each concrete member is reduced to facilitate transportation and working, and pre-tension and post-tension are applied to increase strength of a structure, thereby effectively withstanding earthquake load and wind load, and being used for a long time.

Technical Solution

[11] In order to achieve the above object, according to one aspect of the present invention, there is provided a pipe rack constructed with precast concrete members. The pipe rack

comprises: at least four columns fabricated of precast concrete, arranged in transverse and longitudinal directions, and vertically installed on a footing; a plurality of transverse beams horizontally installed between the two columns arranged in the transverse direction, fabricated of precast concrete members to which pre-tension is applied, having a hollow zone therein, connected between the columns under post-tension in a fixed structure, and having a variety of pipes installed thereon; and a plurality of longitudinal beams horizontally installed between the two columns arranged in the longitudinal direction, fabricated of precast concrete members to which pre-tension is applied, having a hollow zone therein, and connected between the columns in a hinged structure.

[12] According to another aspect of the present invention, each of the transverse beams has an attachable shoulder which is made of steel plate and is fixed to a first face of the column. Each of the longitudinal beams has an integrated shoulder which is integrally formed with the column on a second face of the column which is located perpendicular to the first face of the column.

[13] According to another aspect of the present invention, the column is connected with the transverse beam in the fixed structure in which the post-tension is applied by at least one post-tension embedded section formed at one end of the transverse beam and at least one post-tension pulling section formed on the column so as to correspond to the post-tension embedded section, the post-tension embedded section including a beam embedded stress bar having threads, an anchor plate coupled to a trailing end of the beam embedded stress bar, a coupler coupled to a leading end of the beam embedded stress bar, and a beam duct into which the beam embedded stress bar and the coupler are inserted, and the post-tension pulling section including a column duct horizontally inserted through an interior of the column, a column inserted stress bar passing through the column duct and screwed with the coupler of the transverse beam, and a nut screwed to the column inserted stress bar after a washer is fitted around the column inserted stress bar.

[14] According to another aspect of the present invention, the column is connected with the transverse beam in the fixed structure in which the post-tension is applied by at least one post-tension embedded section formed on an expansion section at one end of the transverse beam, and at least one post-tension pulling section formed on the column so as to correspond to the post-tension embedded section, the post-tension embedded section including a beam duct inserted in the expansion section, and an anchor plate disposed outside the beam duct, and the post-tension pulling section including a column duct horizontally inserted through an interior of the column, an integrated stress bar having threads, passing through the column duct and the beam duct, and screwed with the anchor plate, and a nut screwed to the integrated stress bar

after a washer is fitted around the integrated stress bar.

[15] According to another aspect of the present invention, the column is connected with the longitudinal beam in the hinged structure in which the integrated shoulder of the column is provided with a hole, the longitudinal beam is provided with a through-hole at a position corresponding to the hole, a reinforcement is inserted into the hole and the though-hole, and the hole and the though-hole are filled with mortar.

[16] According to another aspect of the present invention, the column is connected with the longitudinal beam in the hinged structure in which the integrated shoulder of the column is provided with an anchor bolt, the longitudinal beam is provided with a through-hole at a position corresponding to the anchor bolt, and a nut is fastened to a free end of the anchor bolt passing through the through hole of the longitudinal beam with a washer in between.

Advantageous Effects

[17] According to embodiments of the present invention, the pipe rack is configured of an inexpensive concrete structure, so that it can sharply reduce construction expenses. The pipe rack can remarkably reduce a construction period by fabricating the precast concrete members using precast concrete construction. Further, the pipe rack provides each precast concrete member with the hollow zone, so that it can reduce its weight to facilitate transportation and installation. Despite this weight reduction of the members, these members ensure necessary strength by applying pre-tension and post-tension.

[18] In addition, the column is connected with the transverse beam in a fixed structure in which post-tension is applied, the pipe rack can effectively resist lateral force such as earthquake load, wind load, or the like, and bending moment caused by vertical load. The column is connected with the longitudinal beam in a hinged structure, so that the pipe rack can be used for a long time without rupture caused by impacts such as earthquake.

Brief Description of the Drawings

[19] FIG. 1 is a front view illustrating a pipe rack constructed using precast concrete members according to an embodiment of the present invention;

[20] FIG. 2 is a side view illustrating a pipe rack constructed using precast concrete members according to an embodiment of the present invention;

[21] FIGS. 3 through 7 illustrate a transverse beam, a constituent element, of a pipe rack, according to an embodiment of the present invention, wherein FIG. 3 is a top plan view, FIG. 4 is a side view, FIG. 5 is a reinforcement arrangement view, FIG. 6 is a cross-sectional view taken along line A-A of FIG. 5, and FIG. 7 is a cross-sectional view taken along line B-B of FIG. 5;

[22] FIGS. 8 through 12 illustrate a longitudinal beam, a constituent element, of a pipe

rack, according to an embodiment of the present invention, wherein FIG. 8 is a top plan view, FIG. 9 is a side view, FIG. 10 is a reinforcement arrangement view, FIG. 11 is a cross-sectional view taken along line A-A of FIG. 10, and FIG. 12 is a cross-sectional view taken along line B-B of FIG. 10;

[23] FIG. 13 is a partial cross-sectional view illustrating an example of a connection structure of a column and a transverse beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention;

[24] FIG. 14 is a partial cross-sectional view illustrating another example of a connection structure of a column and a transverse beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention;

[25] FIG. 15 is a partial cross-sectional view illustrating another example of a connection structure of a column and a transverse beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention;

[26] FIG. 16 is a cross-sectional view illustrating another example of the stress bar mounting structure of FIGS. 13 through 15;

[27] FIG. 17 is a partial cross-sectional view illustrating an example of a connection structure of a column and a longitudinal beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention;

[28] FIG. 18 is a partial cross-sectional view illustrating another example of a connection structure of a column and a longitudinal beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention; and

[29] FIGS. 19 and 20 are partial cross-sectional views illustrating connection of a column and a footing, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention.

[30] <Description of symbols of the main parts in the drawings>

[31] 10: column 10a: footing plate

[32] 11: attachable shoulder 12: integrated shoulder

[33] 12a: hole 12b: anchor bolt

[34] 13, 13': column duct 14: column inserted stress bar

[35] 15: washer 16: nut

[36] 17: mortar 17': grout

[37] 18: protection cover

[38] 20, 20': transverse beam 20a': expansion section

[39] 20a: lifting loop 20b: hollow zone

[40] 20c: longitudinal reinforcement

[41] 20d: stirrup 20e: pre-tension strand

[42] 21: beam embedded stress bar

[43] 22: anchor plate 23: coupler

[44] 24, 24': beam duct 25: rubber ring

[45] 25': seal ring 26: mortar

[46] 27: integrated stress bar

[47] 28: grout 29: protection cover

[48] 30: longitudinal beam 30a: lifting loop

[49] 30b: hollow zone 30c: longitudinal reinforcement

[50] 30d: stirrup 30e: pre-tension strand

[51] 31: through-hole 32: reinforcement

[52] 32a: spacer 33, 33': mortar

[53] 34: washer 35: nut

[54] 36: grout 37: protection cover

[55] 40, 40': footing 41: anchor bolt

[56] 42: concrete

Best Mode for Carrying Out the Invention

[57] Reference will now be made in greater detail to an exemplary embodiment of the invention with reference to the accompanying drawings.

[58] FIG. 1 is a front view illustrating a pipe rack constructed using precast concrete members according to an embodiment of the present invention. FIG. 2 is a side view illustrating a pipe rack constructed using precast concrete members according to an embodiment of the present invention.

[59] As illustrated in FIGS. 1 and 2, the pipe rack according to an embodiment of the present invention essentially includes four or more columns 10 arranged in transverse and longitudinal directions, a plurality of transverse beams 20 and a plurality of longitudinal beams 30.

[60] Each column 10 is fabricated of precast concrete, has a plurality of shoulders 11 and 12 on which the beams are horizontally installed, and is fixed to a footing 40.

