COMPOSITE STRUCTURAL WALL AND METHOD OF CONSTRUCTION THEREOF

Technical Field

The present invention relates to composite structural walls, methods to construct composite structural walls, prefabricated construction modules, e.g. Prefabricated Prefinished Volumetric Construction (PPVC), and building structures constructed therefrom.

Background of the invention

Construction of buildings with shear walls cast-in situ on site is known, and widely used in the industry. As it is a cast-in situ process, formwork and reinforcement of the shear wall has to be erected before casting with concrete. The curing of concrete on site is time-consuming and dependent on environmental conditions (e.g. weather and temperature). After curing the concrete, it is further necessary to remove formwork. While the cast-in situ method generally provides a monolithic concrete wall that can withstand high loads and is applicable for most, if not all, types of buildings, this method is a time and labour intensive construction activity.

To improve productivity, precast concrete walls and prefabricated construction modules have been developed and used in the construction industry. The prefabricated walls and modules are produced in a factory and transported to the building site as needed. This allows for better control, and reduces variations in the curing process of the concrete due to environmental factors (e.g. weather and temperature) at the building site. However, existing methods of joining two side-by-side precast concrete walls would result in the precast walls functioning as twin or two individual walls rather than as a single or monolithic wall. Similarly, joining precast concrete walls of side-by-side prefabricated construction modules would result in combined twin walls that function as individual walls rather than as a single or monolithic wall.

Consequently, in order to achieve same vertical loading capacity provided by a monolithic wall constructed from existing cast-in situ methods, the combined twin walls, i.e. a combined width of individual walls joined by existing cast-in situ method, would have to be thicker than the monolithic wall.

Alternatively, in order to ensure the width of the combined twin walls, i.e. combined width of individual walls, is no more than the monolithic wall constructed from cast-in situ methods, vertical load bearing limit of the combined twin walls, as well as the height limit of the building structure, would have to be reduced. Either way poses a restriction to design and construction of the building, and prevents the building owner from maximising value from the constructed building.

Summary of the invention

In a first aspect of the invention, there is provided a method for constructing a composite structural wall, the method comprises: adjacently arranging a first pair of wall panels, wherein each wall panel of the first pair of wall panels includes a first panel body, and at least one first guide attached thereto and protruding from a first groove formed in the first panel body, wherein adjacently arranging a first pair of wall panels includes overlapping the first guides of the first pair of wall panels to form a first channel; inserting a first linking rod into the first channel; dispensing a first grout into a first gap between the first pair of wall panels, wherein dispensing a first grout into a first gap includes dispensing the first grout into the first channel; and curing the first grout to join the first pair of wall panels.

In an embodiment of the first aspect of the invention, the method further comprises: vertically-stacking a second pair of adjacently arranged wall panels on the first pair of wall panels, wherein each wall panel of the second pair of wall panels includes a second panel body, and at least one second guide attached thereto and protruding from a second groove formed in the second panel body, wherein vertically-stacking a second pair of adjacently arranged wall panels on the first pair of wall panels includes overlapping the second guides of the second pair of wall panels to form a second channel; inserting a vertical securement rod into the first and the second channel such that the vertical securement rod have opposite end portions at least partially inserted into the first and the second channel respectively; dispensing a second grout into a second gap between the second pair of wall panels, wherein dispensing a second grout into a second gap includes dispensing the second grout into the second channel; and curing the second grout to join the second pair of wall panels.

Claims

1. A method for constructing a composite structural wall, the method comprising:

adjacently arranging a first pair of prefabricated construction modules which provide a first pair of wall panels, wherein each wall panel of the first pair of wall panels includes:

a first panel body having a first width, a first length a first height, and a first surface defined by the first length and the first height wherein the first length and the first height have larger dimensions than the first width; and

at least one first guide attached to the first panel body, wherein adjacently arranging the first pair of prefabricated construction modules includes adjacently arranging the first pair of wall panels, dispensing a first grout into a first gap between the first pair of wall panels; and curing the first grout to join the first pair of prefabricated construction modules, wherein curing the first grout includes joining the first surfaces of the first pair of wall panels to form a first composite structural wall having a width at least twice the first width of the first panel body,

characterised in that the at least one first guide is protruding from a first groove formed in the first surface, adjacently arranging the first pair of prefabricated construction modules includes overlapping the first guides of the first pair of wall panels to form a first channel;

inserting a first linking rod into the first channel;

wherein dispensing the first grout into the first gap includes dispensing the first grout into the first channel; and

wherein a width of the first grout between the non-grooved portions of the first surfaces of the first pair of wall panels is smaller than the first width of the first panel body.

2. The method according to claim 1 further comprising:

vertically stacking a second pair of adjacently arranged prefabricated construction modules, including vertically stacking a second pair of adjacently arranged wall panels, which are respectively provided by the second pair of adjacently arranged prefabricated construction modules on the first pair of wall panels, wherein each wall panel of the second pair of wall panels includes:

a second panel body having a second width, a second length, a second height, and a second surface defined by the second length and the second height, wherein the second length and the second height have larger dimensions than the second width; and

at least one second guide attached to the second panel body and protruding from a second groove formed in the second surface, wherein vertically stacking a second pair of adjacently arranged wall panels on the first pair of wall panels includes overlapping the second guides of the second pair of wall panels to form a second channel;

inserting a vertical securement rod into the first and the second channels such that the vertical securement rod has opposite end portions at least partially inserted into the first and the second channels respectively;

dispensing a second grout into a second gap between the second pair of wall panels, wherein dispensing the second grout into the second gap includes dispensing the second grout into the second channel; and

curing the second grout to join the prefabricated construction modules, wherein curing the second grout includes joining the second surfaces of the second pair of wall panels to form a second composite structural wall having a width at least twice the second width of the second panel body, wherein a width of the second grout between non-grooved portions of the second surfaces of the second pair of wall panels is smaller than the second width of the second panel body.

