PREFABRICATED DOUBLE-SKIN WALL MOLD

Field of the Invention

The invention relates to a mold for manufacturing building components, in particular to a mold for manufacturing a prefabricated double-skin wall.

Background of the Invention

A prefabricated double-skin wall, also called as a laminated wall, mainly consists of two prefabricated wall bodies with a cavity formed therebetween, wherein horizontal and vertical reinforcing bars are arranged in the prefabricated wall bodies. The traditional method for manufacturing the prefabricated double-skin wall includes steps of: laying a certain thickness of first concrete in a mold, so as to form a first prefabricated wall body after the concrete is solidified or substantially solidified; laying a certain thickness of second concrete in another mold; turning over the first wall body with desirable strength before the second concrete is solidified; and pressing truss bars exposed out of the first wall body and other embedded parts into the upper wall body, so that the two wall bodies are combined together.

However, the traditional method for manufacturing the prefabricated double-skin wall mainly suffers the following defects. First, two wall bodies have to be manufactured separately, and then are assembled together after being solidified. Therefore, the prefabricated double-skin wall cannot be manufactured in one single process, so that the construction process is cumbersome and time-consuming. Second, because the two wall bodies are assembled together after being manufactured, the final product suffers poor integrity, resulting in reduced strength. Third, currently a dedicated apparatus is required to combine two prefabricated wall bodies together, so that the construction cost for a building including the double-skin wall is indirectly increased since such an apparatus is expensive.

Summary of the Invention

Concerning the above defects in the prior arts, the present invention aims to

provide a mold for manufacturing a prefabricated double-skin wall, whereby turnover of the product and the mold is no longer necessary, and the double-skin wall obtained enjoys better integrity and high strength.

The present invention proposes a prefabricated double-skin wall mold, which is used for manufacturing a prefabricated double-skin wall including a lower wall body and an upper wall body. The mold comprises a platform, and further comprises a lower side plate assembly surrounding an outer periphery of an area where the lower wall body is located, an upper side plate assembly surrounding an outer periphery of an area where the upper wall body is located, and a horizontal supporting mechanism for supporting the upper wall body. The lower side plate assembly is detachably mounted on the top of the platform, and at least a part of the upper side plate assembly is detachably mounted on the top of the platform or the lower side plate assembly. The horizontal supporting mechanism is arranged between two opposite upper side plates of the upper side plate assembly.

The mold of the present invention further comprises a bottom carrier plate, which is used as a bottom mold member for the upper wall body. The bottom carrier plate is supported by the horizontal supporting mechanism when the mold is assembled.

The bottom carrier plate may be formed by connecting a plurality of carrier plate units, with a plurality of holes being formed at a joint between two adjacent carrier plate units for reinforcing bars to pass through.

A bottom surface of the upper wall body is provided with a thermal insulating panel. A thermal insulating panel bracket is arranged at a position inner of the upper side plate assembly. The thermal insulating panel is placed on the thermal insulating panel bracket and the horizontal supporting mechanism.

A side face of each of the lower side plate assembly and the upper side plate assembly that is in contact with an area to be poured is formed as a rough surface.

The horizontal supporting mechanism comprises a plurality of counter braces, both ends of each counter brace being placed on side walls of two opposite upper side

plates of the upper side plate assembly.

An inverted L-shaped slot is provided at a position on a side wall of the upper side plate assembly where each counter brace is located, and both ends of said counter brace are moveable along the inverted L-shaped slot.

A positioning cone is fixed at a position of the platform to be connected with the lower side plate assembly or the upper side plate assembly. At a position corresponding to the positioning cone, the lower side plate assembly or the upper side plate assembly has a partially tapered inner surface that is in engagement with an outer surface of the positioning cone.

The double-skin wall is provided with a preformed opening. In this case, the mold further comprises an inner mold assembly, which is detachably mounted on the top of the platform and surrounds an outer periphery of an area of the preformed opening.

The mold further comprises an embedded part fastener, one end of which is detachably mounted on the lower side plate assembly or the upper side plate assembly, nd the other end of which is used to fix an embedded part at a set position in an area to be poured.

Compared with the prior arts, the prefabricated double-skin wall mold according to the present invention adopts a plurality of detachable mold plate assemblies. After the first wall body is cast, the mold plate assembly for the second wall body can be directly mounted, without turnover of the product and the mold. Therefore, the expensive dedicated apparatus is no longer necessary, and the prefabricated double-skin wall can be manufactured in one single process. In addition, the final product of the prefabricated double-skin wall is of high integrity and enhanced strength and precision. Moreover, the turnaround time of the mold is short, thus significantly reducing the cost of the mold. Finally, the position of each side plate assembly can be adjusted based on the size of the double-skin wall, so that the mold is flexible in use and also has a high versatility.

