MODULAR INTEGRATED BUILDING UNIT

Field of the Invention

The present invention relates to a building structure, and in particular, to structural improvements on building units of a modular integrated building.

Background of the Invention

The construction of traditional cast-in-situ concrete buildings suffers problems such as long construction period, hardly controlled quality, and great disturbance on surrounding residents. In order to solve these problems, currently the construction of buildings gradually adopts modular integrated buildings. That is, prefabricated building units of reinforcing concrete structure, such as prefabricated kitchens, prefabricated bathrooms, prefabricated bedrooms and so on, have been completed at respective factories in advance, and then assembled together at the construction site. This kind of construction can essentially reduce on-site workload, shorten the construction duration, and cut down labor cost. In addition, the disturbance on surrounding residents can be greatly reduced also.

However, load-bearing structures, such as columns, beams or the like, in a traditional prefabricated building unit are all of reinforcing concrete structures, wherein most of wall plates adopt load-bearing reinforcing concrete walls. Accordingly, the weight of a whole prefabricated building unit is relatively large. Therefore, the prefabricated building unit is difficult to be hoisted, transported and installed, and relevant costs are also relatively high. Moreover, at the connecting positions between adjacent prefabricated building units, there also needs to bind steel bars and cast in-situ concrete for connection, which takes a long time.

Summary of the Invention

In order to overcome the deficiencies existing in the prior arts, the present invention provides a modular integrated building unit, which can be rapidly detachable and thus reconstructable. The modular integrated building unit is light in weight, and can be assembled together on site rapidly and conveniently.

The present invention adopts a technical solution as follows. A modular integrated building unit is provided, comprising wall plates, a top plate, a bottom plate. The modular integrated building unit further comprises a steel skeleton connected to the wall plates, the top plate and the bottom plate for load-bearing, wherein the steel skeleton is formed by welding steel profiles. At least one wall plate is provided therein with wall plate reinforcing bars that are fixedly connected to the steel skeleton, and the steel skeletons of adjacent building units are connected with each other by bolts.

In one embodiment, the bottom plate is made of structural reinforcing concrete and has a thickness ranged from 120 to 130 mm.

In one embodiment, the top plate is made of non-structural lightweight concrete and has a thickness ranged from 75 to 85 mm, and provided therein with top plate reinforcing bars that are fixedly connected to the steel skeleton.

In one embodiment, the wall plate reinforcing bars are arranged in relatively long wall plates, which each are of a reinforcing concrete structure, and relatively short wall plates each are of a reinforcing concrete structure and have a thickness ranged from 120 to 130 mm.

In one embodiment, at least part of the wall plate reinforcing bars are arranged in

cross pairs, and the pair of crossing wall plate reinforcing bars are welded and thus fixed to a top and a bottom of the steel skeleton, respectively.

In one embodiment, the steel skeleton includes: columns arranged at corners of the building unit respectively, longitudinal and transverse top beams connecting tops of adjacent columns, and longitudinal bottom beams connecting bottoms of adjacent columns.

In one embodiment, a top of each column is fixed with a horizontal column top plate, and a bottom of each column is fixed with a horizontal column base plate. A top of the column top plate is fixed with a positioning boss, a side wall of which is provided with a threaded hole, and the column base plate is provided with a positioning through-hole, a side wall of the column being provided with a threaded hole at a bottom thereof. The positioning boss of a lower building unit passes upwardly into the positioning through-hole of an upper building unit, and a bolt passes through the threaded hole at the side wall of the bottom of the column and the threaded hole at the side wall of the positioning boss to connect the upper building unit and the lower building unit together.

In one embodiment, vertically- and horizontally-adjacent building units are connected to each other through a bolt passing through the threaded hole at the side wall of the bottom of the column and the threaded hole at the side wall of the positioning boss.

In one embodiment, a vertical guiding panel is fixed to the column top plate at an outside of the column top plate through welding, and is provided with a guiding slope on an inner side at the top thereof.

In one embodiment, in that both ends of each wall plate and the top plate are

fixed with a steel profile.

