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(71) Applicant: **Korea Hydro&Nuclear Power Co. Ltd**
Gyeongsangbuk-do 780-010 (KR)

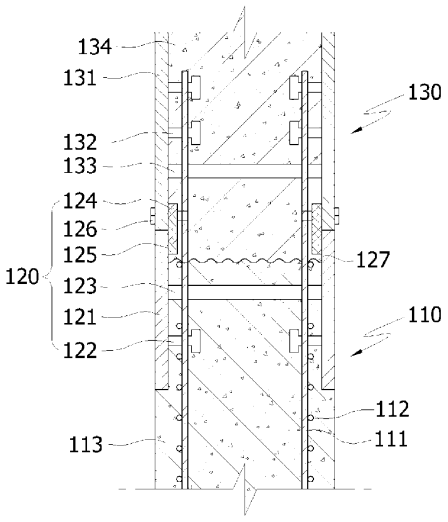
(72) Inventors:
- **LEE, Han-woo**
  Daejeon 302-120 (KR)
- **KIM, Jong-hak**
  Daejeon 305-761 (KR)
- **CHO, Seong-il**
  Daejeon 305-758 (KR)
- **LEE, Jong-bo**
  Daejeon 302-120 (KR)
- **NOH, Sang-hoon**
  Daejeon 305-793 (KR)

(74) Representative: **Habermann, Hruschka & Schnabel**
Montgelasstrasse 2
81679 Munich (DE)

(54) CONNECTION METHOD BETWEEN STEEL-PLATE CONCRETE STRUCTURE AND DIFFERENT STRUCTURE

(57) The present invention relates to a connection method between a steel-plate concrete structure and a different structure in which stress reduction on a connection surface between the steel-plate concrete structure (SC) and the different structure is prevented when the steel-plate concrete structure and the different structure are connected to each other, and a load is continuously and uniformly transmitted into a wall structure to improve connection performance between the steel-plate concrete structure and the different structure. To this end, the connection method between a steel-plate concrete structure, in which concrete is filled between steel plates facing and spaced apart from each other, and a different concrete structure, in which concrete is constructed on an iron reinforcing bar or an iron-frame reinforcing bar, includes: disposing a mold around a space in which concrete is constructed to form the different concrete structure to dispose iron reinforcing bars or iron-frame reinforcing bars inside the mold so that the iron reinforcing bars or the iron-frame reinforcing bars are vertically and horizontally cross-coupled to each other; disposing a steel plate to be connected on a portion of an inner surface of the mold in a direction in which the steel-plate concrete structure and the steel plate for connection are connected to each other; constructing concrete into an inner space of the mold to form a different concrete structure; coupling a steel plate for the steel-plate concrete structure to the steel plate for connection; and constructing concrete inside the steel plate for the steel-plate concrete structure to integrally connect the steel-plate concrete structure to the different concrete structure.

Fig. 3



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Description

TECHNICAL FIELD

[0001] The present invention relates to a connection method between a steel plate concrete structure and a different structure, and more particularly, a connection method between a steel-plate concrete structure and a different structure, in which a steel plate for connecting is previously installed on a portion of a different concrete structure to be connected to the steel-plate concrete structure to secure integrity and construct ability with the steel-plate concrete structure that is connected to the different concrete structure in a follow-up process and continuously and uniformly transmit a load without causing stress reduction on a connection surface, thereby improving connection performance between the steel plate concrete structure and the different concrete structure.

BACKGROUND ART

[0002] Methods for constructing walls of a structure according to a related art include construction methods using a reinforced concrete (RC) structure, a steel framed reinforced concrete (SRC) structure, and a steel plate concrete (SC) structure.

[0003] The RC structure may be a structure in which a compressive force of concrete and a tension force of an iron reinforcing bar are integrated with each other to supplement each other's faults. The SRC structure may be a structure in which a steel frame is coated with reinforced concrete and thus is reinforced. That is, the steel fame resists an external force, and the reinforced concrete surrounding the steel frame protects and reinforces the steel frame when a fire occurs.

[0004] The RC structure and the SRC structure may have relatively long construction duration because a mold and an iron reinforcing bar or steel fame are directly assembled in sites, and then concrete is constructed to construct structures.

[0005] According to the SC structure that is developed for supplementing the above-described limitations, concrete is filled between a pair of steel plates facing each other, a plurality of studs protrudes from inner walls of the steel plates so that the concrete and the steel plates are integrated with each other, and both ends of a tie bar are coupled to the inner walls of the steel plates so that a distance between the steel plates is constantly maintained.

[0006] When the walls of the structure are constructed according to the related art, connection technologies between structures of the same kind among the RC structure, the SRC structure, and the SC structure are being utilized. According to a wall connection method between structures of the same kind in the RC structure and the SRC structure, an iron reinforcing bar or iron-frame reinforcing bar are installed inside the wall, and then concrete is constructed to connect the iron reinforcing bar or iron-frame reinforcing bar to the concrete. That is, a special connection technology is not required for a wall connection portion between structures of the same kind. However, a connection surface may occur merely according to requirements with respect to a design and construction. This will be described with reference to the accompanying drawings.

[0007] FIGS. 1 and 2 are longitudinal cross-sectional views of a vertical connection between walls of an RC structure according to a related art, wherein FIG. 1 is a longitudinal cross-sectional view when a slab does not exist, and FIG. 2 is a longitudinal cross-sectional view when the slab exists.

[0008] In a wall connection method of an RC structure according to the related art, as shown in FIG. 1, a lower RC structure 10 is constructed, and then an upper RC structure 20 having the same structure as the lower RC structure 10 is connected to an upper portion of the lower RC structure 10. That is, concrete 13 is constructed into an iron reinforcing bar structure in which a vertical iron reinforcing bar 11 and a horizontal iron reinforcing bar 12 are coupled to each other to construct a lower RC structure 10. Then, a portion of a lower end of a vertical iron reinforcing bar 21 is coupled to the vertical iron reinforcing bar 11 protruding upward from a connection surface 13 that is disposed on an upper end of the concrete 13, and a concrete 23 is constructed into an iron reinforcing bar structure in which a horizontal iron reinforcing bar is coupled to the vertical iron reinforcing bar 21 to construct an upper RC structure 20, thereby constructing a wall structure.

