

[DESCRIPTION]

PRECAST CONCRETE STAIRWELL CONSTRUCTION METHOD

[Technical Field]

[1] The present invention relates to a method of constructing a stairwell using precast concrete (hereinafter referred to as PC), and more particularly to a precast concrete stairwell construction method of constructing a stairwell in a high-rise building using PC having suitable size and weight for transportation and lifting while reducing the number of lifts and the number of joint positions, enabling safer and simpler assembly, and combining PC with cast-in-place concrete to achieve higher structural integrity than when connected solely by PC.

[Background Art]

[2] In general, a stairwell in a building is constructed by first forming the foundation (floor slab) and then forming a concrete exterior wall with stairs and stair landings in contact with an inner surface of the exterior wall thereon through concrete pouring on site using formwork, which is repeated for each floor.

[3] Such a conventional stairwell construction method requires installation of formwork for walls, pouring concrete, curing the concrete, and removing the formwork before proceeding to the

next process, resulting in cumbersome work and prolonged construction periods.

[4] In order to address these issues, a stairwell construction method using PC structures has been proposed, wherein the method includes pre-fabricating walls, stair treads, and stair landings using concrete at the factory, transporting the same to the site, lifting the same into position, assembling the same, and joining the same to each other to construct a prefabricated stairwell.

[5] The most widely used stairwell construction method using PC structures includes forming four walls constituting a unit stairwell using four flat PC walls, separately fabricating a stair tread and stair landings, and assembling the same into an integrated unit (see FIG. 11). In addition, there is a more advanced method of forming a single box-shaped PC wall with a "□"-shaped section instead of four separate PC walls, separately fabricating a stair tread and stair landings, and assembling the same into an integrated unit (see FIG. 12). Furthermore, a method of horizontally dividing a unit stairwell into two segment structures, each including a "["-shaped wall with half-sized stair landings and a half-sized stair tread, and assembling the two segment structures by joining has also been developed (see FIG. 13).

[6] However, the conventional methods of constructing stairwells using PC as described above have the following problems.

[7] In the conventional stairwell construction methods, the size and weight of segment structures vary depending on how the segment structures are divided, which may make transportation of the segment structures from the factory to the site and lifting of the segment structures at the site difficult or even impossible. This is because the maximum transportable size and weight are specified under the Road Act or the Road Traffic Act and lifting at the site is only possible within the lifting capacity limit of equipment available for specific site conditions.

[8] Therefore, among the construction methods described above, the two methods other than the first construction method shown in FIG. 11, which forms the largest number of segment structures, have the disadvantage of extremely limited applicability and inevitable use of large-capacity equipment.

[9] For high-rise buildings in particular, tower cranes are the only feasible lifting equipment option. However, tower cranes have relatively limited lifting capacity, making it very difficult to employ the two methods other than the first construction method.

[10] Conversely, in the first method, an excessive number of segments are formed, which facilitates transportation and lifting; however, the number of lifting operations increases and significant time is taken for lifting and joining, which prolongs the construction schedule. Furthermore, the increased

number of joints may compromise the structural integrity of a finished structure.

[11] Despite PC being preferred as a solution to address issues, such as schedule delays and quality degradation, caused by worsening labor shortages on construction sites, stairwells in high-rise buildings are not constructed using PC due to the reasons mentioned above.

[12] In many high-rise buildings, a stairwell is constructed using rigid reinforced concrete regardless of whether the structural system of the building is steel or reinforced concrete since the stairwell must structurally serve as the backbone, and construction is done using cast-in-place concrete rather than PC.

[Disclosure]

[Technical Problem]

[13] The present invention has been made in view of the above problems, and it is an object of the present invention to provide a precast concrete stairwell construction method of constructing a stairwell in a high-rise building using PC having suitable size and weight for transportation and lifting while reducing the number of lifts and the number of joint positions, enabling safer and simpler assembly, and combining PC with cast-in-place concrete to achieve higher structural integrity than when connected solely by PC.

[Technical Solution]

[14] A precast concrete stairwell construction method according to the present invention to achieve the above object includes a first segment structure fabrication step of fabricating a first segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, and is located at the bottom, using reinforced concrete, a second segment structure fabrication step of fabricating a second segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a stair landing formed on an upper surface on one side thereof and a stair landing formed on a lower surface on the other side thereof, has a stair tread formed between the two stair landings, has an opening formed in a front surface thereof, and is located at the bottom, using reinforced concrete, a third segment structure fabrication step of fabricating a third segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a communication opening formed in a front surface thereof so as to communicate with the opening, and is located at the top, using reinforced concrete, a fourth segment structure fabrication step of fabricating a fourth segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a stair landing formed on an upper surface on one