According to the rapidly-detachable and reconstructable modular integrated building unit of the present invention, a steel skeleton is used as the load-bearing structure, and reinforcing bars fixed to the steel skeleton are arranged in the wall plates. In this manner, the wall plates can be made relatively thin, thus reducing the weight of the building unit significantly, facilitating the hoisting and the transportation thereof, and further increasing inner useable space inside the building unit. Moreover, removable bolts can be used to connect vertically- and horizontally adjacent building units. Therefore, on-site connection of these building units can be completed rapidly and conveniently, without binding reinforcing bars and casting in-situ concrete on site. This can not only shorten the construction period effectively, but also perform non-destructive demolition for late recycle.

Brief Description of the Drawings

Figure 1 is a front perspective view of a rapidly-detachable and reconstructable modular integrated building unit according to the present invention;

Figure 2 is a rear perspective view of the rapidly-detachable and reconstructable modular integrated building unit according to the present invention;

Figure 3 schematically shows the structure of a steel skeleton and wall plate reinforcing steel bars and top plate reinforcing steel bars fixed on the steel skeleton;

Figure 4 schematically shows the structure of a positioning boss on the top of a column;

Figure 5 schematically shows the structure at the bottom of the column;

Figure 6 schematically shows the structure of a column base plate;

Figure 7 schematically shows the connection structure of two vertically adjacent building units;

Figure 8 schematically shows the connection structure of two horizontally adjacent building units;

Figure 9 is a horizontal sectional view of the connection between the column and the wall plate;

Figure 10 is a plan view of a rapidly-detachable and reconstructable modular integrated building formed by multiple building units; and

Figure 11 is an elevation view of the rapidly-detachable and reconstructable modular integrated building formed by multiple building units.

Detailed Description of the Embodiments

In the following, the embodiments of the present invention will be further illustrated with reference to the appending drawings.

As shown in Figure 1 to Figure 3, a rapidly-detachable and reconstructable modular integrated building unit according to the present invention comprises wall plates 1, a top plate 2, a bottom plate 3, and a steel skeleton 4, which is connected to the wall plates 1, the top plate 2 and the bottom plate 3, as a load-bearing structure. At least one wall plate 1 may also be provided with a door opening or a window opening 13. The steel skeleton 4 is formed by welding steel profiles, and at least one wall plate

1 is provided therein with wall plate reinforcing bars 51 that are fixedly connected to the steel skeleton 4. Further, the top plate 2 is also provided therein with top plate reinforcing bars 52 that are fixedly connected to the steel skeleton 4. The steel skeletons 4 of adjacent building units are connected with each other by bolts.

In this embodiment, the top plate 2 is made of non-structural lightweight concrete and has a thickness of 80 mm, while the bottom plate 3 is made of structural reinforcing concrete and has a thickness of 125 mm. The wall plate reinforcing bars 51 are arranged in relatively long wall plates 11 of the wall plates 1. The relatively long wall plates 11 each are of a reinforcing concrete structure and have a thickness of 100 mm, while the relatively short wall plates 12 each are of a reinforcing concrete structure and have a thickness of 125 mm. It can be seen that according to the present invention the building unit adopts a steel skeleton as a load-bearing member, and the wall plates and the top plates can be made relatively thin because of the reinforcing bars arranged therein. Accordingly, the whole building unit can be significantly lighter in weight than a traditional modular integrated building unit.

In this embodiment, the building unit 10 is of a common rectangular parallelepiped structure. For convenience, it is assumed in the context that the relatively long wall plates 11 of the building unit 10 are in a longitudinal direction, while the relatively short wall plates 12 thereof are in a transverse direction. As shown in Figure 3, the steel skeleton 4 includes: four columns 41 vertically arranged at corners of the building unit respectively, longitudinal and transverse top beams 42 connecting the tops of two adjacent columns 41, and longitudinal bottom beams 43 connecting the bottoms of two adjacent columns 41. Of course, if the length or width of the building unit is large, at least one intermediate column can be provided between the corner columns. Since in the embodiment the top plate 2 is of thin non-structural lightweight concrete, a transverse middle top beam 44 can be additionally provided in the middle of the transverse top beams 42 arranged at both sides. The columns 41, the

top beams 42, and the bottom beams 43 can be formed by square-through profiles, while the middle top beam 44 can be formed by a L-shaped or U-shaped profile. In order to facilitate the connection between adjacent building units, the steel skeleton 4 is arranged at the outer side of the wall plates 1, the top plate 2 and the bottom plate 3.

