

BEAMLESS FLOOR STRUCTURE FOR BUILDING AND CONSTRUCTION METHOD FOR THE SAME

Technical Field

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The present invention relates to a building structure and a construction method thereof, and specifically to a beamless floor structure with no beams arranged between columns, and a method for construction of the beamless floor structure. The present invention is particularly suitable for buildings that require large space, such as shopping malls, refrigerated storages, warehouses, or the like.

Technical Background

Traditionally, a beamless floor structure refers to a bi-directionally stressed floor which is directly supported on columns and has no beams arranged between the columns. Such beamless floor structure has structural advantages including good integrity and large building space, so that it has been widely used in buildings that require large space, such as warehouses or the like. In addition, the building with the beamless floor structure has a construction height smaller than that with a rib beam floor structure, and is not restricted by the beams. Therefore, the building with the beamless floor structure can have a flexible layout for space, and effectively increase the indoor storey height. In this manner, the effective space of the building floor is increased. Moreover, the lighting, ventilation and sanitary conditions can be greatly improved by the smooth bottom plate of the beamless floor structure.

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However, in the beamless floor structure, reinforcing concrete plate is directly supported on the columns because of no beams, so that the plate of the beamless floor structure has a thickness larger than that of the rib beam floor having the same column size. In order to increase the shear bearing capacity of the plate at the top of the columns and to reduce the calculated span of the plate, a column cap is usually placed

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at the top of each column.

The traditional beamless floor structure is established at the construction site through in-situ casting. Because there is no beam, the bearing capacity of the plate becomes larger. In addition, the uncontrollable factors at the site construction are increased, the concrete strength cannot be guaranteed, a large number of templates need to be made, and the on-site workload for binding steel bars is also large. Therefore, problems such as long construction period and inconsistent quality are arisen. Moreover, the construction cost is soared due to a large amount of materials and labor required for construction.

Summary of the Invention

The present invention aims to provide a beamless floor structure for building and a construction method for the beamless floor structure, whereby the construction is convenient and rapid, and the on-site workload is significantly reduced.

The technical solution adopted by the present invention for solving the above technical problem relates to a beamless floor structure for building, comprising: a plurality of columns, a column cap disposed around each of the columns, and a floor slab supported on the columns and the column caps. The floor slab comprises a column plate strip arranged at each column cap, an inter-column plate strip arranged between two adjacent column plate strips, and an intermediate plate strip arranged between two adjacent inter-column plate strips. The column cap is a prefabricated member, and the column plate strip arranged at the top of the column cap has a cast-in-situ reinforcing concrete structure. The column cap is provided with exposed reinforcing bars, which are connected to reinforcing bars arranged in the column and the column plate strip. The inter-column plate strip and the intermediate plate strip are joined together by prefabricated plates at respective bottom portions thereof, and by cast-in-situ reinforcing concrete structure at respective upper portions thereof. The

prefabricated plate arranged at the bottom portion of the inter-column plate strip is provided with exposed reinforcing bars, which are connected to reinforcing bars arranged in said cast-in-situ reinforcing concrete structure.

5 The prefabricated plate arranged at the bottom portion of the intermediate plate strip is formed by connecting a first semi-prefabricated panel with a prefabricated hidden beam panel. The prefabricated hidden beam panel includes a flat panel body and at least two hidden beams protruding therefrom.

10 The first semi-prefabricated panel has a thickness of 60-90 mm. The prefabricated hidden beam panel has a thickness of 200-400 mm at the hidden beam thereof, and the flat panel body has a thickness of 120-180 mm.

15 The hidden beam of the prefabricated hidden beam panel is provided at both ends with exposed reinforcing bars, which are connected to reinforcing bars arranged in the cast-in-situ reinforcing concrete structure of the inter-column plate strip. The hidden beam is embedded in advance with a reinforcing bar connector at its outer side wall, for connecting reinforcing bars arranged in the prefabricated hidden beam panel with reinforcing bars arranged in an outer cast-in-situ reinforcing concrete structure.

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 The prefabricated plate of the inter-column plate strip is a second semi-prefabricated panel having a thickness of 100-150 mm.

25 Each column is surrounded and enclosed by two C-shaped column caps, each of the C-shaped column caps having a thickness of 120-180 mm.