side thereof and a stair landing formed on a lower surface on the other side thereof, has a stair tread formed between the two stair landings, and is located at the top, using reinforced concrete, a segment structure transportation step of transporting the fabricated first segment structure, second segment structure, third segment structure, and fourth segment structure to a building at a construction site, a structure assembly step of lifting the transported segment structures using lifting equipment, placing the first segment structure at a corresponding position in the building at the construction site, placing the second segment structure such that "[\"-shaped ends of the first and second segment structures are in tight contact with each other so as to form a \"□\"-shape when viewed in a plane, placing the fourth segment structure on the placed first segment structure, placing the third segment structure on the placed second segment structure in tight contact such that \"[\"-shaped ends of the third and fourth segment structures are in tight contact with each other so as to form a \"□\"-shape when viewed in a plane, and assembling the segment structures, and a structure joining step of joining and fixing contact parts of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure placed in tight contact to complete a stairwell, wherein the structure assembly step and the structure joining step are performed repeatedly for each floor of the building.

[15] Furthermore, in the precast concrete stairwell construction method according to the present invention, the "["-shaped precast concrete wall of each of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure may be fabricated with a thickness of 30 to 80 mm.

[16] Furthermore, the precast concrete stairwell construction method according to the present invention may further include an external wall combination step of pouring cast-in-place concrete along outer surfaces of the "["-shaped precast concrete walls of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure formed as the stairwell in the structure joining step to combine the precast concrete walls and the cast-in-place concrete wall.

[17] Furthermore, in the precast concrete stairwell construction method according to the present invention, the external wall combination step may include a process of placing reinforcing bars along the outer surfaces of the "["-shaped precast concrete walls of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure assembled by joining, a process of installing formwork around the reinforcement bars, a process of pouring concrete into the formwork with the reinforcement bars and curing the same, and a process of dismantling the formwork.

[18] Furthermore, in the precast concrete stairwell construction method according to the present invention, the cast-in-place concrete wall may be fabricated with a thickness of 100 to 350 mm.

[Advantageous Effects]

[19] As is apparent from the above description, the present invention has the effect of constructing a stairwell in a high-rise building using PC having suitable size and weight for transportation and lifting while reducing the number of lifts and the number of joint positions, enabling safer and simpler assembly, and therefore it is possible to achieve rapid and stable construction of the stairwell.

[20] In addition, the present invention has the effect of completing a unit stairwell structure by combining "["-shaped PC walls of segment structures assembled by joining and cast-in-place concrete, whereby it is possible to achieve higher structural integrity than a stairwell having a conventional single PC structure.

[Description of Drawings]

[21] FIG. 1 is a flowchart showing a construction method according to the present invention.

[22] FIG. 2 is a schematic perspective view showing the configuration of a stairwell to which the construction method according to the present invention is applied.

[23] FIGs. 3 to 9 are schematic perspective views showing a stairwell construction process according to the present invention.

[24] FIG. 10 is a schematic longitudinal sectional view showing a precast concrete wall used in the construction method according to the present invention and a cast-in-place concrete wall.

[25] FIG. 11 is a perspective view showing a stairwell constructed according to a conventional precast concrete stairwell construction method.

[26] FIG. 12 is a perspective view showing a stairwell constructed according to another conventional precast concrete stairwell construction method.

[27] FIG. 13 is a perspective view showing a stairwell constructed according to yet another conventional precast concrete stairwell construction method.

[Best Mode]

[28] Hereinafter, a preferred embodiment of the present invention will be described in more detail with reference to the accompanying drawings. However, it should be understood that the present invention can be implemented in numerous different forms and is not limited to the described embodiment.

[29] FIGs. 1 to 10 are schematic drawings showing a construction method according to the present invention and the configuration thereof. As shown, a precast concrete stairwell construction

method according to the present invention includes a first segment structure fabrication step (S10) of fabricating a first segment structure as a precast element in advance, a second segment structure fabrication step (S20) of fabricating a second segment structure as a precast element in advance, a third segment structure fabrication step (S30) of fabricating a third segment structure as a precast element in advance, a fourth segment structure fabrication step (S40) of fabricating a fourth segment structure as a precast element in advance, a segment structure transportation step (S50) of transporting the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure to a construction site, a structure assembly step (S60) of placing the first segment structure and the second segment structure so as to face each other in tight contact, placing the third segment structure and the fourth segment structure on the first segment structure and the second segment structure in tight contact, and assembling the segment structures, and a structure joining step (S70) of joining the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure placed in tight contact.

[30] The first segment structure fabrication step (S10) is a step of fabricating a first segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, and is located at the bottom, using reinforced concrete.

[31] In the first segment structure fabrication step (S10), the "["-shaped first segment structure is fabricated as a precast element in advance so as to be directly assembled and constructed at the construction site without concrete pouring (see FIG. 2).

[32] The "["-shaped precast concrete wall of the first segment structure is fabricated with a thickness of 30 to 80 mm. This facilitates transportation and handling by minimizing weight.