[0009] For another example, as shown in FIG. 2, concrete 33 is constructed into an iron reinforcing bar structure in which a slab iron reinforcing bar 31 and a horizontal iron reinforcing bar 32 are coupled to each other to construct a slab RC structure 30, and then the slab RC structure 30 is connected to a side of the lower RC to construct a wall structure.

[0010] As described above, the RC structure and the SRC structure that are structures according to the related art have a limitation in reduction of construction duration, The SC structure that is a new structure is advantageous in reduction of construction duration because mold stripping and iron reinforcing bar installation processes are omitted. Thus, usability of the SC structure is increasing. However, to extend use of the SC structure that is advantageous in the reduction of construction duration, a technology for connecting the SC structure to the RC structure is needed.

[0011] However, in the related art, only the connection technology between structures of the same kind is applied, and also, connection technologies between different structures, i.e., technologies for connecting the SC structure to the RC structure or the SRC structure are inadequate in development. Thus, since stress reduction on the connection surface occurs, and a load is not continuously and uniformly transmitted, the wall structure may be weak.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0012] The present invention provides a connection method between a steel plate concrete structure and a different structure in which stress reduction on a connection surface between the steel plate concrete SC structure and the different structure is prevented when the steel plate concrete structure and the different structure are connected to each other, and a load is continuously and uniformly transmitted into a wall structure to improve connection performance between the steel plate concrete and the different structure.

TECHNICAL SOLUTION

[0013] Embodiments of the present invention provide a connection method between a steel plate concrete structure, in which concrete is filled between steel plates facing and spaced apart from each other, and a different concrete structure, in which concrete is constructed on an iron reinforcing bar or iron-frame reinforcing bar, the connection method including: disposing a mold around a space in which the concrete is constructed to form the different concrete structure to dispose the iron reinforcing bar or iron-frame reinforcing bar inside the mold so that the iron reinforcing bar or iron-frame reinforcing bar is vertically and horizontally cross-coupled to each other; disposing a steel plate for connection on a portion of an inner surface of the mold in a direction in which the steel plate for connection and the steel plate concrete structure are connected to each other; constructing concrete into an inner space of the mold to form the different concrete structure; coupling a steel plate for the steel plate concrete structure to the steel plate for connection; and constructing concrete inside the steel plate of the steel plate concrete structure to integrally connect the steel plate concrete structure to the different concrete structure.

[0014] In this case, the disposing of the iron reinforcing bar or iron-frame reinforcing bar inside the mold so that the iron reinforcing bar or iron-frame reinforcing bar is vertically and horizontally cross-coupled to each other may include disposing the iron reinforcing bar or iron-frame reinforcing bar so that the iron reinforcing bar or iron-frame reinforcing bar extends from an inner space of the different concrete structure to an inner space of the steel plate concrete structure.

[0015] Also, a plurality of studs may protrude from each of inner surfaces facing each other of the steel plate for connection and the steel plate for the steel plate concrete structure, and both ends of a tie bar may be fixed to the inner surfaces facing each other.

[0016] Also, the coupling of the steel plate for the steel plate concrete structure to the steel plate for connection may include: disposing the steel plate for connection and the steel plate for the steel plate concrete structure so that an end of the steel plate for connection contacts an end of the steel plate for the steel plate concrete structure; disposing a flat bar on an inner surface of a boundary on which the steel plate for connection and the steel plate for the steel plate concrete structure contact each other; and coupling connection surfaces of the flat bar, the steel plate for connection, and the steel plate for the steel plate concrete structure to each other.

[0017] Also, the connection surfaces of the flat bar, the steel plate for connection, and the steel plate for the steel plate concrete structure may be fixed through welding or screw coupling.

ADVANTAGEOUS EFFECTS

[0018] According to the connection method between the SC structure and the different structure, the SC structure and the different structure may be integrally connected to each other to improve structural performance (interface shear performance and out of plane load performance) and the construct ability. Thus, since the SC structure is extended in use, the construction duration may be reduced.

[0019] Also, according to the present invention, the SC structure and the RC or SRC structure are integrally coupled to each other by using the connection surface as the medium to continuously and uniformly transmit the load without causing the stress reduction on the connection surface, thereby improving the connection performance between the SC structure and the different structure and stably constructing the wall structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIGS. 1 and 2 are longitudinal cross-sectional views of a vertical connection between walls of an RC structure according to a related art, wherein FIG. 1 is a longitudinal cross-sectional view when a slab does not exist, and FIG. 2 is a longitudinal cross-sectional view when the slab exists,

[0021] FIGS. 3 and 4 are longitudinal cross-sectional views of a vertical connection between walls of a steel plate concrete (SC) structure and a different structure according to an embodiment of the present invention, wherein FIG. 3 is a longitudinal cross-sectional view when a slab does not exist, and FIG. 4 is a longitudinal cross-sectional view when the slab exists,

[0022] FIGS. 5 to 8 are cross-sectional views illustrating a construction sequence for each process in a connection method between an SC structure and a different structure according to an embodiment of the present invention,

[0023] FIG. 9 is a flowchart illustrating a connection method between the SC structure and the different structure according to an embodiment of the present invention,

[0024] FIG. 10 is a cross-sectional view illustrating horizontal connection between walls of an SC structure and a different structure according to another embodiment of

the present invention.