As shown in Figure 3, at least part of the wall plate reinforcing bars 51 are arranged in cross pairs, and the pair of crossing wall plate reinforcing bars 51 are welded and thus fixed to the top and bottom of the steel skeleton 4, respectively. Similarly, at least part of the top plate reinforcing bars 52 are arranged in cross pairs, and the pair of crossing top plate reinforcing bars 52 are welded and thus fixed to both sides of the steel skeleton 4, respectively. The cross arrangement of reinforcing bars can enhance the stability and strength of the entire steel skeleton 4.

As shown in Figures 4 and 5, the top of each column 41 is fixed with a horizontal column top plate 411 through welding, and the bottom of the column 41 is fixed with a horizontal column base plate 412 through welding. The top of the column top plate 411 is fixed with a positioning boss 413 through welding. In this embodiment, the positioning boss 413 can be of a 100 mm high 60×60×8 square steel, a side wall of which is provided with a threaded hole 416. As shown in Figure 6, the column base plate 412 is provided with a positioning through-hole 414, which is square to correspond to the positioning boss 413, and the side wall of the column 41 is provided with a threaded hole 417 at a bottom thereof. When assembling the building units on site, as shown in Figure 7, the positioning boss 413 on the top of the column 41 of a lower building unit is inserted upwardly into the positioning through-hole 414 at the bottom of the column 41 of an upper building unit, and a bolt 61 is used to pass through the threaded hole 417 at the bottom of the column 41 of the upper building unit and the threaded hole 416 at the side wall of the positioning boss 413 of the lower building unit. In this manner, the upper building unit and the lower building unit can be connected together.

As for the connection of four vertically- and horizontally-adjacent building units in the middle of a modular integrated building, as shown in Figure 8, a bolt 62 is used to pass through the threaded hole 417 at the bottom of the side wall of the column 41 and the threaded hole 416 at the side wall of the adjacent positioning boss 413, with a gasket 63 being filled in a gap formed between two horizontally-adjacent columns 41.

Through connecting the steel skeletons 4 of adjacent building units together, it can be easily and quickly assembled into a multi-story building 20 with multiple building units 10 on each floor as shown in Figures 10 and 11.

In order to smoothly connect the positioning through-hole 414 at the bottom of the upper building unit 10 with the positioning boss 413 at the top of the lower building unit, as shown in Figure 4, a vertical guiding panel 415 is fixed, such as through welding, at the outside of the column top plate 411. The guiding panel 415 is provided with a guiding slope 418 on the inner side at the top thereof. In addition, the top of the positioning boss 413 can also be formed as a guide slope.

As shown in Figure 9, both ends of the relatively long wall plate 11 are vertically provided with an L-shaped steel profile 13, while both two ends of the relatively short wall plate 11 are vertically provided with a U-shaped channel steel 14. The L-shaped steel profile 13 is fixed to the column 41 through welding, while the U-shaped channel steel 14 is fixed to the L-shaped steel profile 13 through welding. As shown in Figure 4, the top plate 2 is provided, at a side thereof connected to the longitudinal top beam 42, with a horizontal L-shaped steel profile 21, which is fixed to the longitudinal top beam 42 through welding.