[33] The second segment structure fabrication step (S20) is a step of fabricating a second segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a stair landing formed on an upper surface on one side thereof and a stair landing formed on a lower surface on the other side thereof, has a stair tread formed between the two stair landings, has an opening formed in a front surface thereof, and is located at the bottom, using reinforced concrete.

[34] In the second segment structure fabrication step (S20), the second segment structure, in which the stair landings and the stair tread are formed inside the "["-shaped wall, is fabricated as a precast element in advance so as to be directly assembled and constructed at the construction site without concrete pouring (see FIG. 2). The opening is provided to form an entrance/exit to the stairwell.

[35] The "["-shaped precast concrete wall of the second segment structure is fabricated with a thickness of 30 to 80 mm. This facilitates transportation and handling by minimizing weight.

[36] The third segment structure fabrication step (S30) is a step of fabricating a third segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a communication opening formed in a front surface thereof so as to communicate with the opening, and is located at the top, using reinforced concrete.

[37] In the third segment structure fabrication step (S30), the "["-shaped third segment structure is fabricated as a precast element in advance so as to be directly assembled and constructed at the construction site without concrete pouring (see FIG. 2). The communication opening communicates with the opening to form the entrance/exit to the stairwell.

[38] The "["-shaped precast concrete wall of the third segment structure is fabricated with a thickness of 30 to 80 mm. This facilitates transportation and handling by minimizing weight.

[39] The fourth segment structure fabrication step (S40) is a step of fabricating a fourth segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a stair landing formed on an upper surface on one side thereof and a stair landing formed on a lower surface on the other side thereof, has a stair tread formed between the two stair landings, and is located at the top, using reinforced concrete.

[40] In the fourth segment structure fabrication step (S40), the fourth segment structure, in which the stair landings and the

stair tread are formed inside the "["-shaped wall, is fabricated as a precast element in advance so as to be directly assembled and constructed at the construction site without concrete pouring (see FIG. 2).

[41] The "["-shaped precast concrete wall of the fourth segment structure is fabricated with a thickness of 30 to 80 mm. This facilitates transportation and handling by minimizing weight.

[42] Here, the stair landing refers to a plate forming a flat space at the top and bottom of the stairs to change the direction of the stairs, and the stair tread refers to a plate which is provided between the stair landings, has stairs formed on an upper surface thereof, and is inclined.

[43] The "["-shaped precast concrete wall of each of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure is a wall constituting a part of the entire wall and is typically fabricated with a thickness of about 50 mm. Since a smaller thickness is more advantageous for weight reduction, the thickness is reduced as much as possible within limits that do not hinder handling.

[44] The segment structure transportation step (S50) is a step of transporting the fabricated first segment structure, second segment structure, third segment structure, and fourth segment structure to a building at the construction site. In this step, the precast concrete segment structures fabricated in advance are transported to the construction site using a vehicle.

[45] The structure assembly step (S60) is a step of lifting the transported segment structures using lifting equipment, placing the first segment structure at a corresponding position in the building at the construction site, placing the second segment structure such that "["-shaped ends of the first and second segment structures are in tight contact with each other so as to form a "□"-shape when viewed in a plane, placing the fourth segment structure on the placed first segment structure, placing the third segment structure on the placed second segment structure in tight contact such that "["-shaped ends of the third and fourth segment structures are in tight contact with each other so as to form a "□"-shape when viewed in a plane, and assembling the segment structures.

[46] In the structure assembly step (S60), a total of four segment structures, i.e., the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure, are stacked so as to correspond to each other in tight contact, thereby forming a unit stairwell (see FIG. 3).

[47] As described above, the four segment structures form a single stairwell, and the weight of each segment structure becomes relatively light, facilitating transportation and lifting.

[48] The structure joining step (S70) is a step of joining and fixing contact parts of the first segment structure, the second segment structure, the third segment structure, and the fourth

segment structure in tight contact to complete the stairwell. In this step, the contact parts of the segment structures are joined using various methods (e.g., a joining member of FIG. 4) to maintain a stable structure (see FIG. 4).

[49] The stairwell construction method according to the present invention further includes an external wall combination step (S80) of pouring cast-in-place concrete along outer surfaces of the "["-shaped precast concrete walls of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure joined and assembled in the structure joining step (S70) to combine the precast concrete walls and the cast-in-place concrete wall.

[50] In the external wall combination step (S80), the precast concrete walls and the cast-in-place concrete wall are combined to achieve sufficient rigidity, since the precast concrete walls of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure, which are fabricated relatively thin for ease of transport and lifting, cannot function as load-bearing walls (see FIG. 9). That is, the "["-shaped precast concrete wall that forms the wall of each segment structure is fabricated relatively thin. Consequently, concrete is additionally poured around the precast concrete walls at the construction site such that the precast concrete walls and the cast-in-place concrete wall are combined to construct a complete wall.