[61] The transverse shoulder 11 of the column 10 is a detachable shoulder that is made of a steel plate and is fixed to the column 10. The longitudinal shoulder 12 of the column 10 is an integrated shoulder that is integrally formed with the column 10.

[62] Each transverse beam 20 is installed between the two transverse columns 10, particularly on the shoulders 11 of the two transverse columns 10, is fabricated of precast concrete, and is subjected to post-tension between the transverse columns 10. A variety of pipes for transferring raw material of, for instance, liquid, gas or powder, and fuel are installed on the transverse beams 20.

[63] Each longitudinal beam 30 is installed between the two longitudinal columns 10, particularly on the shoulders 12 of the two longitudinal columns 10, and is fabricated from precast concrete.

[64] In an embodiment of the present invention, the transverse beam 20 must be connected with the column 10 in the transverse direction in a fixed structure so as to be able to withstand lateral force such as earthquake load, wind load, or the like, and bending moment caused by vertical load.

[65] Further, the longitudinal beam 30 must be connected with the column 10 in the longitudinal direction in a hinged structure so as not to be ruptured when impact such as earthquake occurs.

[66] FIGS. 3 through 7 illustrate a transverse beam, a constituent element, of a pipe rack, according to an embodiment of the present invention, wherein FIG. 3 is a top plan view, FIG. 4 is a side view, FIG. 5 is a reinforcement arrangement view, FIG. 6 is a cross-sectional view taken along line A-A of FIG. 5, and FIG. 7 is a cross-sectional view taken along line B-B of FIG. 5.

[67] As illustrated, the transverse beam 20 has a hollow zone 20b therein in order to reduce weight. Further, in order to facilitate transportation and installation, the transverse beam 20 has lifting loops 20a on opposite upper sides thereof. In addition, longitudinal reinforcements 20c and stirrups 20d have an ordinary structure for arrangement of reinforcement.

[68] The transverse beam 20 increases strength by arranging pre-tension strands 20e therein for application of pre-tension. The transverse beam 20 reduces the weight due to the hollow zone 20b, and reinforces the strength due to the application of pre-tension.

[69] FIGS. 8 through 12 illustrate a longitudinal beam, a constituent element, of a pipe rack, according to an embodiment of the present invention, wherein FIG. 8 is a top plan view, FIG. 9 is a side view, FIG. 10 is a reinforcement arrangement view, FIG. 11 is a cross-sectional view taken along line A-A of FIG. 10, and FIG. 12 is a cross-sectional view taken along line B-B of FIG. 10.

[70] As illustrated, the longitudinal beam 30 has a hollow zone 30b therein in order to reduce weight. Further, in order to facilitate transportation and installation, the longitudinal beam 30 has lifting loops 30a on opposite upper sides thereof. In addition, longitudinal reinforcements 30c and stirrups 30d have an ordinary structure for arrangement of reinforcement. The longitudinal beam 30 is configured so that pre-tension strands 30e are arranged for application of pre-tension. Owing to these pre-tension strands 30e, the longitudinal beam 30 does not undergo reduction in strength despite the hollow zone 30b.

[71] In the transverse beam 20 and the longitudinal beam 30, their cross-sectional areas and the numbers of pre-tension strands 20e and 30e required for pre-stressing are determined according to a clear span, vertical load, earthquake load, and restraint conditions of a structure of the pipe rack. As illustrated in FIGS. 6 and 7 and FIGS. 11

and 12, the strands 20e and 30e having high tensile strength (18,600 kg/cm2) are properly arranged on upper and lower portions of the beams according to structural characteristics, and then are sequentially tensioned by a jack until they reach design tension prior to pouring concrete. Then, the concrete is poured and cured. When the strands exposed to the outside are cut off after the tension reaches 80% of concrete design strength, pre-stress is applied, and thus the beams serve as an elastic body, a cross section of which is subjected to high tension.

[72] FIG. 13 is a partial cross-sectional view illustrating an example of a connection structure of a column and a transverse beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention.

[73] In the pipe rack constructed with precast concrete members according to an exemplary embodiment of the present invention, the connection structure between the column 10 and the transverse beam 20 has a fixed structure in which post-tension is applied by at least one post-tension embedded section formed at one end of the transverse beam 20, and at least one post-tension pulling section formed on the column 10 so as to correspond to the post-tension embedded section.

[74] The post-tension embedded section includes a beam embedded stress bar 21 having threads, an anchor plate 22 coupled to a trailing end of the beam embedded stress bar 21, a coupler 23 coupled to a leading end of the beam embedded stress bar 21, and a beam duct 24 into which the beam embedded stress bar 21 and the coupler 23 are inserted.

[75] The post-tension pulling section includes a column duct 13 horizontally inserted through the interior of the column 10, a column inserted stress bar 14 passing through the column duct 13 and screwed with the coupler 23 of the transverse beam 20, and a nut 16 screwed to the column inserted stress bar 14 after a washer 15 is fitted around the column inserted stress bar 14.

[76] A process of applying the post-tension is performed by fastening the nut 16 to the column inserted stress bar 14 while pulling the column inserted stress bar 14 using a jack.

[77] When the post-tension is applied, the transverse beam 20 has the same effect as in the case in which the pre-tension is applied, and the column 10 and the transverse beam 20 have the fixed connection structure. As such, although negative moment is generated from a joint of the column 10 and the transverse beam 20 due to support load, wind load, and so on, the fixed connection structure can effectively resist the moment.

[78] FIG. 14 is a partial cross-sectional view illustrating another example of a connection structure of a column and a transverse beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention. FIG. 15 is a partial cross-sectional view illustrating another example of a connection structure of a column and a

transverse beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention.

[79] In these example, the connection structure between the column 10 and the transverse beam 20' has a fixed structure in which post-tension is applied by at least one post-tension embedded section formed on an expansion section 20a' at one end of the transverse beam 20', and at least one post-tension pulling section formed on the column 10 so as to correspond to the post-tension embedded section.

[80] The post-tension embedded section includes a beam duct 24' inserted in the expansion section 20a', and an anchor plate 22 disposed outside the beam duct 24'. The post-tension pulling section includes a column duct 13 horizontally inserted through the interior of the column 10, an integrated stress bar 27 having threads, passing through the column duct 13 and the beam duct 24', and screwed with the anchor plate 22, and a nut 16 screwed to the integrated stress bar 27 after a washer 15 is fitted around the integrated stress bar 27.

[81] In the examples of FIGS. 14 and 15, the column duct 13 of the column 10 is aligned with the beam duct 24' of the transverse beam 20' only by passing the integrated stress bar 27 through these ducts, so that the connecting process becomes easy.

[82] In these examples, after the process of connecting the beam is completed, a protection cover 29 is installed around the anchor plate 22, and then is filled with grout. Thereby, the anchor plate 22 and the integrated stress bar 27 are fixed.

[83] Further, in the examples of FIGS. 13 and 15, mortar 26 is filled between the column 10 and the transverse beam 20 or 20'. In the example of FIG. 13, a rubber ring 25 is installed between the column duct 13 and the beam duct 24' so as to prevent the mortar 26 from being penetrated into the beam duct 24'. In the example of FIG. 15, a seal ring 25' is installed the column duct 13 and the beam duct 24' so as to prevent the mortar 26 from being penetrated into the beam duct 24'.

[84] Further, in the example of FIG. 14, after a pipe (not shown) is first inserted into the column duct 13 and the beam duct 24' first, and then the mortar 26 is filled and cured. Afterwards, the pipe is extracted.

[85] In the examples of FIGS. 13 to 15, the washer 15 and the nut 16 are disposed inside the column 10. After the process of connecting the beam (i.e. the process of applying post-tension) is completed, mortar 17 is filled into a depression part.