 The cast-in-situ reinforcing concrete structure of the intermediate plate strip is provided therein with weight reducing blocks that are arranged in a plurality of rows and columns.

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The floor slab has a concrete grade of 50D/20 for its prefabricated part and cast-in-situ part, and a thickness of 500-700 mm.

A construction method of the beamless floor structure for building according to the present invention comprises: step A, mounting and fixing temporary supports for the column plate strips at positions of the column plate strips around the columns on an Nth floor; step B, hoisting the column caps to the temporary supports for the column plate strips and fixing them there; step C: mounting and fixing temporary braces for the inter-column plate strips at positions of the inter-column plate strips; step D, hoisting the prefabricated plates to the temporary braces for the inter-column plate strips and fixing them there; step E, mounting and fixing temporary braces for the intermediate plate strips at positions of the intermediate plate strips; step F, hoisting the prefabricated plates to the temporary braces for the intermediate plate strips and fixing them there; step G, binding reinforcing bars on each plate strip and pouring cast-in-situ concrete; and step H, removing all temporary supports and braces of said Nth layer when strength of the cast-in-situ concrete on each plate strip meets related requirements.

In step G, weight reducing blocks are placed on the prefabricated plate of the intermediate plate strip before reinforcing bars are bound.

Compared with the prior arts, the beamless floor structure for building according to the present invention has the following advantages.

First, the bottom portion of each plate strip is formed by connecting prefabricated plates together, and the column caps is also a prefabricated member, thus serving as a bottom mold for the floor slab. Therefore, the on-site molding step can be eliminated so that the template engineering can be greatly reduced, thus simplifying the construction process. In addition, since the prefabricated member is provided with reinforcing bars therein and also exposed reinforcing bars that are

arranged in advance, the workload of on-site binding the reinforcing bars can be significantly reduced. Accordingly, a large amount of on-site construction workload can be saved, thus reducing the construction cost.

5 Second, the construction schedule can be accelerated, the construction efficiency can be increased, and the construction period as a whole can be shortened.

Third, since the prefabricated members can be prepared at factories in advance, the concrete strengthen and quality thereof can be guaranteed.

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Fourth, for the beamless floor structure for building according to the present invention, the construction is simple, the binding of reinforcing bars at the floor slab is convenient, and the apparatus can be simply mounted, thus significantly improving the construction speed.

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Last, the beamless floor structure for building according to the present invention has a span larger than 9 m and thus has a larger bearing capacity, so that it is more economical than the traditional beamless floor structure.

20 **Brief Description of the Drawings**

Fig. 1 shows the inter-column layout in one unit of a beamless floor structure for building according to the present invention;

25 Fig. 2 is a cross-sectional view of Fig. 1 along line 1-1, with the exposed steel bars that are arranged in advance not being shown;

Fig. 3 is a detailed view of area A of Fig. 2;

30 Fig. 4 is a cross-sectional view of Fig. 1 along line 2-2, with the exposed steel

bars that are arranged in advance not being shown;

Fig. 5 is a cross-sectional view of Fig. 1 along line 3-3, with the exposed steel bars that are arranged in advance not being shown;

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Fig. 6 is a cross-sectional view of Fig. 1 along line A-A;

Fig. 7 is a cross-sectional view of Fig. 1 along line B-B;

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Fig. 8 is a cross-sectional view of Fig. 1 along line C-C;

Fig. 9 is a cross-sectional view of Fig. 1 along line D-D;

Fig. 10 schematically shows the structure of a first semi-prefabricated panel;

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Fig. 11 schematically shows the structure of a prefabricated hidden beam panel;

Fig. 12 schematically shows the structure of a second semi-prefabricated panel;

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Fig. 13 schematically shows the structure of a column cap;

Fig. 14 schematically shows step 1 for construction of the beamless floor structure for building according to the present invention;

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Fig. 15 schematically shows step 2 for construction of the beamless floor structure for building according to the present invention;

Fig. 16 schematically shows step 3 for construction of the beamless floor structure for building according to the present invention;

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Fig. 17 schematically shows step 4 for construction of the beamless floor structure for building according to the present invention;

Fig. 18 schematically shows step 5 for construction of the beamless floor structure for building according to the present invention;

Fig. 19 schematically shows step 6 for construction of the beamless floor structure for building according to the present invention;

Fig. 20 schematically shows step 7 for construction of the beamless floor structure for building according to the present invention;

Fig. 21 schematically shows step 8 for construction of the beamless floor structure for building according to the present invention;

Fig. 22 schematically shows step 9 for construction of the beamless floor structure for building according to the present invention; and

Fig. 23 schematically shows step 10 for construction of the beamless floor structure for building according to the present invention.