[0025] * DESCRIPTION OF REFERENCE NUMERALS *

[0026] 10: Lower reinforced concrete structure 11: Vertical iron reinforcing bar

[0027] 12: Horizontal iron reinforcing bar 13: Concrete

[0028] 15: Connection surface 20: Upper reinforced concrete structure

[0029] 21: Vertical iron reinforcing bar 22: Horizontal iron reinforcing bar

[0030] 23: Concrete 30: Slab reinforced concrete structure

[0031] 31: Slab iron reinforcing bar 32: Horizontal iron reinforcing bar

[0032] 33: Concrete 101: Mold

[0033] 110: Reinforced concrete structure 111: Vertical iron reinforcing bar

[0034] 112: Horizontal iron reinforcing bar 113: Concrete

[0035] 120: Connection part 121: lower steel plate

[0036] 122: Stud 123: Tie bar

[0037] 124: Flat bar 125: Welded part

[0038] 126: Coupling bolt 130: Steel plate concrete structure

[0039] 131: Upper steel plate 132: Stud

[0040] 133: Tie bar 134: Concrete

[0041] 140: Slab reinforced concrete structure 141: Bottom steel plate

[0042] 142: Stud 144: Slab iron reinforcing bar

[0043] 210: Reinforced concrete structure 211: Vertical iron reinforcing bar

[0044] 212: Horizontal iron reinforcing bar 213: Concrete

[0045] 221: Steep plate for connection 222: Stud

[0046] 223: Tie bar 224: Flat bar

[0047] 225: Welded part 226: Coupling bolt

[0048] 227: Connection surface 230: Steel plate concrete structure

[0049] 231: Steel plate 232: Stud

[0050] 233: Tie bar 234: Concrete

MODE FOR CARRYING OUT THE INVENTION

[0051] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0052] FIGS. 3 and 4 are longitudinal cross-sectional views of a vertical connection between walls of a steel plate concrete (SC) structure and a different structure according to an embodiment of the present invention, wherein FIG. 3 is a longitudinal cross-sectional view when a slab does not exist, and FIG. 4 is a longitudinal cross-sectional view when the slab exists.

[0053] As shown in FIGS. 3 and 4, a connection method between a steel plate concrete structure and a different structure according to an embodiment of the present invention relates to a construction method of a structure in which a steel plate concrete (SC) structure 130 is connected to an upper portion of a lower reinforced concrete (RC) structure 110 by using a connection part 120 as a medium. Before processes of the connection method are described, a structure in which the SC structure is connected to a different structure will be described below.

[0054] Referring to FIG. 3, the RC structure 110 installed at a lower side may be a structure in which concrete 113 is constructed into a vertical iron reinforcing bar 111 and a horizontal iron reinforcing bar 112 and thus the concrete 113 are coupled to the vertical and horizontal iron reinforcing bars 111 and 112. Here, a lower steel plate 121 is coupled to a portion of an outer surface of an upper portion of the RC structure 110.

[0055] The connection part 120 may serve as a medium unit for integrally connecting the SC structure 130 to the upper portion of the RC structure 110. The connection part 120 includes lower steel plates 121. Also, a plurality of studs 122 for easily attaching the concrete 113 thereto protrude inward from an inner surface of each of the lower steel plates 121. A tie bar 123 for constantly maintaining a spaced distance between the lower steel plates 121 is coupled to the lower steel plates 121 facing each other.

[0056] Also, a flat bar 124 disposed inside a boundary on which an upper end of the lower steel plate 121 contacts a lower end of an upper steel plate 131 is welded and coupled to an inner surface of the lower steel plate 121. The flat bar 124 and the upper steel plate 131 are coupled to each other by a coupling bolt 126. An unexplained reference numeral 125 represents a welded part between the flat bar 124 and the lower steel plate 121 on the connection surface.

[0057] In the SC structure 130, the plurality of studs 132 and the tie bar 133 are coupled to the inner surface of the upper steel plate 131. Also, concrete 134 is filled between the upper steel plates 131 on the connection surface 127.

[0058] As described above, since the upper SC structure 130 is integrally connected to the lower RC structure 110 by using the connection part 120 as a medium, the connection between different structures may be smoothly performed to improve construct ability. Also, the connection portions of the SC structure 130 and the RC structure 110 may be improved in hardness and strength to prevent stress from be reduced in the connection surface 127 and uniformly maintain load distribution.

[0059] In the embodiment of FIG. 4, a slab RC structure 140 is additionally connected to a side of the RC structure 110 of the connection structure of FIG. 3. The slab RC structure 140 includes a plurality of studs 142 on a top surface of a bottom steel plate 141. Also, an upper space of the bottom steel plate 141 has a structure in which the concrete 113 is constructed into a slab iron reinforcing bar 114 in a horizontal direction.

[0060] According to the present invention, since the SC structure and the different structure are easily connected to each other in a horizontal direction as well as in a vertical direction, the various connection structures may be allowable in design.

[0061] Hereinafter, the connection method between the SC structure and the different structure according to the present invention will be described with reference to the embodiment of FIG. 3.

[0062] FIGS. 5 to 8 are cross-sectional views illustrating a construction sequence for each process in a connection method between an SC structure and a different structure according to an embodiment of the present invention, and FIG. 9 is a flowchart illustrating a connection method between the SC structure and the different structure according to an embodiment of the present invention.

[0063] Referring to FIG. 5, to realize the RC structure 110 having a structure different from an SC structure 130, a mold 101 is disposed around a space in which concrete 113 is constructed. Also, an iron reinforcing bar structure in which a vertical iron reinforcing bar 111 and a horizontal iron reinforcing bar 112 are coupled to each other is disposed inside a mold 101 (S10). Here, the vertical iron reinforcing bar 111 extends up to an inner space of the SC structure 130 connected to an upper portion of the RC structure 110.

[0064] Also, lower steel plates 121 facing each other are disposed on upper inner surfaces of the mold 101, respectively. A plurality of studs 122 are disposed on an inner surface of each of the lower steel plates 121. Both ends of a tie bar 123 are coupled between the lower steel plates 121 to maintain the lower steel plates 121 at a predetermined distance (S20).