3. The method according to claim 2, further comprising: inserting a second linking rod into the second channel.

4. The method according to claim 2 or claim 3, wherein the first and/or the second surface includes an opening therethrough for a door and/or a window fitting.

5. The method according to claim 4, wherein each wall panel of the first and the second pair of wall panels includes a bottom end portion attached to a floor slab,

the method further comprising:

inserting a plurality of backing rods between the first pair of prefabricated construction modules and floor slabs of the second pair of prefabricated construction modules to provide a third gap which intersects the first and the second channels,

wherein dispensing a second grout into a second gap includes dispensing the second grout into the third gap,

wherein curing the second grout includes curing the second grout to join the second pair of prefabricated construction modules to the first pair of prefabricated construction modules.

6. A composite structural wall formed of a first pair of joined prefabricated construction modules, comprising:

a first pair of wall panels, wherein each panel is provided by one of the prefabricated construction modules of the first pair of prefabricated construction modules, each wall panel of the first pair of wall panels comprising:

a first panel body having a first width, a first length, a first height, and a first surface defined by the first length and the first height, wherein the first length and the first height have larger dimensions than the first width; and the first pair of prefabricated construction modules are arranged adjacent to each other and further comprise:

at least one first guide attached to the first panel body;

a first grout disposed in a first gap between the first pair of wall panels, wherein the first grout joins the first surfaces of the first pair of the wall panels to form the composite structural wall having a width at least twice the first width of the first panel body,

characterised in that the at least one first guide is protruding from a first groove formed in the first surface, wherein the first guides of the first pair of wall panels overlap to provide a first channel;

a first linking rod inserted into the first channel;

the first gap includes the first channel;

wherein a width of the first grout between non-grooved portions of the first surfaces of the first pair of wall panels is smaller than the first width of the first panel body.

7. The composite structural wall according to claim 6 further comprising:

a reinforcement structure embedded in the first panel body, wherein the first guide is attached to the reinforcement structure, wherein the reinforcement structure is any one selected from the group consisting of a plurality of steel bars, a plurality of corrugated pipes each adapted to receive a steel bar of a vertically stacked wall panel, a mesh of steel bars, a mesh of steel wires, and a plurality of steel bars each attached to a splice connector adapted to receive a steel bar of a vertically stacked wall panel.

8. The composite structural wall according to claim 6 or claim 7, wherein the first surface of the first panel body is roughened.

9. The composite structural wall according to claim 6, claim 7 or claim 8 further comprising: a floor slab attached to a bottom end portion of the first wall panel.

10. A building structure constructed from a plurality of prefabricated construction modules comprising:

a first composite wall being the composite structural wall of any of claim 6, claim 7, or claim 8;

a second pair of prefabricated construction modules joined together by a second composite structural wall which is vertically stacked on the first composite structural wall, wherein the second composite structural wall comprises:

a second pair of wall panels respectively provided by the second pair of prefabricated construction modules and arranged adjacent to each other, each of the second pair of wall panels comprises:

a second panel body having a second width, a second length, a second height, and a second surface defined by the second length and the second height, wherein the second length and the second height have larger dimensions than the second width; and

at least one second guide attached to the second panel body and protruding from a second groove formed in the second surface, wherein the second pair of guides of the second pair of prefabricated construction modules overlap to provide a second channel;

a second linking rod inserted into the second channel;

a vertical securement rod having opposite end portions at least partially inserted into the first channel and the second channel respectively; and

a second grout disposed in a second gap, including the second channel, between the second pair of wall panels, wherein the second grout joins the second surfaces of the second pair of wall panels to form the second composite structural wall, wherein a width of the second composite structural wall is at least twice the second width of the second panel body, wherein a width of the second grout between non-grooved portions of the second surfaces of the second pair of wall panels is smaller than the second width of the second panel body.

11. The building structure according to claim 10, wherein the first and/or the second surface includes at least one opening therethrough for a door and/or a window fitting.

12. The building structure according to claim 11, wherein each wall panel of the first and the second pair of the wall panels includes a top end portion attached to a ceiling slab and a bottom end portion attached to a floor slab,

the building structure further comprising:

a plurality of backing rods interposed between the ceiling slabs of the first pair of prefabricated construction modules and the floor slabs of the second pair of prefabricated construction modules to provide a third gap,

wherein the second grout is further disposed in the third gap and joins the second pair of prefabricated construction modules to the first pair of prefabricated construction modules.

13. The building structure according to claim 12, wherein each floor slab of the second pair of prefabricated construction modules includes at least one floor slab guide attached to each respective floor slab and protruding from each respective floor slab, and

wherein the floor slab guides of the second pair of prefabricated construction modules overlap with the second channel.

14. The building structure according to claim 10, claim 11, claim 12, or claim 13, wherein the vertical securement rod is integral with the first and/or the second linking rod.