Detailed Description of the Embodiments

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

As shown in Figs. 1 and 5, the beamless floor structure for building according to the present invention comprises: a plurality of columns 1, a column cap 2 disposed around each of the columns 1, and a floor slab supported on the columns 1 and the associated column caps 2. Among others, the floor slab comprises: a column plate

strip 31 arranged at each column cap 2, an inter-column plate strip 32 arranged between two adjacent column plate strips 31, and an intermediate plate strip 33 arranged between two adjacent inter-column plate strips 32.

5 A special feature of the present invention is that: the column cap 2 arranged at the column plate strip 31 is a prefabricated member; bottom portions of the inter-column plate strip 32 and the intermediate plate strip 33 are both formed by connecting prefabricated plates; and upper portions of the column plate strip 31 arranged at the top of the column cap 2, the inter-column plate strip 32 and the
10 intermediate plate strip 33 are joined together by a cast-in-situ reinforcing concrete structure 34. The prefabricated member and the prefabricated plate are both embedded in advance with reinforcing bars, and the prefabricated plate at the bottom of each inter-column plate strip 32 is also provided with exposed reinforcing bars that are arranged in advance, which are connected to reinforcing bars arranged in the
15 cast-in-situ reinforcing concrete structure. In addition, the column cap 2 is also provided with exposed reinforcing bars that are arranged in advance, which are connected to reinforcing bars arranged in the column 1 and the column plate strip 31. In this manner, the bottom portion of each plate strip is formed by connecting prefabricated members together, and also serves as a bottom mold for the floor slab.
20 Therefore, not only the template engineering can be greatly reduced and the on-site molding step can be eliminated, but also the workload of binding the reinforcing bars on-site can be significantly reduced. Accordingly, a large amount of on-site construction workload can be saved, thus shortening the construction period and reducing the construction cost.

25 The prefabricated plate located at the bottom portion of the intermediate plate strip 33 may be a first semi-prefabricated panel 331 as shown in Fig. 10, which has a thickness of 60-90 mm. When the panel has a relatively large span, the prefabricated plate may also be a prefabricated hidden beam panel 332 as shown in Fig. 11, which
30 includes a flat panel body 333 and at least two hidden beams 334 protruding from the

flat panel body 333. The flat panel body 333 may have a thickness of 120-180 mm at a middle portion thereof, a thickness that is equal to the thickness of an adjacent prefabricated plate to be connected at two sides thereof, and a thickness of 200-400 mm at the hidden beam 334 thereof. In this embodiment, the intermediate plate strip 33 has a span of 8.5 m. As shown in Fig. 2, the prefabricated plate at the bottom portion of the intermediate plate strip 33 is formed by arranging the first semi-prefabricated panel 331 and the prefabricated hidden beam panel 332 alternately and connecting them together. The first semi-prefabricated panel 331 has a thickness of 75 mm, and the flat panel body 333 of the prefabricated hidden beam panel 332 has a thickness of 150 mm at its middle portion, a thickness of 75 mm at its both sides, and a thickness of 300 mm at its hidden beam 334.

As shown in Fig. 7, the prefabricated plate of the inter-column plate strip 32 may be a second semi-prefabricated panel 321 as shown in Fig. 12, which may have a thickness of 100-150 mm. In this embodiment, the semi-prefabricated panel 321 has a span of 8.5 m and a thickness of 125 mm.

As shown in Fig. 13, the column cap 2 has a C-like shape. As shown in Figs. 1 and 5, each column 1 of the beamless floor structure is surrounded and enclosed by two C-shaped column caps 2. The column cap 2 may have a thickness of 120-180 mm, and in the present embodiment, the thickness is 150 mm.