[86] Further, as illustrated in FIG. 16, the column duct 13' can be installed such that the washer 15 and the nut 16 protrude outwards. In this case, the process of applying post-tension can be easily performed. In this example, a protection cover 18 is installed, and then is filled with grout 17', thereby fixing the washer 15 and the nut 16.

[87] FIG. 17 is a partial cross-sectional view illustrating an example of a connection structure of a column and a longitudinal beam, constituent parts, of a pipe rack

according to an exemplary embodiment of the present invention.

[88] The connection structure between the column 10 and the longitudinal beam 30 has a hinged structure in which the integrated shoulder 12 of the column 10 is provided with a hole 12a, which the longitudinal beam 30 is provided with a through-hole 31 at a position corresponding to the hole 12a, which a reinforcement 32 is inserted into the hole 12a and the though-hole 31, and which the hole 12a and the though-hole 31 are filled with mortar 33. A spacer 32a is disposed between the shoulder 12 and the longitudinal beam 30, and a gap between an end face of the longitudinal beam 30 and the column 10 is filled with mortar 33'.

[89] FIG. 18 is a partial cross-sectional view illustrating another example of a connection structure of a column and a longitudinal beam, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention.

[90] The connection structure between the column 10 and the longitudinal beam 30 has a hinged structure in which the integrated shoulder 12 of the column 10 is provided with an anchor bolt 12b, the longitudinal beam 30 is provided with a through-hole 31 at a position corresponding to the anchor bolt 12b, and a nut 35 is fastened to a free end of the anchor bolt 12b passing through the through hole 31 of the longitudinal beam 30 with a washer 34 in between. In this example, a spacer 32a is also disposed between the shoulder 12 and the longitudinal beam 30, and a gap between an end face of the longitudinal beam 30 and the column 10 is filled with mortar 33'.

[91] In this example, since the washer 34 and the nut 35 protrude from the top of the longitudinal beam 30, a protection cover 37 is covered, and then is filled with grout 36.

[92] FIGS. 19 and 20 are partial cross-sectional views illustrating connection of a column and a footing, constituent parts, of a pipe rack according to an exemplary embodiment of the present invention.

[93] In the embodiment of FIG.19, a footing plate 10a is welded to reinforcements arranged in the column 10, and then is fixed to the footing 40 in which anchor bolts 10a are installed. Thereby, the column 10 is installed on the footing 40.

[94] In the embodiment of FIG. 20, a footing 40' is provided with an insertion recess into which a lower end of the column 10 can be inserted, and then the lower end of the column 10 is inserted into the insertion recess. Then, a gap between the column 10 and the recess is poured with concrete. Thereby, the column 10 is installed on the footing 40'.

[95] According to an embodiment of the present invention, the pipe rack is configured of an inexpensive concrete structure, so that it can sharply reduce construction expenses. Further, the pipe rack provides the transverse beam 20 and the longitudinal beam 30 with the respective hollow zones 20b and 30b, so that it can reduce its weight, and thus facilitate transportation and installation. Despite this weight reduction of the members,

these members ensure necessary strength by applying pre-tension and post-tension.

[96] Further, since the connection structure between the column 10 and the transverse beam 20 or 20' has the fixed structure, the pipe rack can effectively resist positive bending moment and negative bending moment caused by lateral force such as earthquake load, wind load, etc. and vertical load. Since the connection structure between the column 10 and the longitudinal beam 30 has the hinged structure, the pipe rack can absorb impacts attributable to earthquake, etc., and thus be used for a long time without damage to an overall structure.

[97] According to an embodiment of the present invention, the pipe rack can simultaneously perform fabrication and installation using precast concrete construction, so that it can considerably reduce a construction period. Further, since there is no process of welding a structure, such a construction period is additionally reduced. For example, in the case in which the steel frames of 700 tons per unit are required, the construction period including purchase, fabrication, transportation and installation of the steel frames requires at least 10 months. According to this precast concrete construction, the construction period requires a range from 4 months to 5 months, which is merely a half of the conventional construction period. In this manner, the precast concrete construction exerts remarkable effects.

[98] In addition, the construction expenses are sharply reduced. Recently, prices of oil and steel raw materials have jumped by 100% or more during one year, but price of cement has merely been raised by about 6%. In the case in which a steel frame structure is constructed, the expense of 5,000 dollars per ton is required. In contrast, in the case in which a pre-stress or post-stress structure is constructed, the construction can be performed at the expense of about 70% of the steel frame structure including materials and installation expenses, and thus the expenses can be sharply reduced.

[99] According to an embodiment of the present invention, the pipe rack also ensures positive connection between the structures. In detail, the structures exert positive functions in the individual processes of fabrication, installation and connection and after completion, and the process for the connection is simple, and the results of the connection can be directly checked in the construction field.

[100] In the case of a conventional pipe rack having reinforced concrete construction, it is difficult to deal with the members in the construction field using equipment because the weight of each member is heavy. In contrast, in the case of the pipe rack to which a composite pre-stressed and precast construction is applied, an amount of reinforcements is reduced, and thus each member becomes lightweight. Accordingly, the pipe rack provides good economical effects and easy installation.

[101] According to an embodiment of the present invention, the pipe rack can extend to at least twice a span length of the steel frame pipe rack, and thus the resulting economy

and reduction in construction period are ensured.

[102] Further, a superstructure of the pipe rack is constructed first, and thus piping work can be advanced, which leads to the reduction in construction period. Further, as soon as piping materials arrive at the construction field, they are deposited on the pipe rack, and thus the thoroughfare is easy in the construction field, and other works may proceed without hindrance. Thus, a considerable operational effect is produced in a plant field in which all works must be comprehensively carried out.

[103] In the case of the steel frame pipe rack, after installation, the steel frames must be subjected to fireproofing using, for instance, separate shotcrete. Thus, additional expenses and construction period are required. Further, the construction field is put in disorder. In contrast, the pipe rack according an embodiment of the present invention does not require the fireproofing, and thus reduction in expenses and construction period is possible, and the construction field is put in order.

[104] The pipe rack according an embodiment of the present invention does not require the welding in the superstructure construction, so that the construction period is not delayed, and the construction field is free from fire and injury. Thus, the pipe rack exerts an effect on safety management.

[105] In the case of the concrete, its compressive strength is tested in advance, a future pattern can be predicted. In reality, the compressive structure of the concrete is tested with a specimen each time prior to pouring the concrete. Thus, the test results can be checked, and thus quality management is considerably easy as compared to the welding.

[106] According to an embodiment of the present invention, the results of pre-stress tension and elongation of the concrete can be directly checked using a pressure gauge and calculated data, so that the quality management associated with the construction is easy.

[107] Further, a period required for preparation of a fabrication site and orders and arrival of various materials is about two months. Thus, the structures are fabricated during the construction period of piling work and footing 40 or 40' of the pipe rack at the same time, so that there is no impact on the construction period.

[108] While the present invention has been described with reference to the particular illustrative embodiments and the accompanying drawings, it is not to be limited thereto but will be defined by the appended claims. It is to be appreciated that those skilled in the art can substitute, change or modify the embodiments in various forms without departing from the scope and spirit of the present invention.

Claims

[1] A pipe rack constructed with precast concrete members, the pipe rack comprising:
at least four columns (10) fabricated of precast concrete, arranged in transverse and longitudinal directions, and vertically installed on a footing (40)(40');
a plurality of transverse beams (20)(20') horizontally installed between the two columns (10) arranged in the transverse direction, fabricated of precast concrete members to which pre-tension is applied, having a hollow zone (20b) therein, connected between the columns (10) under post-tension in a fixed structure, and having a variety of pipes installed thereon; and
a plurality of longitudinal beams (30) horizontally installed between the two columns (10) arranged in the longitudinal direction, fabricated of precast concrete members to which pre-tension is applied, having a hollow zone (30b) therein, and connected between the columns (10) in a hinged structure.