[51] Referring to FIGs. 5 to 9, the external wall combination step (S80) includes a process of placing reinforcing bars along the outer surfaces of the "["-shaped precast concrete walls of the first segment structure, second segment structure, third segment structure, and fourth segment structure assembled by joining, a process of installing formwork around the reinforcement bars, a process of pouring concrete into the formwork with the reinforcement bars and curing the same, and a process of dismantling the formwork. A composite wall formed by combining the precast concrete walls and the cast-in-place concrete wall in the above processes is thicker than the precast concrete wall.

[52] Here, the thickness of the cast-in-place wall is greater than the thickness of the precast concrete wall of each segment structure. This is because main reinforcing bars cannot be placed in the relatively thin precast concrete wall due to the structure thereof and thus the main reinforcing bars must be placed in the cast-in-place wall, necessitating a larger section (see FIG. 10).

[53] It is desirable for the cast-in-place concrete wall to be fabricated with a thickness of 100 to 350 mm so as to function as a load-bearing wall with sufficient strength and durability.

[54] Although the preferred embodiment of the present invention has been described above, the present invention may be practiced with various modifications, alterations, and equivalents. It is clear that the present invention can be applied identically by

appropriately modifying the above embodiment. Therefore, the above description does not limit the scope of the present invention as defined by the scope of the appended claims.

[55] Meanwhile, although the specific embodiment has been described in the detailed description of the present invention, it will be obvious to those skilled in the art that various modifications are possible within the scope of the present invention.

[CLAIMS]

[Claim 1] A precast concrete stairwell construction method comprising:

a first segment structure fabrication step (S10) of fabricating a first segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, and is located at a bottom, using reinforced concrete;

a second segment structure fabrication step (S20) of fabricating a second segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a stair landing formed on an upper surface on one side thereof and a stair landing formed on a lower surface on the other side thereof, has a stair tread formed between the two stair landings, has an opening formed in a front surface thereof, and is located at the bottom, using reinforced concrete;

a third segment structure fabrication step (S30) of fabricating a third segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open surface, and a lower open surface, has a communication opening formed in a front surface thereof so as to communicate with the opening, and is located at a top, using reinforced concrete;

a fourth segment structure fabrication step (S40) of fabricating a fourth segment structure, which is bent in a "[" shape when viewed in a plane, has an inner open surface, an upper open

surface, and a lower open surface, has a stair landing formed on an upper surface on one side thereof and a stair landing formed on a lower surface on the other side thereof, has a stair tread formed between the two stair landings, and is located at the top, using reinforced concrete;

a segment structure transportation step (S50) of transporting the fabricated first segment structure, second segment structure, third segment structure, and fourth segment structure to a building at a construction site;

a structure assembly step (S60) of lifting the transported segment structures using lifting equipment, placing the first segment structure at a corresponding position in the building at the construction site, placing the second segment structure such that "["-shaped ends of the first and second segment structures are in tight contact with each other so as to form a "□"-shape when viewed in a plane, placing the fourth segment structure on the placed first segment structure, placing the third segment structure on the placed second segment structure in tight contact such that "["-shaped ends of the third and fourth segment structures are in tight contact with each other so as to form a "□"-shape when viewed in a plane, and assembling the segment structures; and

a structure joining step (S70) of joining and fixing contact parts of the first segment structure, the second segment structure, the third segment structure, and the fourth segment

structure placed in tight contact to complete a stairwell, wherein

the structure assembly step (S60) and the structure joining step (S70) are performed repeatedly for each floor of the building.

[Claim 2] The precast concrete stairwell construction method according to claim 1, wherein the "[\"-shaped precast concrete wall of each of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure is fabricated with a thickness of 30 to 80 mm.

[Claim 3] The precast concrete stairwell construction method according to claim 2, further comprising an external wall combination step (S80) of pouring cast-in-place concrete along outer surfaces of the "[\"-shaped precast concrete walls of the first segment structure, the second segment structure, the third segment structure, and the fourth segment structure formed as the stairwell in the structure joining step (S70) to combine the precast concrete walls and the cast-in-place concrete wall.

[Claim 4] The precast concrete stairwell construction method according to claim 3, wherein the external wall combination step (S80) comprises:

a process of placing reinforcing bars along the outer surfaces of the "[\"-shaped precast concrete walls of the first segment

structure, the second segment structure, the third segment structure, and the fourth segment structure assembled by joining; a process of installing formwork around the reinforcement bars; a process of pouring concrete into the formwork with the reinforcement bars and curing the same; and a process of dismantling the formwork.

[Claim 5] The precast concrete stairwell construction method according to claim 3, wherein the cast-in-place concrete wall is fabricated with a thickness of 100 to 350 mm.