As shown in Figs. 3 and 6, the first semi-prefabricated panel 331 and the prefabricated hidden beam panel 332 are both embedded in advance with longitudinal and transverse reinforcing bars therein, and the hidden beams 334 are further provided with stirrups therein. In an outer side wall of each hidden beam 334 a reinforcing bar connector 335 is embedded in advance, for connecting reinforcing bars 71 arranged in the prefabricated hidden beam panel 332 with reinforcing bars 74 or 72 arranged in the cast-in-situ reinforcing concrete structure of the intermediate plate strip 33 or of the inter-column plate strip 32. As shown in Fig. 8, each hidden beam 334 of the

prefabricated hidden beam panel 332 is also provided at both ends thereof with exposed reinforcing bars 77 that are arranged in advance, for connecting with reinforcing bars arranged in the cast-in-situ reinforcing concrete structure of the inter-column plate strip 32. The cast-in-situ reinforcing concrete structure of the intermediate plate strip 33 is also provided with longitudinal and transverse reinforcing bars 75.

As shown in Figs. 7-9, the second semi-prefabricated panel 321 of the inter-column plate strip 32 is similarly embedded in advance with longitudinal and transverse reinforcing bars, and also exposed reinforcing bars 73 for connecting with reinforcing bars 76 arranged in the cast-in-situ reinforcing concrete structure of the inter-column plate strip 32. Some of the reinforcing bars 76 further extend into the cast-in-situ reinforcing concrete structure of an adjacent intermediate plate strip 33.

As shown in Figs. 1, 2 and 4, in order to reduce the weight of the floor slab itself, a plurality of weight reducing blocks 5 is placed on the prefabricated plate of the intermediate plate strip 33. The weight reducing block 5 is a cubic structure made of lightweight extruded polystyrene foam (XPS). Said plurality of weight reducing blocks 5 is arranged in a plurality of rows and columns uniformly in the intermediate plate strip 33, and formed into one piece with the cast-in-situ reinforcing concrete structure arranged there.

The thickness of the entire floor slab is in a range of 500-700 mm. In this embodiment, the floor slab has a thickness of 600 mm at each plate strip, and of 750 mm at the column plate strip 31 in view of the column cap 2. The concrete grade of the prefabricated part and the cast-in-situ part of the floor slab is 50D/20.

The construction method of the beamless floor structure for building according to the present invention comprises the following steps.

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In Step 1, as shown in Fig. 14, an Nth floor is cleaned, and thus is ready for construction.

In Step 2, as shown in Fig. 15, columns 1 are poured through in-situ casting.

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In Step 3, as shown in Fig. 16, temporary supports 61 for the column plate strips are mounted and fixed at the positions of the column plate strips 31 around the columns 1, when concrete of the columns 1 reaches its required strength.

10 In Step 4, as shown in Fig. 17, the column caps 2 are hoisted to the temporary supports 61 for the column plate strips, and fixed there.

In Step 5, as shown in Fig. 18, temporary braces 62 for the inter-column plate strips are mounted and fixed at the positions of the inter-column plate strips 32;

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In Step 6, as shown in Fig. 19, the second semi-prefabricated panels 321 are hoisted to the temporary braces 62 for the inter-column plate strips, and fixed there.

20 In Step 7, as shown in Fig. 20, temporary braces 63 for the intermediate plate strips are mounted and fixed at the positions of the intermediate plate strips 33.

In Step 8, as shown in Fig. 21, the first semi-prefabricated panels 331 and the prefabricated hidden beam panels 332 are hoisted to the temporary braces 63 for the intermediate plate strips, and fixed there.

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In Step 9, as shown in Fig. 22, weight reducing blocks 5 are placed on the first semi-prefabricated panels 331 and the prefabricated hidden beam panels 332 of the intermediate plate strips 33, reinforcing bars are bound on each plate strip, and cast-in-situ concrete is poured.

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In Step 10, as shown in Fig. 23, when the strength of the cast-in-situ concrete on each plate strip meets related requirements, all temporary supports and braces of said Nth layer are removed, and the above steps are repeated to perform the floor construction.

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The foregoing description is merely illustrative of preferred embodiments of the present invention, and is not intended to limit the present invention. Various changes and modifications may be made by those skilled in the art. 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.