[2] The pipe rack as set forth in claim 1, wherein each of the transverse beams (20)(20') has an attachable shoulder (11) which is made of steel plate and is fixed to a first face of the column (10), and each of the longitudinal beams (30) has an integrated shoulder (12) which is integrally formed with the column (10) on a second face of the column (10) which is located perpendicular to the first face of the column (10).

[3] The pipe rack as set forth in claim 1 or 2, wherein the column (10) is connected with the transverse beam (20) in the fixed structure in which the post-tension is applied by at least one post-tension embedded section formed at one end of the transverse beam (20) and at least one post-tension pulling section formed on the column (10) so as to correspond to the post-tension embedded section, the post-tension embedded section including a beam embedded stress bar (21) having threads, an anchor plate (22) coupled to a trailing end of the beam embedded stress bar (21), a coupler (23) coupled to a leading end of the beam embedded stress bar (21), and a beam duct (24) into which the beam embedded stress bar (21) and the coupler (23) are inserted, and the post-tension pulling section including a column duct (13) horizontally inserted through an interior of the column (10), a column inserted stress bar (14) passing through the column duct (13) and screwed with the coupler (23) of the transverse beam (20), and a nut (16) screwed to the column inserted stress bar (14) after a washer (15) is fitted around the column inserted stress bar (14).

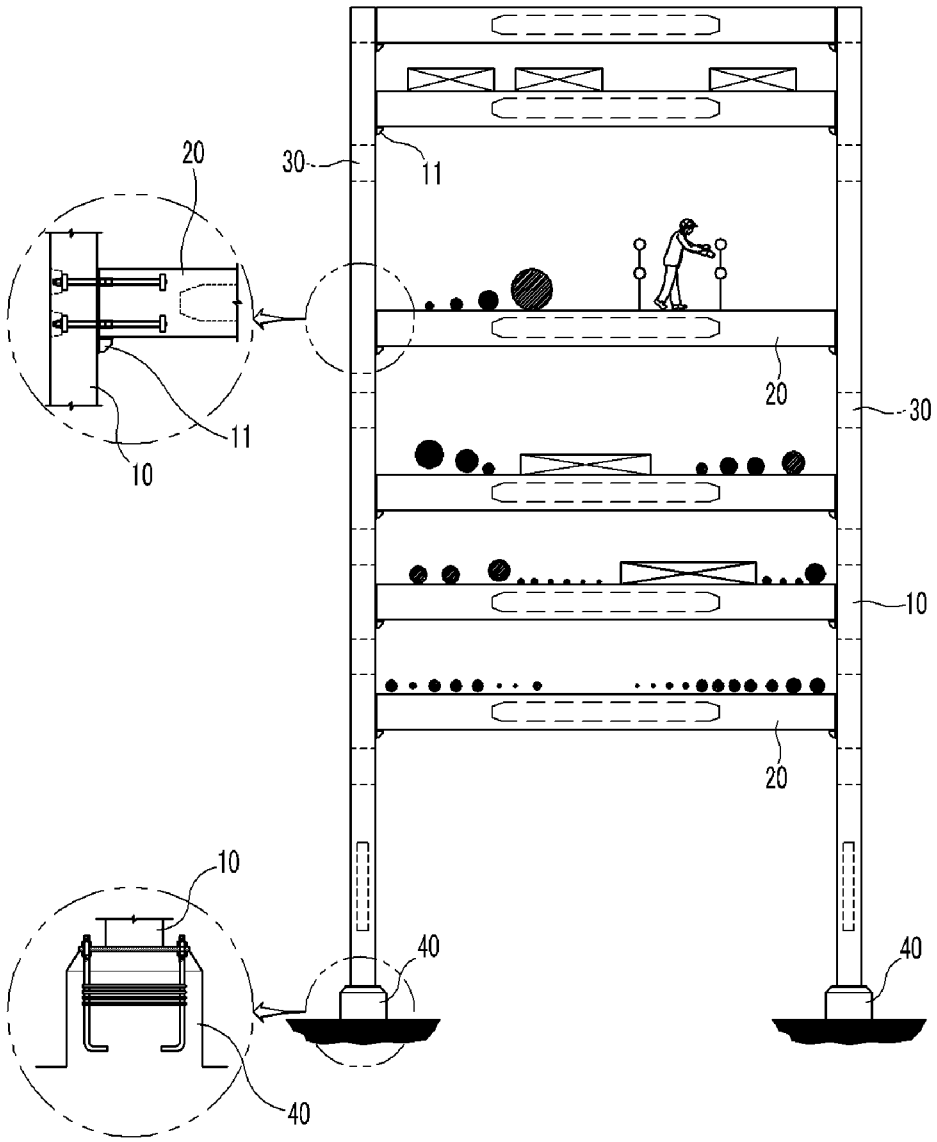
[4] The pipe rack as set forth in claim 1 or 2, wherein the column (10) is connected with the transverse beam (20') in the fixed structure in which the post-tension is

applied by at least one post-tension embedded section formed on an expansion section (20a') at one end of the transverse beam (20'), and at least one post-tension pulling section formed on the column (10) so as to correspond to the post-tension embedded section, the post-tension embedded section including a beam duct (24') inserted in the expansion section (20a'), and an anchor plate (22) disposed outside the beam duct (24'), and the post-tension pulling section including a column duct (13) horizontally inserted through an interior of the column (10), an integrated stress bar (27) having threads, passing through the column duct (13) and the beam duct (24'), and screwed with the anchor plate (22), and a nut (16) screwed to the integrated stress bar (27) after a washer (15) is fitted around the integrated stress bar (27).

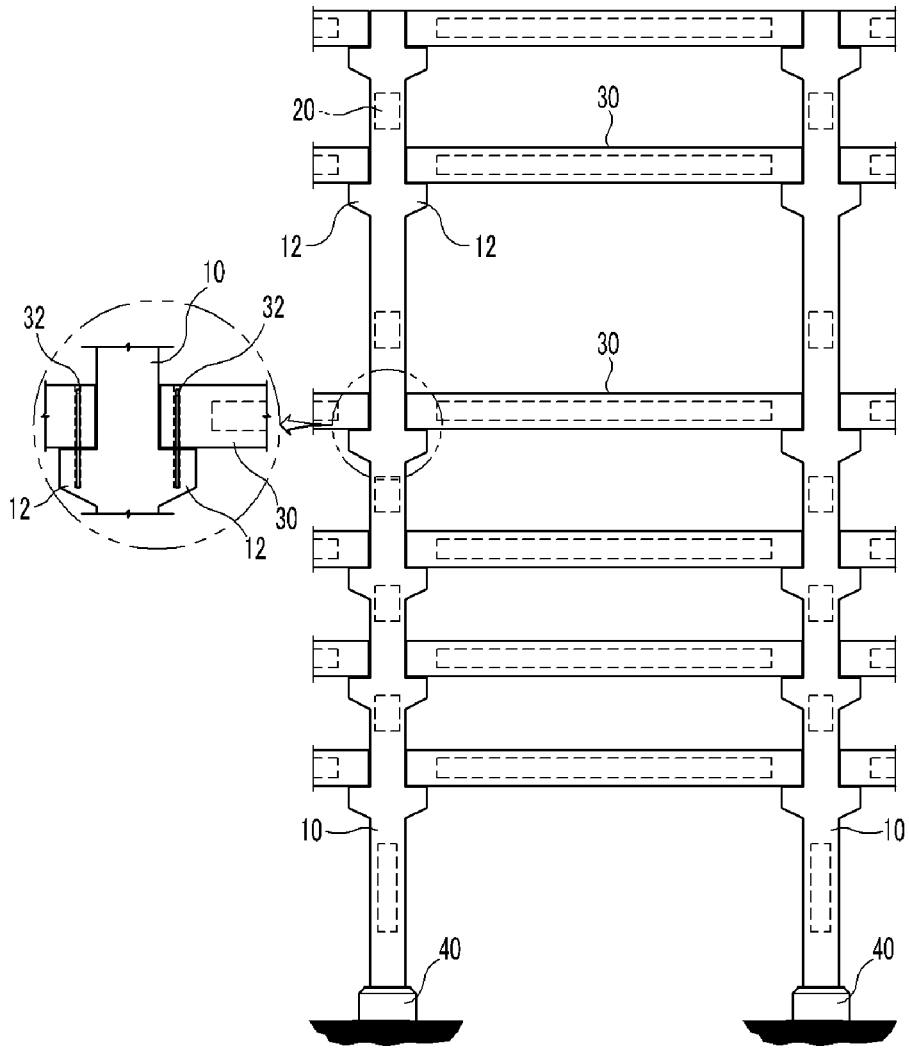
[5] The pipe rack as set forth in claim 1 or 2, wherein the column (10) is connected with the longitudinal beam (30) in the hinged structure in which the integrated shoulder (12) of the column (10) is provided with a hole (12a), the longitudinal beam (30) is provided with a through-hole (31) at a position corresponding to the hole (12a), a reinforcement (32) is inserted into the hole (12a) and the though-hole (31), and the hole (12a) and the though-hole (31) are filled with mortar (33).