[0065] Next, a plurality of flat bars 124 are coupled to the upper inner surface of the lower steel plate 121 at a predetermined distance. The upper steel plate 131 may be easily coupled to the upper portion of the lower steel plate 121 by the flat bars 124 in a follow-up process. The lower steel plate 121 and the flat bars 124 may be coupled to each other around a connection surface by welding.

[0066] Referring to FIG. 6, the concrete 113 is constructed into an inner space of the molds 101 to cure the concrete 113 for a predetermined time, thereby forming the RC structure 110 (S30).

[0067] Referring to FIG. 7, the mold 101 is removed, and the upper steel plate 131 is disposed on the lower steel plate 121. Then, the upper steel plate 131 and the flat bars 124 are coupled to each other by using a coupling bolt 126 (S40).

[0068] Although the lower steel plate 121 and the flat bars 124 are coupled to each other through welding, and the upper steel plate 131 and the flat bars 124 are coupled to each other through the coupling bolt 126 in the current embodiment, the present invention is not limited thereto. For example, the welding method may be applied to the current embodiment. Alternatively, the welding method and the bolt coupling method may be applied to the current embodiment at the same time. Also, if the upper steel plate 131 and the flat bars 124 are not coupled through the welding or the bolt, the upper steel plate 131 and the lower steel plate 121 may be coupled to each other through the welding.

[0069] Then, concrete 134 is constructed into an inner space of the upper steel plates 131 to cure the concrete 134, thereby integrally connecting the SC structure 130 to the RC structure 110 (S50).

[0070] FIG. 10 is a cross-sectional view illustrating horizontal connection between walls of an SC structure and a different structure according to another embodiment of the present invention.

[0071] Although the method for constructing the structure in which the RC structure 110 is disposed at a lower side, and the SC structure 130 is vertically connected to the upper portion of the RC structure 110 is described in the above-described embodiment, the present invention is not limited thereto. For example, as shown in another embodiment of FIG. 10, an SC structure 230 and an RC structure 210 may be horizontally connected to each other by using a connection part 220 as a medium.

[0072] In a construction method of the connection structure illustrated in FIG. 10, an iron reinforcing bar structure in which a vertical iron reinforcing bar 211 and a horizontal iron reinforcing bar 212 are coupled to each other is installed in an inner space of a portion in which the SC structure 210 will be formed. Here, the horizontal iron reinforcing bar 212 may extend up to a space in which the SC structure 230 will be formed.

[0073] Next, a mold (not shown) is installed around a space in which the RC structure 210 will be formed. A steel plate 221 for connection to which a stud 222, a tie bar 223, and a flat bar 224 are coupled is fixed to an inner surface of a side of the mold. Also, concrete 213 is constructed into an inner space that is surrounded by the mold and the steel plate 221 for connection to cure the concrete 213, thereby completing the RC structure 210.

[0074] When the RC structure 210 is completed, the mold is removed, and an end of a steel plate 231 constituting the RC structure 230 is connected to an end of the steel plate 221 for connection. Then, the steel plate 231 and the flat bar 224 are coupled to each other by a coupling bolt 226.

[0075] In this case, the coupling among the steel plate 221 for connection, the steel plate 231, and the flat bar 224 may be performed through the same method as the above-described embodiments.

[0076] Next, concrete 234 is constructed into an inner space that is surrounded by the steel plate 231 to cure the concrete 234, thereby integrally connecting the SC structure 230 to the RC structure 210.

[0077] An unexplained reference numeral 225 represents a welded part between the flat bar 224 and the steel plate 221 for connection. Also, a reference numeral 227 represents a connection surface between the concrete 213 of the RC structure 210 and the concrete 234 of the SC structure 230.

[0078] Although the connection method between the SC structure and the RC structure is described as an example in the above-described embodiments, the present invention may be equally applied to a connection method between the SC structure and a steel framed

reinforced concrete (SRC) structure.

[0079] Also, although an unstiffened steel plate concrete (USC) structure, in which a structural material (H beam) is not provided, of the SC structure is described as an example in the above-described embodiments, the present invention may be applied to a stiffened steel plate concrete (SSC) structure that is reinforced by the structural material (H beam).

Claims

1. A connection method between a steel plate concrete structure, in which concrete is filled between steel plates facing and spaced apart from each other, and a different concrete structure, in which concrete is constructed on an iron reinforcing bar or iron-frame reinforcing bar, the connection method comprising:

   disposing a mold around a space in which the concrete is constructed to form the different concrete structure to dispose the iron reinforcing bar or iron-frame reinforcing bar inside the mold so that the iron reinforcing bar or iron-frame reinforcing bar is vertically and horizontally cross-coupled to each other;
   disposing a steel plate for connection on a portion of an inner surface of the mold in a direction in which the steel plate for connection and the steel plate concrete structure are connected to each other;
   constructing concrete into an inner space of the mold to form the different concrete structure;
   coupling a steel plate for the steel plate concrete structure to the steel plate for connection; and
   constructing concrete inside the steel plate of the steel plate concrete structure to integrally connect the steel plate concrete structure to the different concrete structure.

2. The connection method of claim 1, wherein the disposing of the iron reinforcing bar or iron-frame reinforcing bar inside the mold so that the iron reinforcing bar or iron-frame reinforcing bar is vertically and horizontally cross-coupled to each other comprises disposing the iron reinforcing bar or iron-frame reinforcing bar so that the iron reinforcing bar or iron-frame reinforcing bar extends from an inner space of the different concrete structure to an inner space of the steel plate concrete structure.

3. The connection method of claim 1, wherein a plurality of studs protrude from each of inner surfaces facing each other of the steel plate for connection and the steel plate for the steel plate concrete structure, and both ends of a tie bar are fixed to the inner surfaces facing each other.