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CLAIMS

1. A beamless floor structure for building, comprising: a plurality of columns (1), a column cap (2) disposed around each of the columns (1), and a floor slab supported on the columns (1) and the column caps (2), the floor slab comprising a column plate strip (31) arranged at each column cap (2), an inter-column plate strip (32) arranged between two adjacent column plate strips (31), and an intermediate plate strip (33) arranged between two adjacent inter-column plate strips (32),

characterized in that the column cap (2) is a prefabricated member, and the column plate strip (31) arranged at the top of the column cap (2) has a cast-in-situ reinforcing concrete structure, the column cap (2) being provided with exposed reinforcing bars, which are connected to reinforcing bars arranged in the column (1) and the column plate strip (31); and

the inter-column plate strip (32) and the intermediate plate strip (33) are joined together by prefabricated plates at respective bottom portions thereof, and by cast-in-situ reinforcing concrete structure at respective upper portions thereof, wherein the prefabricated plate arranged at the bottom portion of the inter-column plate strip (32) is provided with exposed reinforcing bars, which are connected to reinforcing bars arranged in said cast-in-situ reinforcing concrete structure.

2. The beamless floor structure for building according to claim 1, characterized in that the prefabricated plate arranged at the bottom portion of the intermediate plate strip (33) is formed by connecting a first semi-prefabricated panel (331) with a prefabricated hidden beam panel (332), the latter including a flat panel body (333) and at least two hidden beams (334) protruding therefrom.

3. The beamless floor structure for building according to claim 2, characterized in that the first semi-prefabricated panel (331) has a thickness of 60-90 mm, the prefabricated hidden beam panel (332) has a thickness of 200-400 mm at the hidden beam (334) thereof, and the flat panel body (333) has a thickness of 120-180 mm.

4. The beamless floor structure for building according to claim 2, characterized in that the hidden beam (334) of the prefabricated hidden beam panel (332) is provided at both ends with exposed reinforcing bars, which are connected to
5 reinforcing bars arranged in the cast-in-situ reinforcing concrete structure of the inter-column plate strip (32), and

the hidden beam (334) is embedded in advance with a reinforcing bar connector (335) at its outer side wall, for connecting reinforcing bars arranged in the prefabricated hidden beam panel (332) with reinforcing bars arranged in an outer
10 cast-in-situ reinforcing concrete structure.

5. The beamless floor structure for building according to any one of claims 1 to 4, characterized in that the prefabricated plate of the inter-column plate strip (32) is a second semi-prefabricated panel (321) having a thickness of 100-150 mm.

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6. The beamless floor structure for building according to any one of claims 1 to 4, characterized in that each column (1) is surrounded and enclosed by two C-shaped column caps (2), each of the C-shaped column caps (2) having a thickness of 120-180 mm.

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7. The beamless floor structure for building according to any one of claims 1 to 4, characterized in that the cast-in-situ reinforcing concrete structure of the intermediate plate strip (33) is provided therein with weight reducing blocks (5) that are arranged in a plurality of rows and columns.

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8. The beamless floor structure for building according to any one of claims 1 to 4, characterized in that the floor slab has a concrete grade of 50D/20 for its prefabricated part and cast-in-situ part, and a thickness of 500-700 mm.

30 9. A construction method of the beamless floor structure for building according

to claim 1, comprising:

step A: mounting and fixing temporary supports (61) for the column plate strips at positions of the column plate strips around the columns (1) on an Nth floor;

5 step B: hoisting the column caps (2) to the temporary supports (61) for the column plate strips and fixing them there;

step C: mounting and fixing temporary braces (62) for the inter-column plate strips at positions of the inter-column plate strips;

step D: hoisting the prefabricated plates to the temporary braces (62) for the inter-column plate strips and fixing them there;

10 step E: mounting and fixing temporary braces (63) for the intermediate plate strips at positions of the intermediate plate strips;

step F: hoisting the prefabricated plates to the temporary braces (63) for the intermediate plate strips and fixing them there;

15 step G: binding reinforcing bars on each plate strip and pouring cast-in-situ concrete; and

step H: removing all temporary supports and braces of said Nth layer when strength of the cast-in-situ concrete on each plate strip meets related requirements.

10. The construction method according to claim 9, characterized in that in step G,
20 weight reducing blocks (5) are placed on the prefabricated plate of the intermediate plate strip before reinforcing bars are bound.