Brief Description of the Drawings

Fig. 1 shows a planar assembly view for first casting in a prefabricated double-skin wall mold according to the present invention in an embodiment that the prefabricated double-skin wall is provided without opening and thermal insulating panel;

Fig. 2 is a cross sectional view of Fig. 1 along line 1-1 thereof;

Fig. 3 is a cross sectional view of Fig. 1 along line 2-2 thereof;

Fig. 4 is a detail view of area A in Fig. 2 or Fig. 3;

Fig. 5 shows a planar assembly view for mounting counter braces in the prefabricated double-skin wall mold according to the present invention in the embodiment that the prefabricated double-skin wall is provided without opening and thermal insulating panel;

Fig. 6 shows a planar assembly view for second casting in the prefabricated double-skin wall mold according to the present invention in the embodiment that the prefabricated double-skin wall is provided without opening and thermal insulating panel;

Fig. 7 is a cross sectional view of Fig. 6 along line 3-3 thereof;

Fig. 8 is a cross sectional view of Fig. 6 along line 4-4 thereof;

Fig. 9 is a detail view of area B in Fig. 7;

Fig. 10 is a detail view of area C in Fig. 8;

Fig. 11 schematically shows the counter braces disposed on the side surface of the upper side plate assembly;

Fig. 12 shows a planar assembly view for first casting in the prefabricated double-skin wall mold according to the present invention in an embodiment that the prefabricated double-skin wall is provided with opening;

Fig. 13 is a cross sectional view of Fig. 12 along line 5A-5A thereof;

Fig. 14 is a cross sectional view of Fig. 12 along line 5B-5B thereof;

Fig. 15 is a cross sectional view of Fig. 12 along line 6A-6A thereof;

Fig. 16 is a cross sectional view of Fig. 12 along line 6B-6B thereof;

Fig. 17 is a detail view of area D in Fig. 16;

Fig. 18 shows a planar assembly view for mounting the upper side plate assembly in the prefabricated double-skin wall mold according to the present invention in the embodiment that the prefabricated double-skin wall is provided with opening;

Fig. 19 shows a planar assembly view for mounting the counter braces in the prefabricated double-skin wall mold according to the present invention in an embodiment that the prefabricated double-skin wall is provided with opening and thermal insulating panel;

Fig. 20 is a cross sectional view of Fig. 19 along line 7A-7A thereof;

Fig. 21 is a cross sectional view of Fig. 19 along line 7B-7B thereof;

Fig. 22 is a cross sectional view of Fig. 19 along line 8A-8A thereof;

Fig. 23 is a cross sectional view of Fig. 19 along line 8B-8B thereof;

Fig. 24 is a detail view of area E in Fig. 21;

Fig. 25 is a detail view of area F in Fig. 21;

Fig. 26 is a detail view of area G in Figs. 22 and 23;

Fig. 27 schematically shows the structure of the double-skin wall without opening and thermal insulating panel; and

Fig. 28 schematically shows the structure of the double-skin wall with opening and thermal insulating panel.

Detailed Description of the Embodiments

The present invention will be described in further detail with reference to the embodiments as shown in the accompanying drawings.

The prefabricated double-skin wall mold according to the present invention is used to manufacture a prefabricated double-skin wall including a lower wall body 10, an upper wall body 20, and a cavity formed therebetween. The mold according to the present invention is composed of combined, detachable mold plates. As shown in Fig. 7 or 8, the mold of the present invention mainly includes: a platform 1, a lower side plate assembly, an upper side plate assembly, and a horizontal supporting mechanism. Dependent on different structures of the double-skin wall, the mold may further include an inner mold assembly 7, a bottom carrier plate 4, a thermal insulating panel bracket 5, or an embedded part fastener 8, and so on.

As shown in Figs. 1 to Fig. 3, the platform 1 can be a base structure that is able to provide sufficient supporting force. The platform 1 may be formed by welding horizontal and vertical profiles, such as channel beams, I-beams or the like, which are arranged side by side along the longitudinal and the lateral directions. In addition, a steel plate is fixed on the top of the platform to serve as a bottom mold member for the lower wall body 10. Naturally, the size of the horizontal surface of the platform 1 must be larger than that of the upper wall body or the lower wall body when they are placed horizontally.

