

Interface Structure of Modular Integrated Building and Interface Leak-Proof Treatment Method

5 Field of the Invention

The present invention relates to a building structure, and a treatment method for the building structure. In particular, the present invention relates to an improvement on an interface structure between units of a modular integrated building, and a
10 leak-proof treatment method at the interface.

Background of the Invention

The construction of traditional cast-in-situ concrete buildings suffers problems
15 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 reinforced concrete structure, such as prefabricated kitchens, prefabricated bathrooms, prefabricated bedrooms and so on, have been completed at
20 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.

25 In the existing modular integrated buildings, as shown in Figure 1, an interface between two adjacent prefabricated building units adopts five different structures for water leak-proof, from inside to outside, as follows. First, a moisture-proof layer 91 is arranged at each side of the interface between two adjacent prefabricated building units, for preventing moisture from entering the prefabricated building units during

long-term use. Second, a PVC sleeve 92 is sandwiched between two adjacent moisture-proof layers. Third, a polyurethane foam 93 with a support rod is provided, which is a self-expandable polyurethane foam sealant for filling, sealing and insulating purposes, in order to form, together with concrete substrate, a durable,
5 air-resistant and water-proof compound. Fourth, a cement mortar section 94 is provided in a gap of the interface, which is formed by hydraulic cement and used as an additional defense for water ingression. Finally, a fire-proof joint sealant 95 with a support rod is provided to meet the requirement on fire compartment.

10 However, the existing interface structure and its treatment method not only need a number of procedures and long time of treatment, but also will require greater maintenance workload in the future.

Summary of the Invention

15 In order to overcome the deficiencies of the existing interface structure, the present invention provides an interface structure of modular integrated building, which features simple procedures, quick construction, and litter maintenance workload in the future, and a leak-proof treatment method at the interface.

20 The present invention adopts a technical solution as follows. An interface structure of a modular integrated building is proposed, which is located at a joint between two adjacent prefabricated building units. A plurality of vertical recesses are provided at both ends and in a middle portion of the joint, and cement grouting is
25 poured into the joint and the vertical recesses, each vertical recess having a maximum dimension ranging from 40 to 100 mm in a direction vertical to the joint and in a direction parallel to the joint.

A horizontal cross-section of each of the vertical recesses located at both ends of

the joint has a shape of circle, which has a diameter ranging from 80 to 90 mm.

5 A horizontal cross-section of each of the vertical recesses located in the middle portion of the joint has a shape of circle, which has a diameter ranging from 45 to 55 mm.

The joint is further provided with foam padding rod and sealant, which are both arranged outside of the vertical recesses at both ends of the joint.

10 Said vertical recesses pass through an entire height of the prefabricated building unit, with a distance ranging from 500 to 700 mm between two adjacent vertical recesses.

15 For the cement grouting filled in the vertical recesses at both ends of the joint, a weight ratio thereof is 10 kg of cement : (4-4.3) L of water. For the cement grouting filled in a portion of the joint between said vertical recesses at both ends of the joint and that filled in the vertical recesses in the middle portion of the joint, a weight ratio thereof is 10 kg of cement : (3.5-4) L of water : 0.05 L of water-proof admixture : 0.15 L of adhesive.

20 The present invention further proposes an interface leak-proof treatment method for a modular integrated building, comprising: step A, providing a plurality of vertical recessed halves on a side wall of each of two adjacent prefabricated building units facing the other prefabricated building unit, so that a plurality of vertical recesses are
25 formed at both ends and in a middle portion of a joint between said two adjacent prefabricated building units; step B, pouring cement grouting into the vertical recesses at both ends of the joint; and step C, pouring cement grouting into the vertical recesses in the middle portion of the joint, so that the joint and the vertical recesses in the middle portion of the joint are completely filled with cement grouting.

The interface leak-proof treatment method further includes step D: providing foam padding rod and sealant in respective positions outside of the vertical recesses at both ends of the joint.

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In step B, a plastic bag is guided by a UPVC pipe into each of the vertical recesses at both ends of the joint, and the cement grouting is introduced into the plastic bag from top to bottom, till the plastic bag is completely filled, and then the UPVC pipe is removed.

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Step C begins when the cement grouting in the vertical recesses at the ends of the joint (2) poured in step B reaches initial setting, and in step C, a UPVC pipe is inserted into each of the vertical recesses in the middle portion of the joint (2), and grouting is carried out from a bottom thereof.

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Compared with the prior arts, the interface structure of modular integrated building and the leak-proof treatment method thereof according to the present invention propose to provide several vertical recesses of different diameters at both ends and the middle portion of the joint, and then pour into the vertical recesses and the joint with cement grouting, thereby achieving a satisfactory leak-proof and moisture-proof effect. In this manner, the procedure and duration for treatment can be greatly reduced, and the interface can be completely sealed from a workbench during the construction of the building, without taking future maintenance into consideration. Moreover, it is very trouble-free and cost-saving in maintenance, and can reduce a large number of external wall operations after the construction of the superstructures.