[6] The pipe rack as set forth in claim 1, wherein the column (10) is connected with the longitudinal beam (30) in the hinged structure in which the integrated shoulder (12) of the column (10) is provided with an anchor bolt (12b), the longitudinal beam (30) is provided with a through-hole (31) at a position corresponding to the anchor bolt (12b), and a nut (35) is fastened to a free end of the anchor bolt (12b) passing through the through hole (31) of the longitudinal beam (30) with a washer (34) in between.

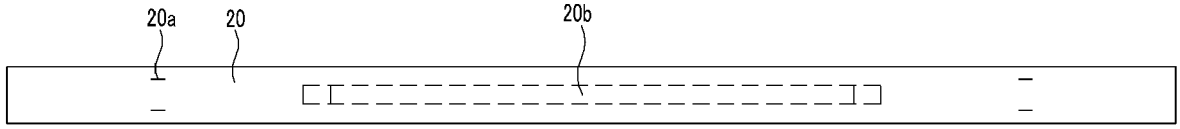
[Fig. 1]



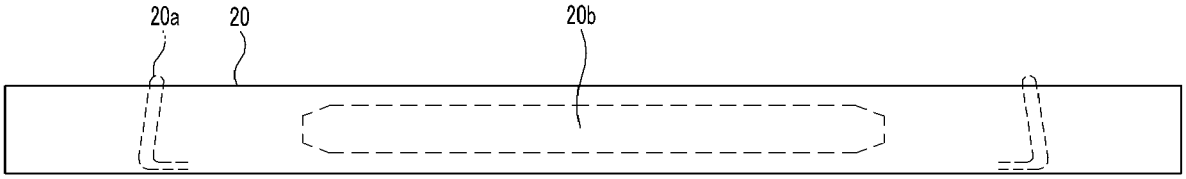
[Fig. 2]



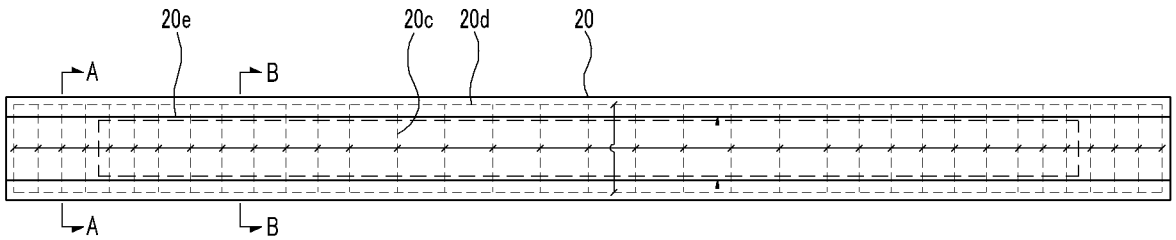
[Fig. 3]



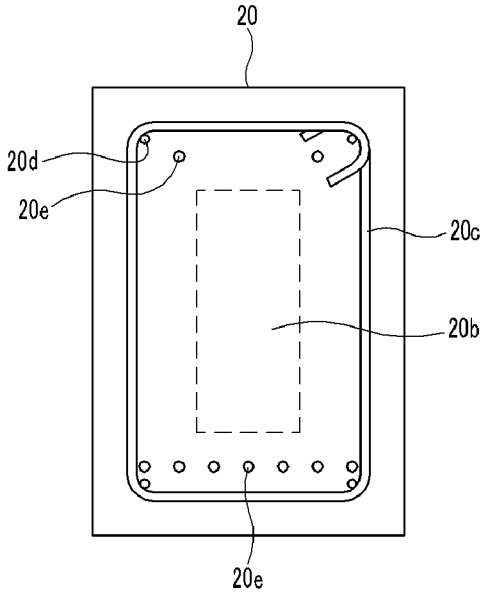
[Fig. 4]



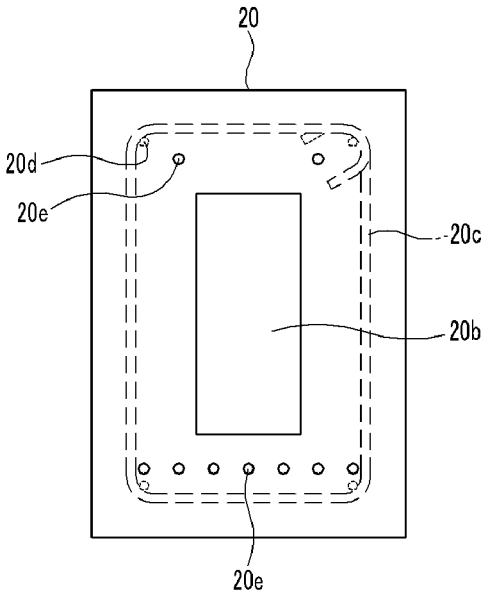
[Fig. 5]



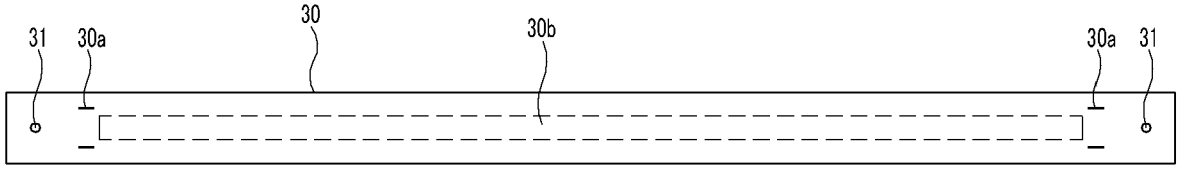
[Fig. 6]



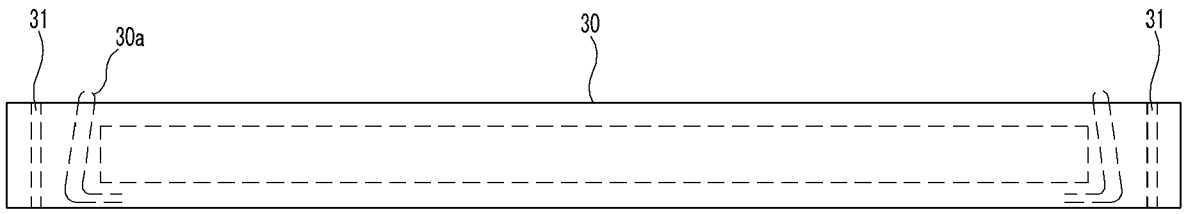
[Fig. 7]