The lower side plate assembly consists of multiple lower side plates. These lower side plates can be detachably mounted on the top of the platform 1 with conventional connectors, such as bolts, so as to surround the outer periphery of the area where the lower wall body 10 is located, as a side mold member for the lower wall body 10. In an embodiment of the mold for manufacturing a double-skin wall without opening and thermal insulating panel as shown in Fig. 27, the lower side plate assembly includes a front lower side plate 21 and a back lower side plate 22 that are opposite to each other, and a left lower side plate 23 and a right lower side plate 24 that are opposite to each other, as shown in Fig. 1. Alternatively, in an embodiment of the mold for manufacturing a double-skin wall with opening and thermal insulating panel as shown in Fig. 28, the lower side plate assembly includes a front lower side plate 25 and a back lower side plate 26 that are opposite to each other, and a left lower side plate 27 and a right lower side plate 28 that are opposite to each other, as shown in Fig. 12. In the above two embodiments, four lower side plates enclose a rectangular area, which precisely corresponds to the periphery of the lower wall body 10 in terms of shape and size thereof. As shown in Figs. 2 to 4, the lower side plate assembly can be formed by welding steel plates, angle steel elements, channel steel elements or the like. The side face of the lower side plate assembly that is in contact with the area of the lower wall body 10 to be poured with concrete is formed as a rough surface. Generally, it can be provided with a patterning board 211. Therefore, such a wall body has a rough surface at its periphery, so that tightness of the connection between the prefabricated double-skin wall and the cast-in-situ structure can be enhanced.

Similarly, the upper side plate assembly consists of multiple upper side plates. At least a part of the upper side plates can be detachably mounted on the top of the platform 1 or the lower side plate assembly with conventional connectors, such as bolts, so as to surround the outer periphery of the area where the upper wall body 20 is located, as a side mold member for the upper wall body 20. In the embodiment of the mold for manufacturing the double-skin wall without opening and thermal insulating panel as shown in Fig. 27, the upper side plate assembly includes a front upper side plate 31 and a back upper side plate 32 that are opposite to each other, and a left upper side plate 33 and a right upper side plate 34 that are opposite to each other, as shown in Fig. 5 or Fig. 6. Alternatively, in the embodiment of the mold for manufacturing the double-skin wall with opening and thermal insulating panel as

shown in Fig. 28, the upper side plate assembly includes a front upper side plate 35 and a back upper side plate 36 that are opposite to each other, and a left upper side plate 37 and a right upper side plate 38 that are opposite to each other, as shown in Fig. 18 or Fig. 19. In the above two embodiments, four upper side plates enclose a rectangular area, which precisely corresponds to the periphery of the upper wall body 20 in terms of shape and size thereof. Again, the side face of the upper side plate assembly that is in contact with the area of the upper wall body 20 to be poured with concrete is formed as a rough surface 311, for example, a patterning board (see Fig. 10).

The horizontal supporting mechanism is arranged between two upper side plates opposite to each other, so as to support the upper wall body 20. In an embodiment of the present invention, the horizontal supporting mechanism includes a plurality of counter braces 6, both ends of each counter brace being disposed on the side walls of said two upper side plates opposite to each other. As shown in Fig. 11, a steel plate 312 is fixed through welding at a position where each counter brace 6 is located on the side wall of the upper side plate 31. The steel plate 312 is provided with an inverted L-shaped slot 313, along which the end of the counter brace 6 can move. During the production of the double-skin wall, the counter brace 6 is moved to a top leg of the inverted L-shaped slot 313 as shown in Fig. 11, while during removal of the mold after the double-skin wall is formed, the counter brace 6 can be moved to a bottom leg of the L-shaped slot 313, thus facilitating the removal of the mold.

In the embodiment of the mold for manufacturing the double-skin wall with opening as shown in Fig. 28, the double-walled wall is provided with a preformed opening 40. As shown in Figs. 12, 14 and 16, the mold in this case further includes an inner mold assembly 7, which is composed of several inner mold members, and detachably mounted on the top of the platform 1 to surround the outer periphery of the area of the preformed opening 40, serving as a side mold member for the lower wall body 10 and the upper wall body 20 around the area of the preformed opening 40. As shown in Fig. 17, the inner mold assembly 7 can be formed by welding angle steel elements, steel plates or the like, and has a top height larger than that of the upper wall body 20.