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Brief Description of the Drawings

Figure 1 is a horizontal cross-sectional view of an existing interface structure of a

modular integrated building;

Figure 2 is a horizontal cross-sectional view of an interface structure of a modular integrated building according to the present invention; and

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Figure 3 schematically shows an interface leak-proof treatment method for a modular integrated building according to the present invention.

Detailed Description of the Embodiments

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

As shown in Figure 2, an interface structure of a modular integrated building according to the present invention is located at a joint 2 between two adjacent prefabricated building units 1. A plurality of vertical recesses are provided at both ends and in a middle portion of the joint 2, and cement grouting is poured into the joint 2 and the vertical recesses. These vertical recesses can be formed as follows. A plurality of vertical recessed halves is provided in advance on an outer side wall of each of the prefabricated building units 1 facing the other prefabricated building unit 1, and then two adjacent prefabricated building units 1 are connected with each other at the construction site, thus forming said vertical recesses, respectively.

The maximum dimension of each vertical recess in a direction vertical to or parallel to the joint 2 ranges from 40 to 100 mm, and is greater than a width of the joint 2. The width of the joint 2 is usually 10 to 20 mm, and in the present embodiment, it is 15 mm. The vertical recesses 5 located at both ends of the joint 2 are larger than the vertical recesses 6 located in the middle portion thereof. The horizontal cross-section of these vertical recesses can have a shape of circle, ellipse,

or quadrilateral, which is not limited in any manner. In this embodiment, the horizontal cross-section of the vertical recesses 5 at both ends of the joint 2 is in a shape of circle, which has a diameter of 85 mm. The horizontal cross-section of the vertical recesses 6 in the middle portion of the joint 2 is also in a shape of circle, which has a diameter of 50 mm. Preferably, these vertical recesses pass through the entire height of the prefabricated building units 1, with a distance of 500 to 700 mm between two adjacent vertical recesses. In this embodiment, the distance between the centers of two adjacent vertical recesses is 615 mm. Of course, this distance and the number of vertical recesses located in the middle portion of the joint can be appropriately adjusted according to the length of mating surfaces of the prefabricated building units 1.

In addition, the joint 2 is further provided with a foam padding rod 3 with a diameter of 20 mm and sealant 4, which are both arranged outside of the vertical recesses 5 located at both ends of the joint. In this embodiment, the sealant 4 is a fire-proof sealant, in order to meet the requirement on fire compartment.

In this embodiment, the weight ratio of the cement grouting filled in the vertical recesses 5 at both ends of the joint 2 is 10 kg of cement : (4-4.3) L of water. However, for the cement grouting filled in a portion of the joint 2 between the vertical recesses 5 at both ends of the joint 2 and that filled in the vertical recesses 5 in the middle portion of the joint 2, its weight ratio is 10 kg of cement : (3.5-4) L of water : 0.05 L of water-proof admixture : 0.15 L of adhesive, in order to further enhance the water-proof and moisture-proof effect. The water-proof admixture can use Conmix W1 water-proof admixture or equivalent, and the adhesive can use Boncrete SBR adhesive or equivalent.

As shown in Figures 2 and 3, the interface leak-proof treatment method for the modular integrated building according to the present invention based on the above

interface structure includes the following steps.

In step A, a plurality of vertical recessed halves is provided in advance on an outer side wall of each of the prefabricated building units 1 facing the other prefabricated building unit 1, so that a plurality of vertical recesses are formed at both ends and in the middle portion of the joint 2 between two adjacent prefabricated building units 1.

In step B, cement grouting is poured into the vertical recesses 5 at both ends of the joint 2.

In step C: cement grouting is poured into the vertical recesses 6 in the middle portion of the joint 2, so that the vertical recesses 6 in the middle portion of the joint 2 and the joint 2 are filled with cement grouting.

In step D: A foam padding rod 3 and fire-proof sealant 4 are arranged in positions outside of the vertical recesses 5 at both ends of the joint 2.

In the following, the materials and tools/equipment used in the above steps are described by taking a full length of the joint 2 of the prefabricated building unit 1 with a height of 2.8 m as an example.

The materials used in the above steps are as follows:

- a) 0.12 mm thick plastic bag (75 mm in diameter);
- b) Cement grouting at both ends of the joint (in the plastic bag), with a weight ratio of 10 kg of cement : (4 to 4.3) L of water;
- c) Water-proof cement grouting for the joint, with a weight ratio of 10 kg of cement : 3.85 L of water : 0.05 L of water-proof admixture : 0.15 L of adhesive;
- d) Foam padding rod (support rod); and

e) Fire-proof sealant.

The tools/equipment used in the above steps are as follows:

a) A UPVC pipe with a diameter of 50 mm and a length of 3 m, for guiding the plastic bag into the vertical recesses at both ends of the joint;

b) A UPVC pipe with a diameter of 32 mm and a length of 1 m, with a guide cone for pouring cement grouting into the vertical recesses in the middle of the joint and the gap of the joint; alternatively, a grouting machine with a guide tube having a diameter of 25 mm can be used;

c) A stirring rod with a diameter of 20 mm, for reducing bubbles in the joint.