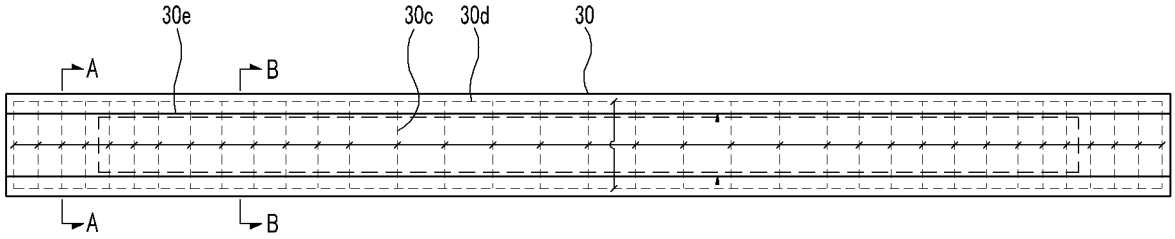
[Fig. 8]



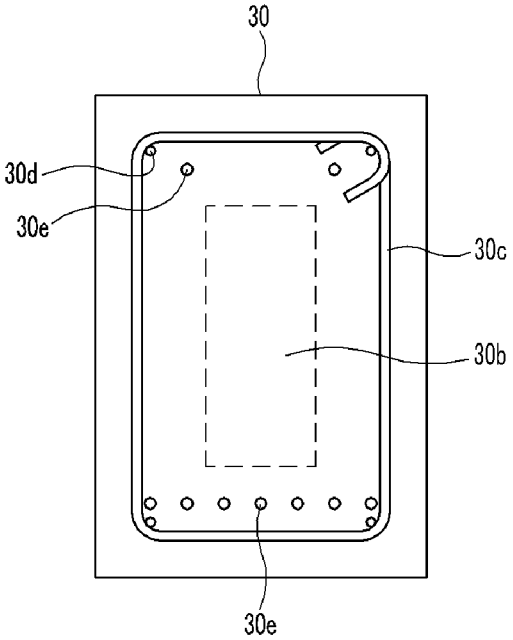
[Fig. 9]



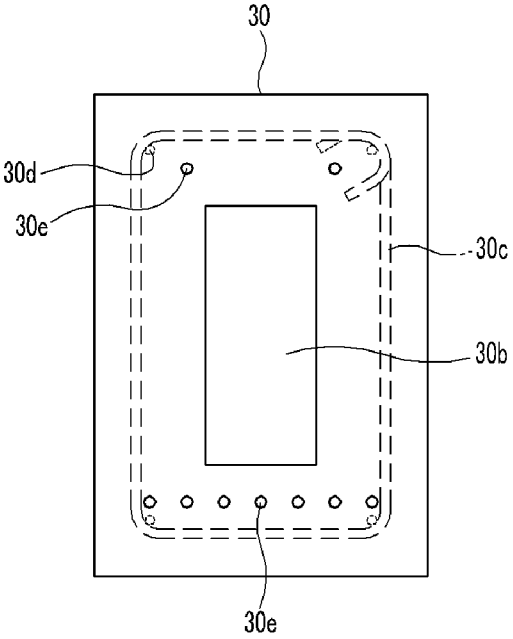
[Fig. 10]



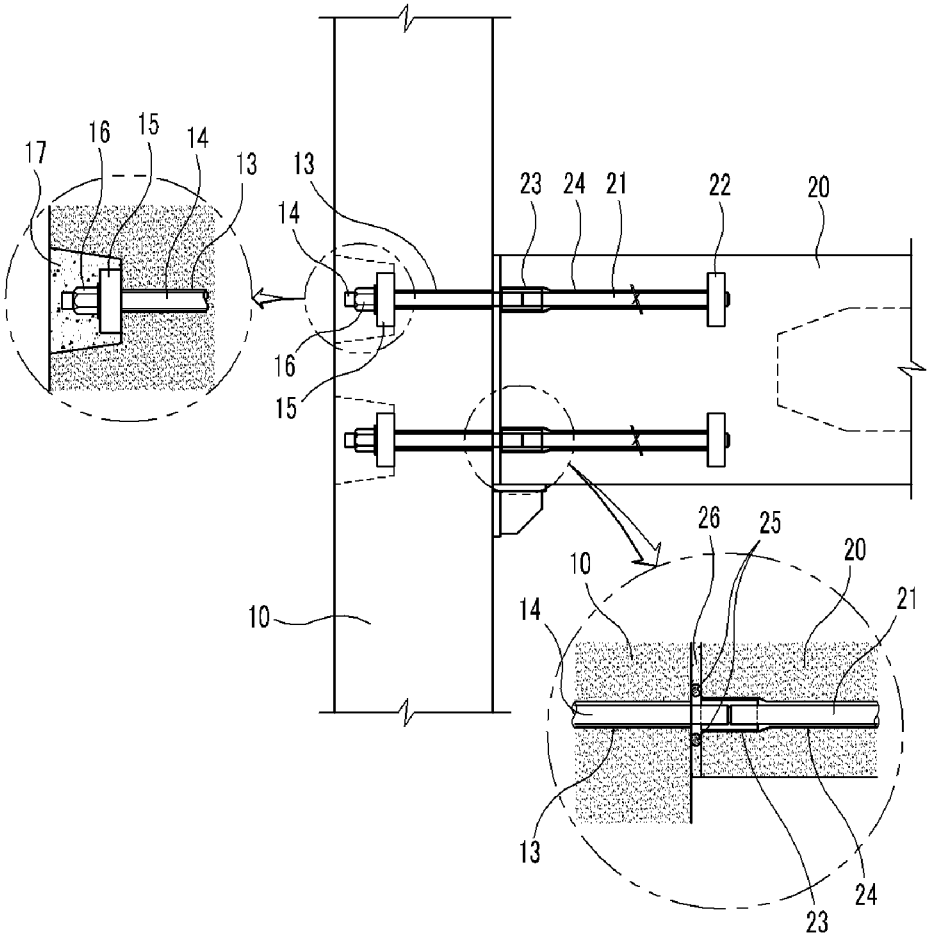
[Fig. 11]



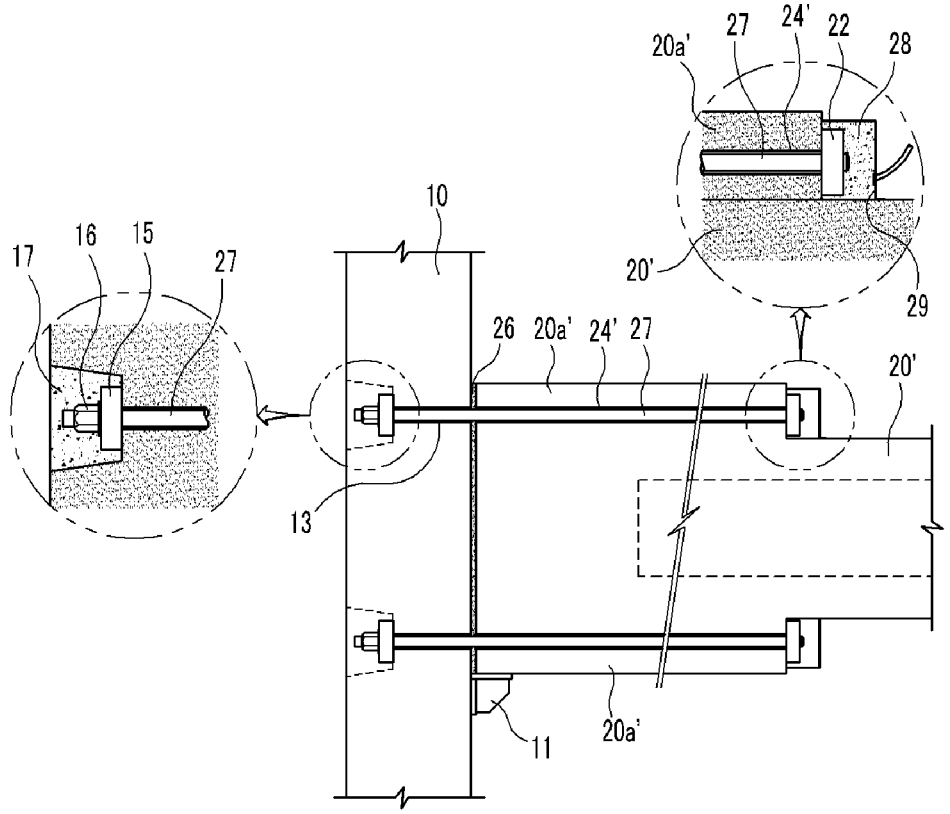
[Fig. 12]