In the embodiment of the mold for manufacturing the double-skin wall without opening and thermal insulating panel as shown in Fig. 27, the mold of the present invention includes a bottom carrier plate 4, as shown in Figs. 6, 7 and 8. In this embodiment, the bottom carrier plate 4 is provided on the top thereof with a steel plate, under which a corrugated plate is arranged to increase supporting strength of the bottom carrier plate 4. When the mold is assembled, the bottom carrier plate 4 is disposed on the counter braces 6 to serve as the bottom mold member for the upper wall body 20. Because the truss reinforcing bars 50 of the lower wall body 10 should extend into the pouring area of the upper wall body 20 to connect with the reinforcing bars of the upper wall body 20, the bottom carrier plate 4 can be formed by connecting several carrier plate units 41. In terms of position, the joints between adjacent carrier plate units 41 correspond to the truss reinforcing bars, respectively, and each joint has a plurality of holes 42 through which the reinforcing bars can pass.

In the embodiment of the mold for manufacturing the double-skin wall without opening and thermal insulating panel as shown in Fig. 27, the front upper side plate 31 and the back upper side plate 32 can be formed through welding profiles, such as angle steel elements and steel plates, as shown in Figs. 8 and 10, and detachably mounted on the tops of the lower side plates 21 and 22, respectively, with conventional connectors, such as bolts. As shown in Figs. 7 and 9, in this embodiment, the right side face of the upper wall body 20 is located at a position inner of the right side face of the lower wall body 10, and the right upper side plate 34 can be formed through welding U-shaped steel elements or steel plates and detachably installed on the top surface of the bottom carrier plate 4 with bolts. In addition, an angle steel element 342 is installed at a position outer of the upper side plate 34, and a middle side plate 341 is sandwiched between the bottom carrier plate 4 and the right and left lower side plates 23 and 24. The angle steel element 342, the bottom carrier plate 4, the middle side plate 341, the lower side plate 24 and the platform 1 are fixed together by bolts. The left upper side plate 33 has a structure the same as the left lower side plate 23. The left upper side plate 33, the bottom carrier plate 4, the middle side plate 341, the lower side plate 23 and the platform 1 are fixed together by bolts.

In an embodiment of the mold for manufacturing a double-skin wall with thermal insulating panel, the bottom surface of the upper wall body 20 is provided with a

thermal insulating panel 30. Since the thermal insulating panel 30 *per se* can also serve as the bottom mold member for the upper wall body 20, the mold according to this embodiment does not include the bottom carrier plate 4, but instead a thermal insulating panel bracket 5. As shown in Figs. 19 to 23 and Fig. 26, a thermal insulating panel bracket 5 is fixed at a position inner of the front and back upper side plates 35 and 36. The upper portion of the thermal insulating panel bracket 5 is formed as a supporting table having a square cross section through welding channel steel elements, steel plates or the like. The supporting table has a lower portion to which supporting feet 51 are fixed through welding. The supporting feet 51 are mounted on the top of the platform 1 with bolts. The thermal insulating panel 30 is disposed on the supporting table of the insulating panel bracket 5 at the front and back sides thereof and on the counter braces 6 at the middle thereof. As shown in Fig. 26, an inverted-L shaped angle steel element 351 is arranged below the upper side plate 35 or 36. The angle steel element 351 has a leg arranged under the bottom of the upper side plate 35 or 36, and another leg fixed to the outer side face of the supporting table of the insulating panel bracket 5 by welding. Since the upper side plates 35 and 36 are located high, a hollow supporting column 352 may be provided between the platform 1 and the upper side plates 35 and 36, so that the upper side plates 35 or 36, the angle steel element 351, the supporting column 352 and the platform 1 can be connected together with bolts. In addition, as shown in Figs. 18 to 21 and Fig. 24, an additional side plate 371 may be fixed at a position inner of the left upper side plate 37 with bolts. The additional side plate 371 may be formed by welding angle steel elements, steel plates, or the like. The top portion of the additional side plate 371 is supported below the left end portion of the thermal insulating panel 30.

In the embodiment of the mold for manufacturing the double-skin wall with thermal insulating panel as shown in Fig. 28, the upper side plate can be formed by welding angle steel elements, steel plates, or the like, as shown in Figs. 20 to 25. The right end face of the upper wall body 20 and that of the lower wall body 10 are located in the same vertical plane. Therefore, the right upper side plate 38 is mounted to the top of the right lower side plate 28 and connected to the platform 1 with bolts. However, the left end face of the upper wall body 20 is located outer of that of the lower wall body 10. Therefore, the left upper side plate 37 is higher than the right upper side plate 38, and thus is directly mounted on the platform 1 with bolts. Since

the front and back end faces of the upper wall body 20 are located inner of the front and back end faces of the lower wall body 10, respectively, the front and back upper side plates 35 and 36 are mounted on the top of the platform 1 with bolts.