In step B, a UPVC pipe 71 with a diameter of 50 mm is used to guide the 0.12 mm thick plastic bag 8 into each of the vertical recesses 5 at both ends of the joint 2, and the cement grouting is introduced into the plastic bag from top to bottom, till the bag 8 is fully filled. Then, the UPVC pipe 71 is removed, and the initial setting time of cement grouting is about 30 minutes. During the period from the cement grouting is poured into the plastic bag 8 to setting, the plastic bag 8 will be slightly swelled due to thermal expansion of the cement grouting material, so that the plastic bag 8 will be in a close contact with the vertical recess 5 at each end of the joint. This step B is used to seal two ends of the joint 2, so as to prevent grouting leakage when the middle portion of the joint 2 is grouted in step C.

When the cement grouting in the vertical recesses 5 at both ends of the joint in the above step B reaches initial setting, step C is started. In this step C, a UPVC pipe 72 with a diameter of 32 mm is inserted into each of the vertical recesses in the middle portion of the joint 2, and grouting is carried out from the bottom. The vertical recesses 6 in the middle portion of the joint 2 and the adjacent portions of the joint 2 are fully filled with water-proof cement grouting under the action of gravity. During this period, a tamping rod with a diameter of 20 mm is used for regularly stirring the

grouting, in order to reduce air bubbles entering the mixture during the pouring procedure. The joint 2 and the vertical recesses should be completely grouted before the concrete slab is cast.

5 Tests show that the interface leak-proof treatment method according to the present invention can achieve satisfactory water tightness. It can not only solve the problem concerning future maintenance, but also reduce a large amount of external wall operations after the construction of the superstructure.

10 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. An interface structure of a modular integrated building, located at a joint (2) between two adjacent prefabricated building units (1),

5 wherein a plurality of vertical recesses are provided at both ends and in a middle portion of the joint (2), and cement grouting is poured into the joint (2) and the vertical recesses, each vertical recess having a maximum dimension ranging from 40 to 100 mm in a direction vertical to the joint (2) and in a direction parallel to the joint (2).

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2. The interface structure of a modular integrated building according to claim 1, wherein a horizontal cross-section of each of the vertical recesses located at both ends of the joint (2) has a shape of circle, which has a diameter ranging from 80 to 90 mm.

15 3. The interface structure of a modular integrated building according to claim 2, wherein a horizontal cross-section of each of the vertical recesses located in the middle portion of the joint (2) has a shape of circle, which has a diameter ranging from 45 to 55 mm.

20 4. The interface structure of a modular integrated building according to claim 1, 2 or 3, wherein the joint (2) is further provided with foam padding rod (3) and sealant (4), which are both arranged outside of the vertical recesses at both ends of the joint.

5. The interface structure of a modular integrated building according to claim 1,
25 2 or 3, wherein said vertical recesses pass through an entire height of the prefabricated building unit (1), with a distance ranging from 500 to 700 mm between two adjacent vertical recesses.

6. The interface structure of a modular integrated building according to claim 1,

2 or 3, wherein for the cement grouting filled in the vertical recesses at both ends of the joint (2), a weight ratio thereof is 10 kg of cement : (4-4.3) L of water; and

for the cement grouting filled in a portion of the joint (2) between said vertical recesses at both ends of the joint (2) and that filled in the vertical recesses in the middle portion of the joint (2), a weight ratio thereof is 10 kg of cement : (3.5-4) L of water : 0.05 L of water-proof admixture : 0.15 L of adhesive.

7. An interface leak-proof treatment method for a modular integrated building, comprising:

10 step A, providing a plurality of vertical recessed halves on a side wall of each of two adjacent prefabricated building units (1) facing the other prefabricated building unit, so that a plurality of vertical recesses are formed at both ends and in a middle portion of a joint (2) between said two adjacent prefabricated building units (1);

step B, pouring cement grouting into the vertical recesses at both ends of the joint (2); and

step C, pouring cement grouting into the vertical recesses in the middle portion of the joint (2), so that the joint (2) and the vertical recesses in the middle portion of the joint (2) are completely filled with cement grouting.

20 8. The interface leak-proof treatment method for a modular integrated building according to claim 7, wherein further including step D: providing foam padding rod (3) and sealant (4) in respective positions outside of the vertical recesses at both ends of the joint (2).

25 9. The interface leak-proof treatment method for a modular integrated building according to claim 7 or 8, wherein in step B, a plastic bag is guided by a UPVC pipe into each of the vertical recesses at both ends of the joint (2), and the cement grouting is introduced into the plastic bag from top to bottom, till the plastic bag is completely filled, and then the UPVC pipe is removed.

10. The interface leak-proof treatment method for a modular integrated building according to claim 7 or 8, wherein step C begins when the cement grouting in the vertical recesses at the ends of the joint (2) poured in step B reaches initial setting, and
5 in step C, a UPVC pipe is inserted into each of the vertical recesses in the middle portion of the joint (2), and grouting is carried out from a bottom thereof.