In order to manufacture the building unit of the present invention, the following method can be used. First, the steel skeleton 4 is formed through welding. Then, the

wall plate reinforcing bars 51, the top plate reinforcing bars 52, the L-shaped steel profile 13 and the U-shaped channel steel 14 on both ends of each wall plate 1, and the steel profiles 21 at both ends of the top plate 2 are all welded to the steel skeleton 4. Subsequently, the reinforcing bars in the top plate 2, the wall plates 1 and the bottom plate 3 are bound together, wherein the reinforcing bars at the top of wall plates 1 are connected with the reinforcing bars of the top plate 2, and the reinforcing bars at the bottom of the wall plates 1 are connected with the reinforcing bars of the bottom plate 3. Finally, concrete is poured between the steel profiles 13 and 14 on both sides to form the wall plates 1, poured between the steel profiles 21 on both sides to form the top plate 2, and poured on the transverse bottom beams 43 to form the bottom plate 3. Of course, when the building unit is produced, the top plate 2 and the bottom plate 3 can be formed through in-situ casting as described above, or they can adopt prefabricated plates directly.

The foregoing are only preferred embodiments of the present invention, and are not intended to limit the present invention. Any modification, equivalent replacement or improvement made within the spirit and principle of the present invention should be included in the protection scope of the present invention.

CLAIMS

1. A modular integrated building unit, comprising wall plates (1), a top plate (2), a bottom plate (3),

characterized in that the modular integrated building unit further comprises a steel skeleton (4) connected to the wall plates (1), the top plate (2) and the bottom plate (3) for load-bearing, wherein the steel skeleton (4) is formed by welding steel profiles,

at least one wall plate (1) is provided therein with wall plate reinforcing bars (51) that are fixedly connected to the steel skeleton (4), wherein the steel skeleton (4) is configured to be connected to another steel skeleton of adjacent building units by bolts,

the steel skeleton (4) includes: columns (41) arranged at corners of the building unit respectively, longitudinal and transverse top beams (42) connecting tops of adjacent columns (41), and longitudinal bottom beams (43) connecting bottoms of adjacent columns (41),

a top of each column (41) is fixed with a horizontal column top plate (411), and a bottom of each column (41) is fixed with a horizontal column base plate (412),

a top of the column top plate (411) is fixed with a positioning boss (413), a side wall of which is provided with a threaded hole (416), and the column base plate (412) is provided with a positioning through-hole (414), a side wall of the bottom of the column (41) being provided with a further threaded hole; and

the positioning boss (413) of a lower building unit passes upwardly through the positioning through-hole (414) of an upper building unit, and a bolt passes through the further threaded hole at the side wall of the bottom of the column (41) and the threaded hole at the side wall of the positioning boss (413) to connect the upper building unit and the lower building unit together.

2. The modular integrated building unit according to claim 1, characterized in

that the bottom plate (3) is made of structural reinforcing concrete and has a thickness ranged from 120 to 130 mm.

3. The modular integrated building unit according to claim 1, characterized in that the top plate (2) is made of non-structural lightweight concrete and has a thickness ranged from 75 to 85 mm, and provided therein with top plate reinforcing bars (52) that are fixedly connected to the steel skeleton (4).

4. The modular integrated building unit according to claim 1, characterized in that the wall plate reinforcing bars (51) are arranged in relatively long wall plates (11), which each are of a reinforcing concrete structure, and relatively short wall plates (12) each are of a reinforcing concrete structure and have a thickness ranged from 120 to 130 mm.

5. The modular integrated building unit according to claim 4, characterized in that at least part of the wall plate reinforcing bars (51) are arranged in cross pairs, and the pair of crossing wall plate reinforcing bars (51) are welded and thus fixed to a top and a bottom of the steel skeleton (4), respectively.

6. The modular integrated building unit according to claim 1, characterized in that vertically- and horizontally-adjacent building units are connected to each other through a bolt passing through the further threaded hole at the side wall of the bottom of the column (41) and the threaded hole at the side wall of the positioning boss (413).

7. The modular integrated building unit according to claim 1, characterized in that a vertical guiding panel (415) is fixed to the column top plate (411) at an outside of the column top plate (411) through welding, and is provided with a guiding slope on an inner side at the top thereof.

8. The modular integrated building unit according to any one of claims 1 to 5, characterized in that both ends of each wall plate (1) and the top plate (2) are fixed with a steel profile.