4. The connection method of claim 1, wherein the coupling of the steel plate for the steel plate concrete structure to the steel plate for connection comprises:

   disposing the steel plate for connection and the steel plate for the steel plate concrete structure so that an end of the steel plate for connection contacts an end of the steel plate for the steel plate concrete structure;
   disposing a flat bar on an inner surface of a boundary on which the steel plate for connection and the steel plate for the steel plate concrete structure contact each other; and
   coupling connection surfaces of the flat bar, the steel plate for connection, and the steel plate for the steel plate concrete structure to each other.

5. The connection method of claim 4, wherein the connection surfaces of the flat bar, the steel plate for connection, and the steel plate for the steel plate concrete structure are fixed through welding or screw coupling.

Fig. 1

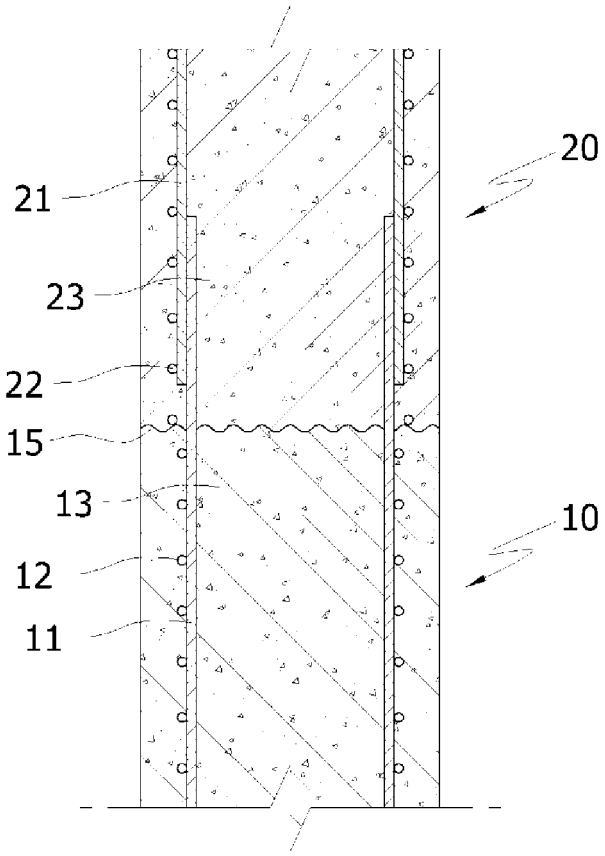

Fig. 2

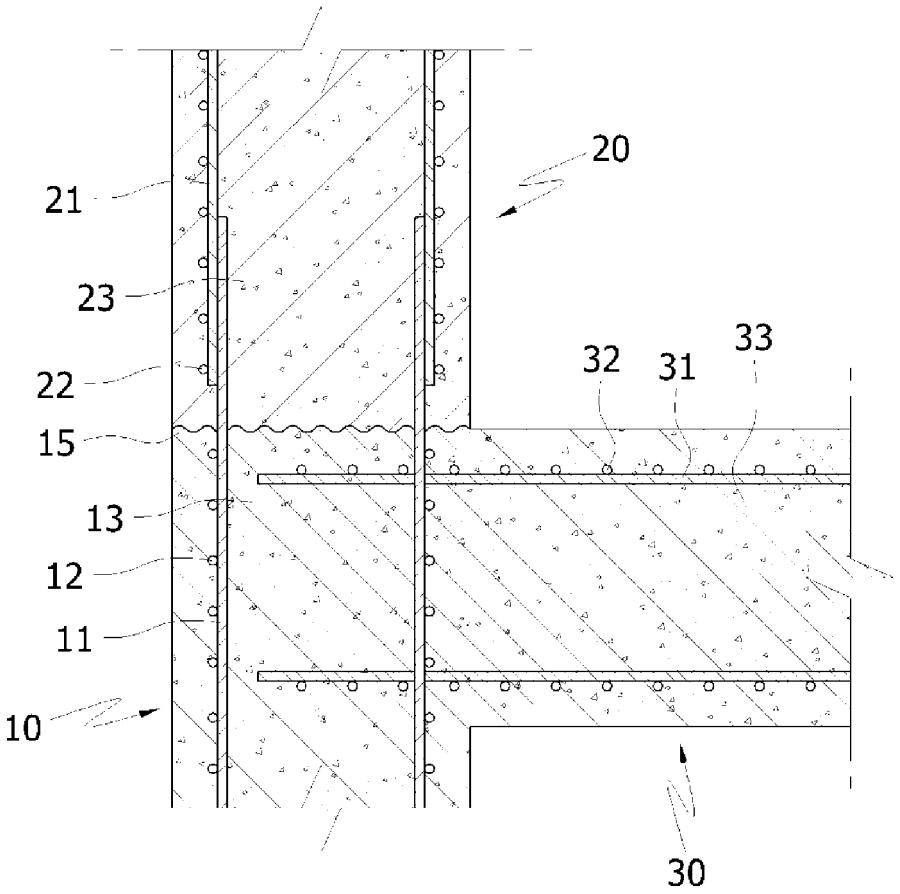

Fig. 3

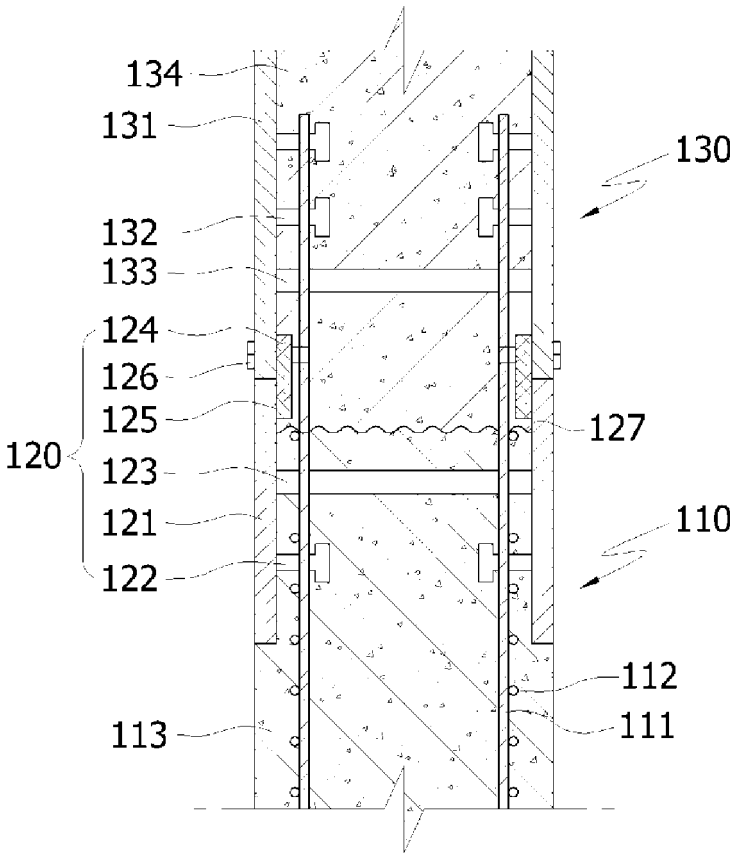
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Fig. 4

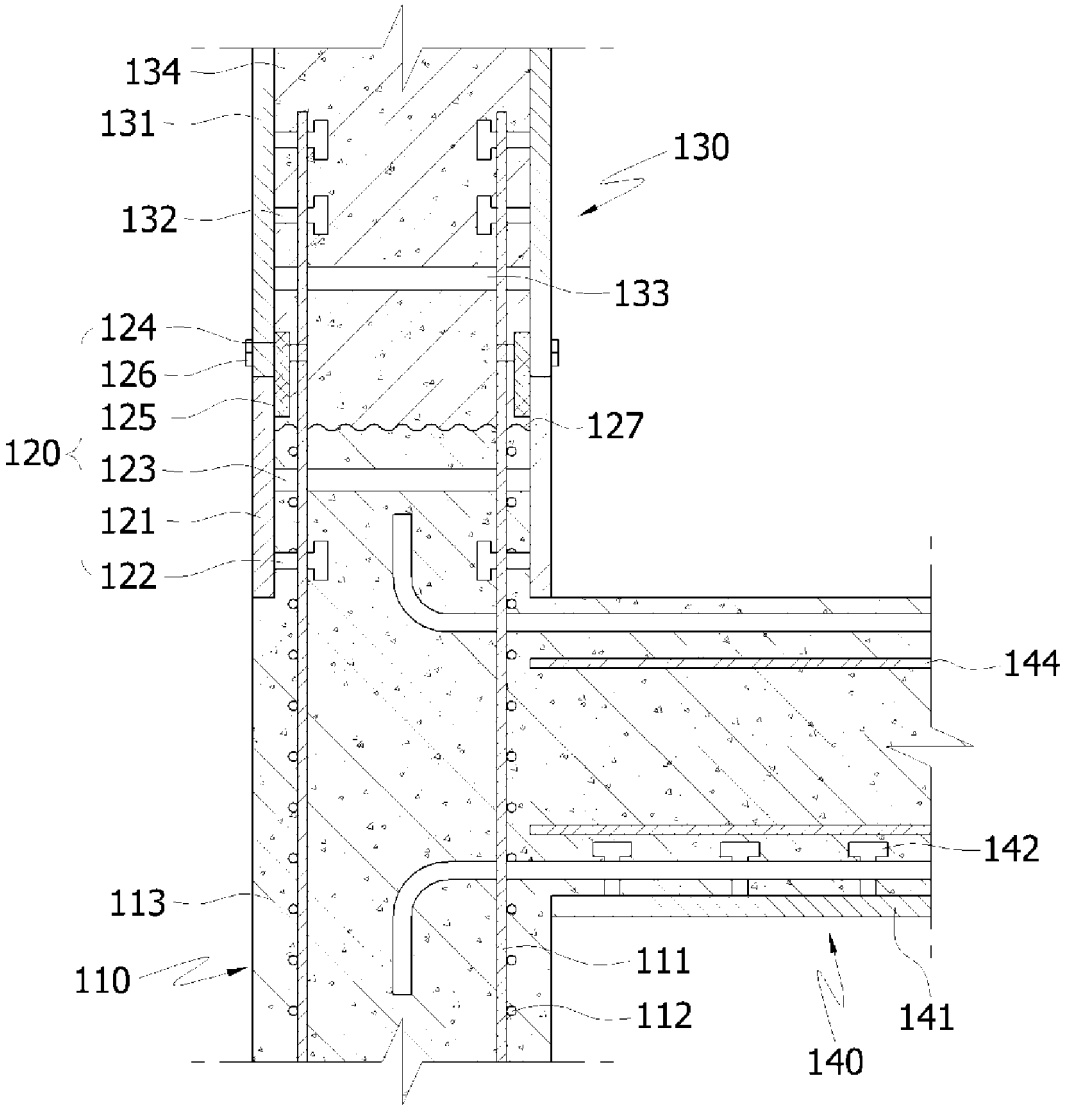
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Fig. 5