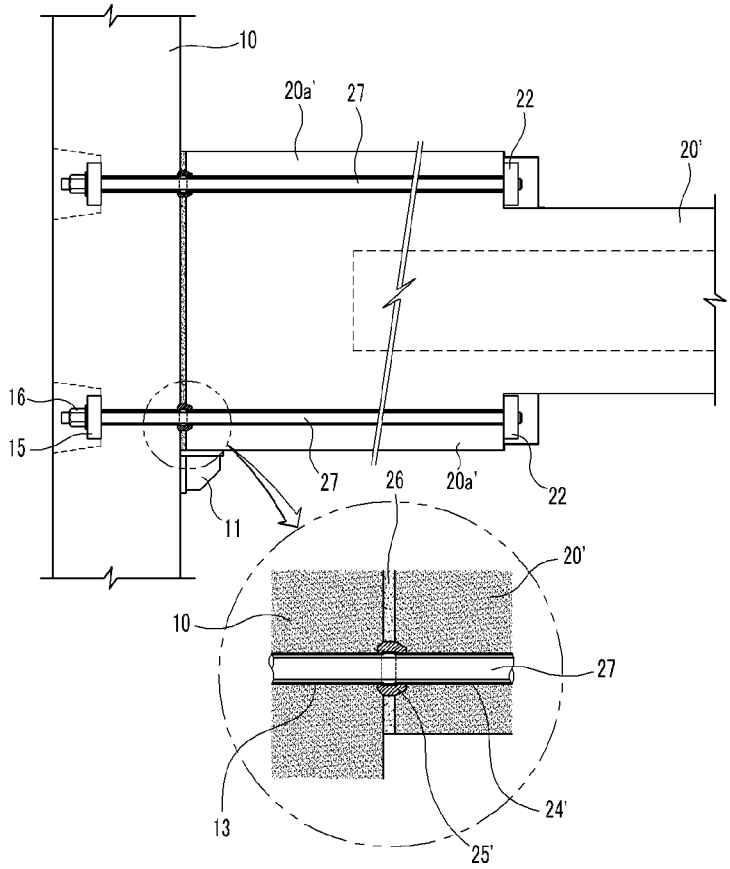
[Fig. 13]


17
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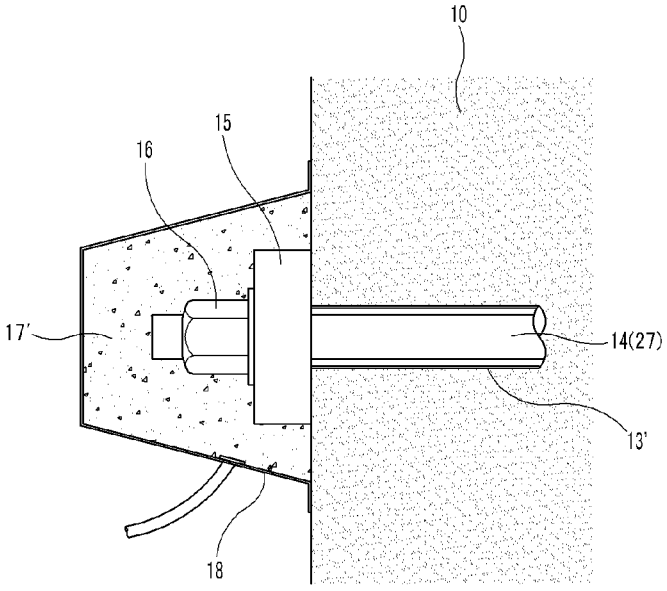
[Fig. 14]


20a'
27
24'
22
28
10
17
16
15
27
20'
29
26
20a'
24'
27
20'
13
20a'
11

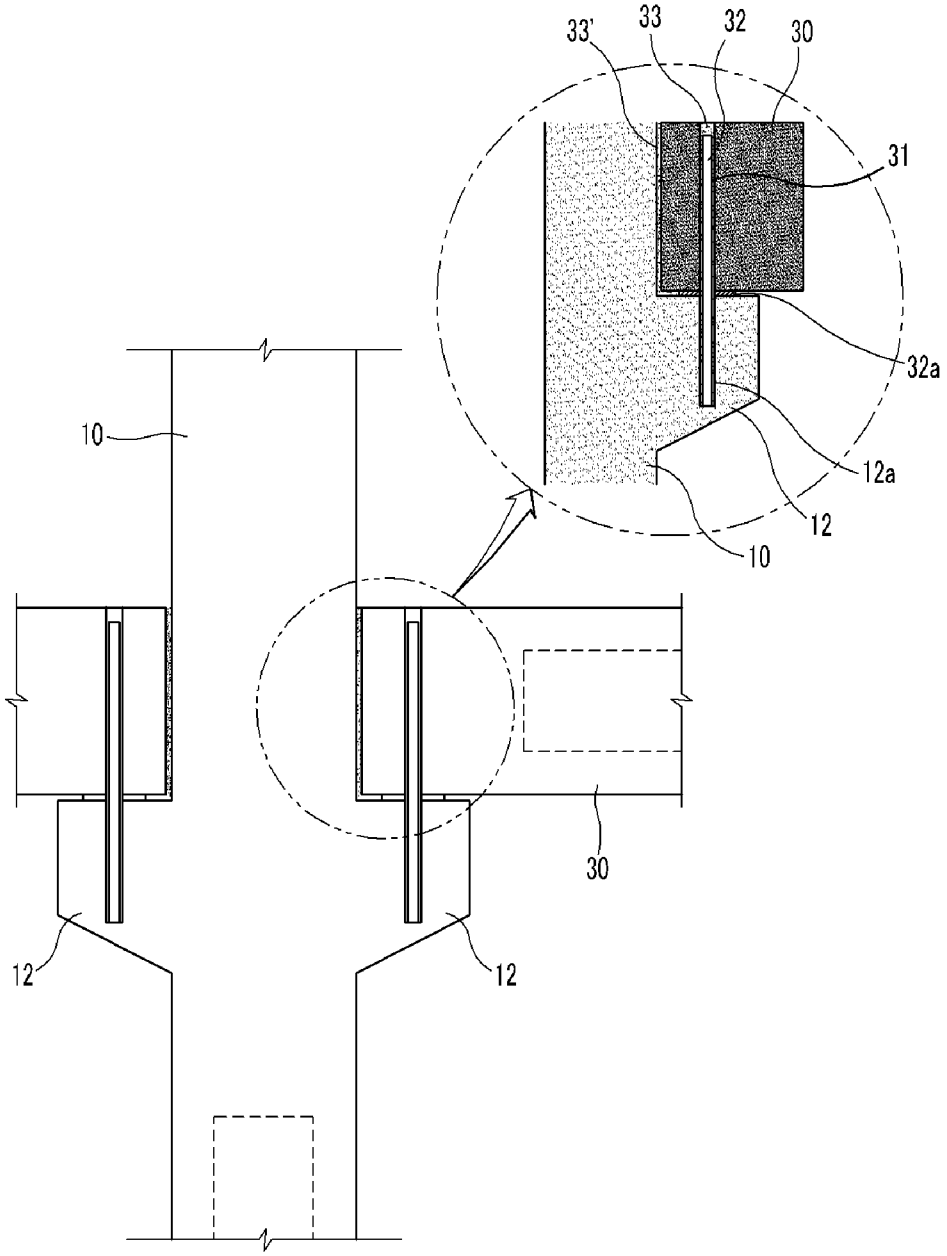
[Fig. 15]


10
20a'
27
22
20'
16
15
27
26
20a'
22
11
20'
10
27
13
24'
25'