As shown in Figs. 4, 9, 18, and 26, a plurality of positioning cones 11 and 12 are fixed at positions where the lower side plate assembly or the upper side plate assembly is connected to the platform 1, each of the positioning cones 11 and 12 having a partially tapered outer surface. At a position corresponding to that of each positioning cone, the lower side plate assembly or the upper side plate assembly has a partially tapered inner surface 212, which can be in engagement with the partially tapered outer surface of said positioning cone. Such a connection structure of positioning cones can more accurately define the positions of the upper and lower side plates, so that the positioning error during installation of the side plates can be controlled within a limited range.

When embedded parts are to be installed in the double-skin wall, the mold of the present invention may further include an embedded part fastener 8. As shown in Figs. 6 and 8, the embedded part fastener 8 has a first end detachably mounted on the lower side plate assembly or the upper side plate assembly, and a second end for fixing the embedded part at a set position in the area to be poured.

In addition, as shown in Figs. 12 and 15, the mold of the present invention may further include a tie piece fastener 9. When the concrete is poured and the tie pieces 60 are mounted, the tie piece fastener 9 is mounted at a corresponding position for fixing each of the tie pieces 60. The tie piece fastener 9 can be fixed to the lower side plate assembly with bolts at both ends of the tie piece fastener 9.

The process of manufacturing a double-skin wall without opening and thermal insulating panel as shown in Fig. 27 with the mold of the present invention mainly includes the following steps.

As shown in Fig. 1, the lower side plates 21 to 24 of the lower side plate assembly are mounted on the platform 1. As shown in Figs. 2 and 3, a mesh of reinforcing bars and truss reinforcing bars 50 used for the upper wall body 20 are

arranged in the area of the lower wall body 10 surrounded by the lower side plate assembly, and concrete is poured in the area of the lower wall body 10. As shown in Fig. 5, the front and back upper side plates 31 and 32 are mounted, and a plurality of counter braces 6 are disposed on the side walls of the front and back upper side plates 31 and 32. As shown in Figs. 6 to 8, the bottom carrier plate 4 is placed on the counter braces 6, with the truss reinforcing bars 50 extending from the holes 42 formed at the joints of the bottom carrier plate 4, and the right and left upper side plates 33 and 34 are mounted on the top of the bottom carrier plate 4, with the embedded part fastener 8 being arranged if necessary. As shown in Figs. 7 and 8, a mesh of reinforcing bars is arranged in the area of the upper wall body 20 surrounded by the upper side plate assembly and connected to the truss reinforcing bars 50, various embedded parts, pipelines, or the like are arranged, and then concrete is poured in the area of the upper wall body 20. After the concrete of the upper and lower wall bodies has reached the design strength, the side plates, embedded part fasteners 8, the bottom carrier plate 4, the counter braces 6 and the like are removed from top to bottom. Therefore, the prefabricated double-skin wall as shown in Fig. 27 can be obtained.

The process of manufacturing a double-skin wall with opening and thermal insulating panel as shown in Fig. 28 with the mold of the present invention mainly includes the following steps. As shown in Fig. 12, the upper side plates 25 to 28 of the upper side plate assembly and the inner mold assembly 7 are mounted on the platform 1. As shown in Figs. 13 to 16, a mesh of reinforcing bars and truss reinforcing bars 50 are arranged in the area of the lower wall body 10 surrounded by the lower side plate assembly and the inner mold assembly 7, tie pieces 60 and tie piece fasteners 9 for the upper and lower wall bodies are mounted, and then concrete is poured in the area of the lower wall body 10. As shown in Figs. 19 to 23, the thermal insulating panel brackets 5, the upper side plates 35 to 38 of the upper side plate assembly and the counter braces 6 are mounted, and the thermal insulating panels 30 are placed on the thermal insulating panel brackets 5 and the counter braces 6. A mesh of reinforcing bars is arranged in the area of the upper wall body 20 surrounded by the upper side plate assembly and the inner mold assembly 7, embedded parts, pipelines, and the embedded part fasteners 8, if necessary, are mounted, and then concrete is poured in the area of the upper wall body 20. After the concrete of the upper and lower wall bodies has reached the design strength, the side plates, the inner mold assembly 7, the

thermal insulating panel brackets 5, the embedded part fasteners 8, the counter braces 6 and the like are removed from top to bottom. Therefore, the prefabricated double-skin wall as shown in Fig. 28 can be obtained.

The foregoing description is merely illustrative of preferred embodiments of the present invention, and is not intended to limit the present invention. Any modifications, equivalent substitutions, improvements, and the like within the spirit and principles of the present invention are intended to be included within the scope of the present invention.