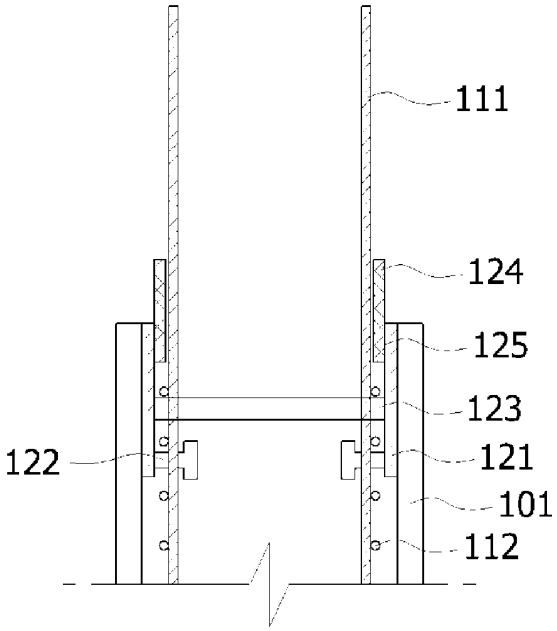
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Fig. 6

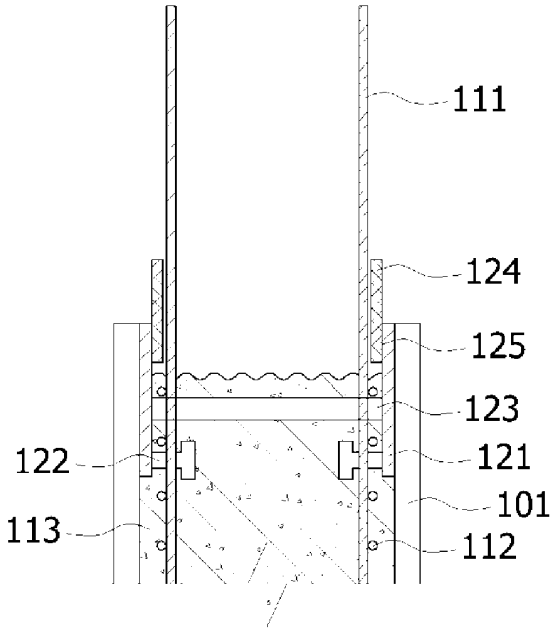
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Fig. 7

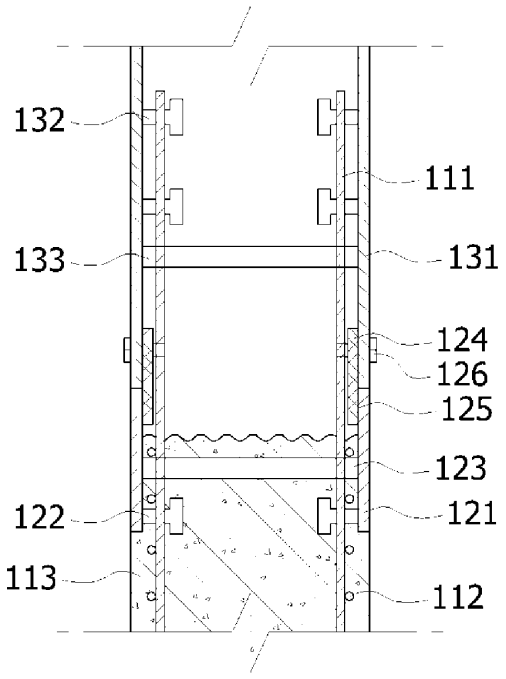
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Fig. 8

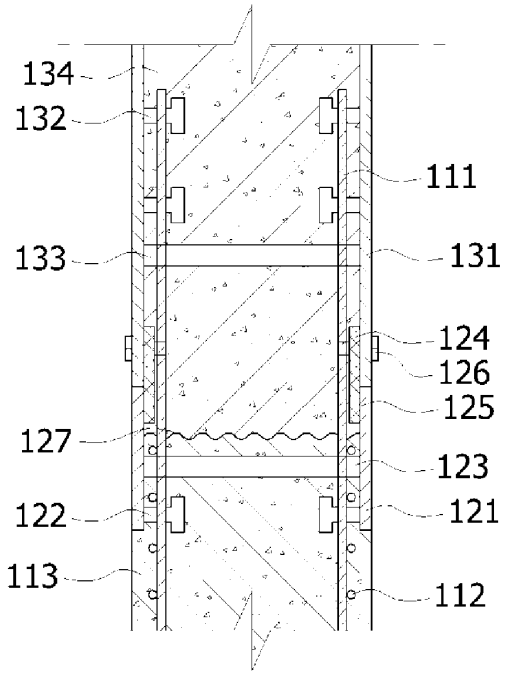
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Fig. 9