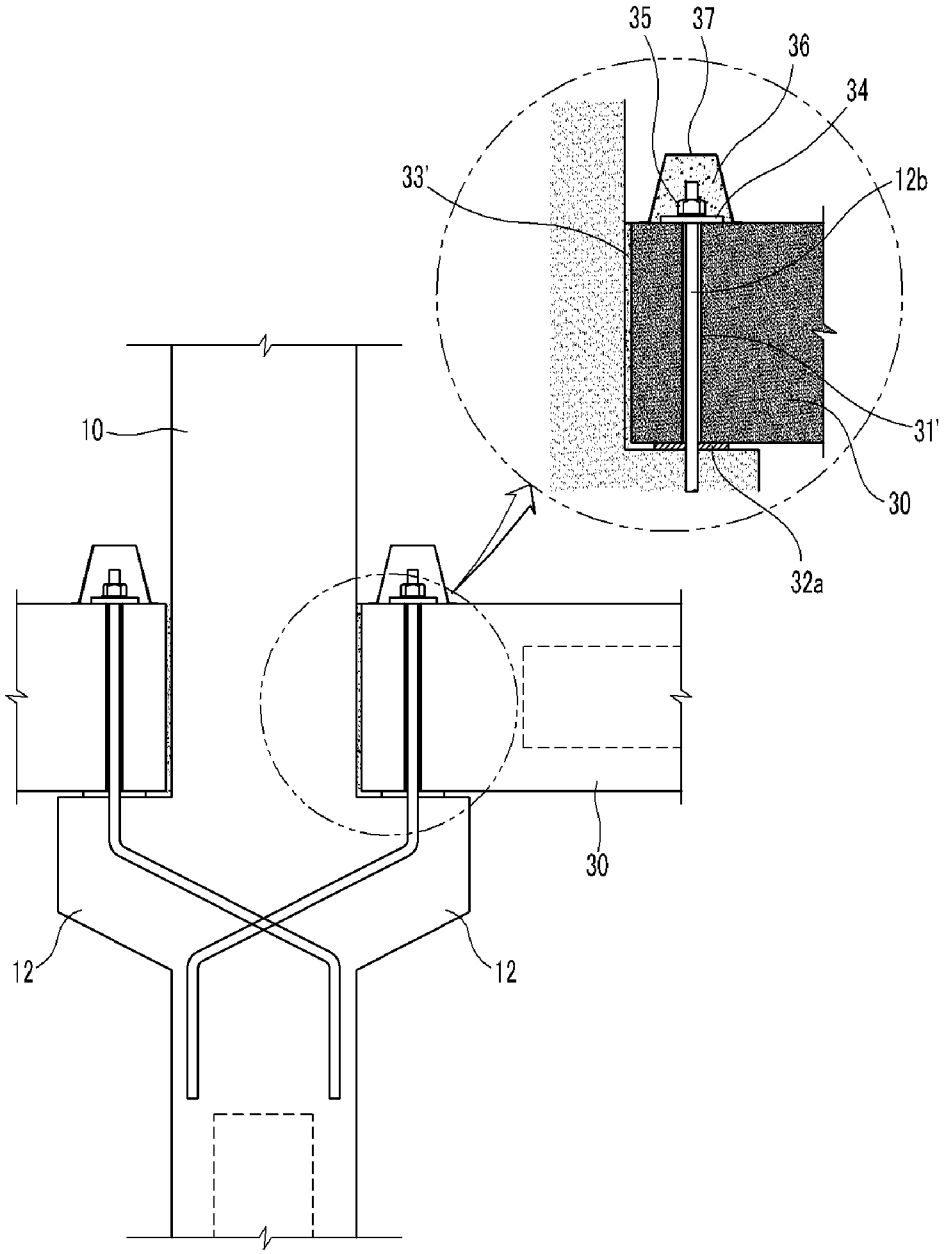
[Fig. 16]


10
15
16
17'
14(27)
13'
18

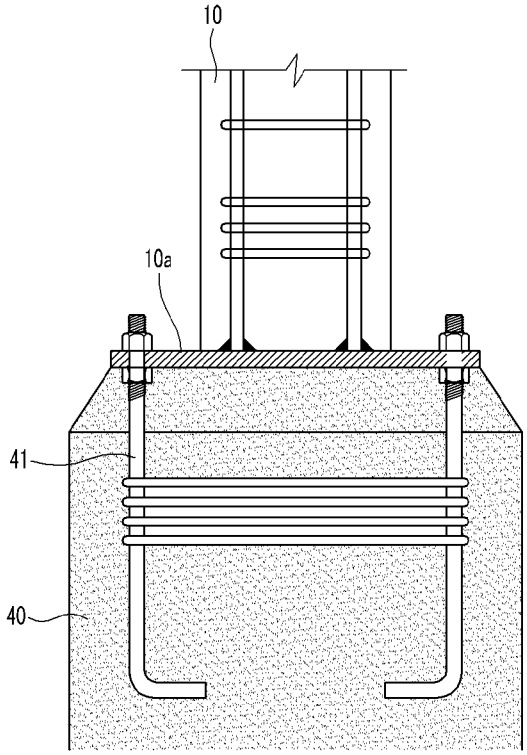
[Fig. 17]



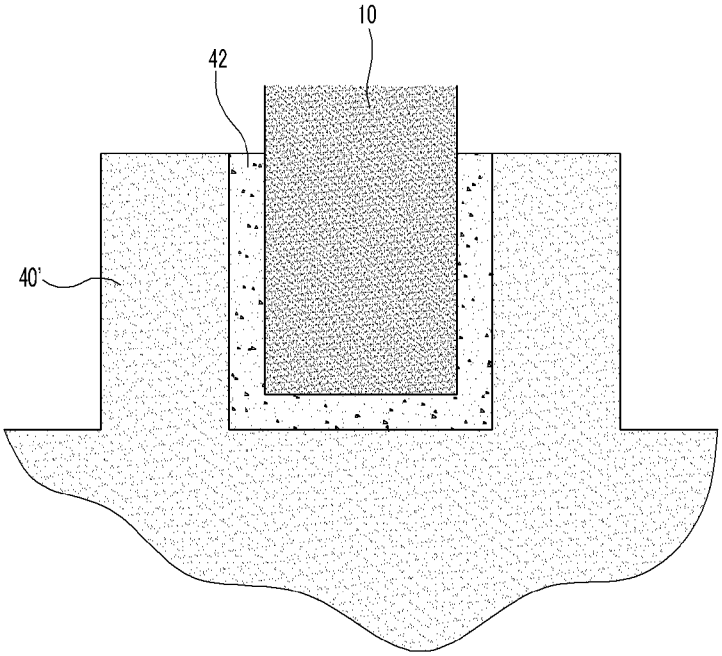
[Fig. 18]



[Fig. 19]



[Fig. 20]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/003688

A. CLASSIFICATION OF SUBJECT MATTER

E04C 3/20(2006.01)i, E04B 1/20(2006.01)i, F16L 3/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC E04C 3/20, E04B 1/20, F16L 3/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility Models and applications for Utility Models since1975
Japanese Utility Models and applications for Utility Models since1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) & Keyword : precast, beam, column, and cavity

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y		2,4,6
Y	KR 10-2001-0046006 A (YI, WON HO et al.) 05 June 2001 See figure 3.	2,4,6
Y	KR 10-0807395 B1 (SAMSUNG CORPORATION) 28 February 2008 See figure 4.	2,4,6
Y	KR 10-2006-0000492 A (WOOLIM C&C CO., LTD.) 06 January 2006 See figures 1-3.	4
A	US 4,951,438 A (BJORN O. THORESEN) 28 August 1990 See figures 1-5.	1-6
A	US 5,887,405 A (RENE CARRANZA-AUBRY) 30 March 1999 See figure 7.	1-6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 MARCH 2009 (12.03.2009)	**13 MARCH 2009 (13.03.2009)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/003688

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