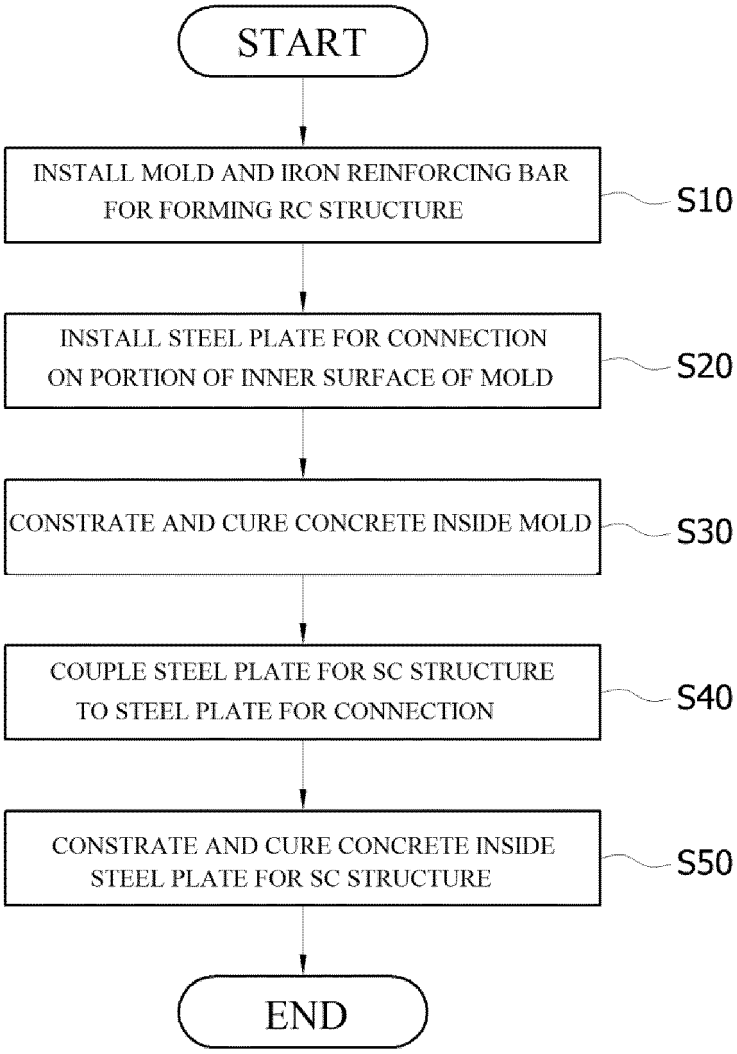
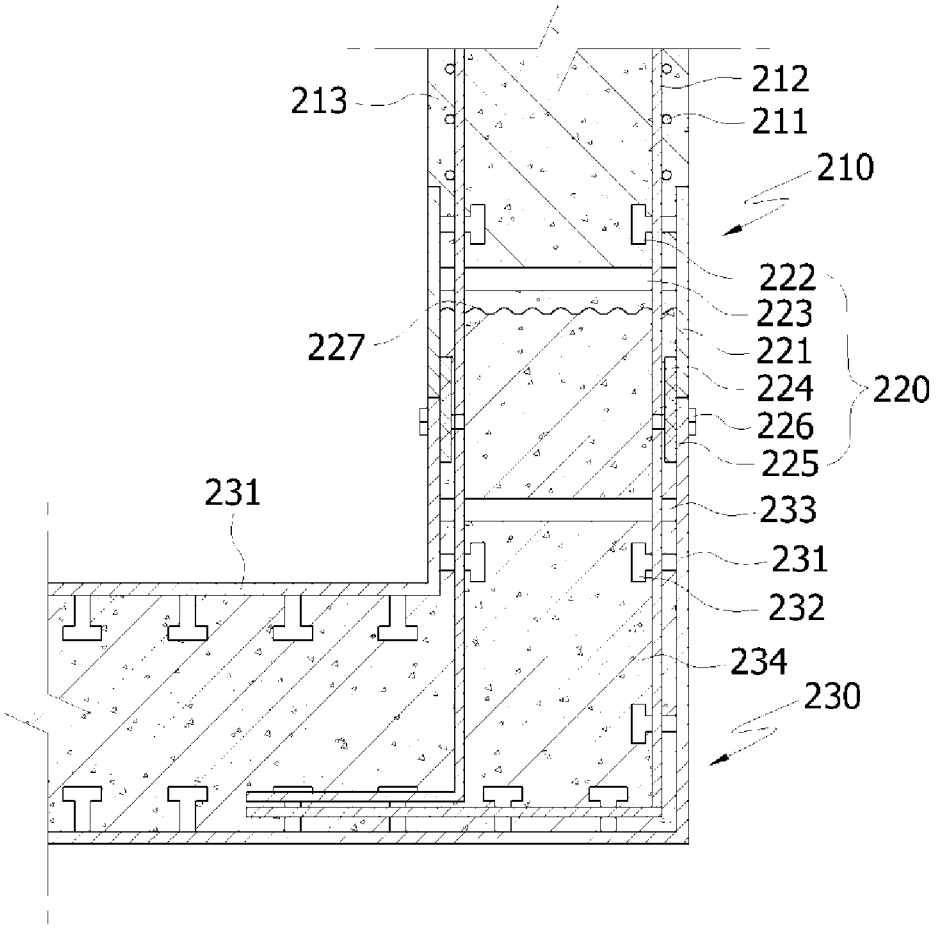

START
INSTALL MOLD AND IRON REINFORCING BAR FOR FORMING RC STRUCTURE
S10
INSTALL STEEL PLATE FOR CONNECTION ON PORTION OF INNER SURFACE OF MOLD
S20
CONSTRATE AND CURE CONCRETE INSIDE MOLD
S30
COUPLE STEEL PLATE FOR SC STRUCTURE TO STEEL PLATE FOR CONNECTION
S40
CONSTRATE AND CURE CONCRETE INSIDE STEEL PLATE FOR SC STRUCTURE
S50
END

Fig. 10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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2010/006555

A. CLASSIFICATION OF SUBJECT MATTER

E04B 1/28(2006.01)i, E04B 1/58(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)

E04B 1/28; E02D 23/00; E04B 1/61; E04B 1/04; E04B 1/16; E04B 1/41; E02B 3/06; E04B 1/30

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: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: reinforced concrete, joint, connet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003-049489 A (KAJIMA CO. et al.) 21 February 2003 See figures 1-21.	1-5
A	JP 2009-024359 A (SHIMIZU CO. et al.) 05 February 2009 See figures 1-22.	1-5
A	JP 2009-084930 A (RAILWAY TECHNICAL RES INST) 23 April 2009 See figures 1-6.	1-5
A	JP 11-006125 A (MITSUBISHI HEAVY IND., LTD.) 12 January 1999 See figures 1-9.	1-5

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

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 SEPTEMBER 2011 (26.09.2011)	**26 SEPTEMBER 2011 (26.09.2011)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2010/006555

Patent document cited in search report	Publication date	Patent family member	Publication date
JP 2003-049489 A	21.02.2003	JP 03-899866 B2 US 2003-0029111 A1	28.03.2007 13.02.2003
JP 2009-024359 A	05.02.2009	NONE	
JP 2009-084930 A	23.04.2009	NONE	
JP 11-006125 A	12.01.1999	JP 3426916 B2	14.07.2003

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