

MODULAR SYSTEM FOR CONSTRUCTING A TIMBER-FRAMED BUILDING

The present invention relates to the field of timber-framed building construction. More particularly, the invention relates to a modular system for constructing a timber-framed building.

In this field, it is generally provided that a plurality of timber-framed modules are created and assembled to form the building. The modules generally comprise a plurality of horizontal beams and joists and a plurality of posts defining a plurality of frameworks that can be assembled vertically to form an upper floor and a lower floor. Moreover, modules are assembled horizontally to define a building wall between two modules.

For mechanical resistance that is sufficient both horizontally and vertically, the beams are generally formed from solid timber and fixed in each framework of each module, with a bracing means external to the posts that conventionally comprises at least an external or upper panel and/or a joist or beam connecting said posts. During the assembly of modules, the walls between two horizontally assembled modules are found to have a significant thickness, which decreases the internal area of the building. Thus, the creation of conventional modules is often criticized for an excessive thickness of the shear walls. In particular, a conventional composition is based on 120×45 mm posts for example with a wind-bracing panel external to the wall, and in the center a double wall, leading to, at best, by way of example, thicknesses of two panels of 12 mm each, two 120 mm posts, associated with a 10 mm play and a 0.1 mm vapor barrier, or a total wall thickness of 274 mm excluding lining.

The terms “external” and “internal” refer to the interior of the module in question unless stated otherwise.

An object of the present invention is to propose a modular construction system in which the thickness of the walls between two horizontally assembled modules is significantly reduced while still improving the horizontal and vertical mechanical resistance properties of the modular system.

A further object of the invention is to propose a modular system for designing the multi-story timber-framed building with high three-dimensional rigidity.

For this purpose, a modular system for constructing a timber-framed building is proposed, comprising a plurality of timber-framed modules which have a rectangular parallelepipedal cross-section and are composed of vertical posts which are continuous up the entire height thereof and are interconnected in pairs by at least two horizontal joists, including at least two modules which are assembled horizontally, thereby defining a wall between said modules, and at least two timber-framed modules which are assembled vertically, at least one wall post being provided between said vertical posts.

According to the invention, at least said wall posts of horizontally adjacent modules are offset and overlap, at least in part, with respect to one another, and the posts of an upper module rest on the posts of a lower module, directly or indirectly by means of a layer of non-compressible material, such as a metal sheet, a sealing film, or any other non-compressible material except for a horizontal, fibered timber layer.

Advantageously, the arrangement of the posts, and more particularly of the wall posts, limits the thickness of the wall as a function of their overlap, without affecting the mechanical properties of the wall, since the number of posts is not reduced.

In other aspects, taken in isolation or combined in any technically feasible combinations:

- the system comprises at least one post bracing means that allows said overlap, between which at least one wall reinforcement is preferably provided, and said wall reinforcement is internal to said wall post of the corresponding module; and/or
- the bracing means of the posts comprise at least an internal wind-bracing panel and/or one or more joists that preferably form a framework with the post, defining each module; and/or
- the system comprises at least one insulator between two horizontally assembled modules, the insulator being arranged between the exterior of said post of a module and the exterior of a wind-bracing panel of the second module; and/or
- the system comprises at least one insulator between two horizontally assembled modules, the insulator being arranged in the space between the two wind-bracing panels of the horizontally adjacent modules; and/or
- the system comprises at least one spar for each of two horizontally arranged modules, which is associated with at least one joist fixed to the end of the spar, and

said spar is housed in an at least partial recess in said beam and/or said beam is housed in an at least partial recess in said spar; and/or

- the system comprises at least one spar for each of the two horizontally arranged modules, and said spars are offset and overlap, at least in part, with respect to one another; and/or
- the system comprises a gap between, on the one hand, said post and/or said bracing means of a first module and, on the other hand, said post and/or said bracing means of a second module arranged horizontally with respect to the first module; and/or
- the system comprises a means for fixing between, on the one hand, said post and/or said bracing means of a first module and, on the other hand, said post and/or said bracing means of a second module arranged horizontally with respect to the first module.

A further subject matter of the invention relates to a timber-framed building comprising at least one modular system according to the invention.

The invention will be detailed further by way of the description of non-limiting embodiments and on the basis of the accompanying drawings, in which:

- Fig. 1 is a three-dimensional view of a modular system according to a preferred variant of the invention;
- Fig. 2 is a view similar to that of Fig. 1, further illustrating panels;
- Fig. 3 is a sectional view of a system according to a variant similar to that of Fig. 1;
- Fig. 4 is a three-dimensional view of part of a timber-framed building; and
- Fig. 5A to 5D illustrate different arrangement of walls, including the insertion of posts of increased section or spars which may be located at the singular points.

The present invention relates to a modular construction system 1. The modular system 1 according to the invention is for constructing a timber-framed building 2.

The modular system 1 according to the invention comprises at least three timber-framed modules 3A, 3B, 3C which have a rectangular parallelepipedal cross-section and are each composed of at least two vertical posts 4, connected by at least two horizontal joists 5, preferably a series of posts 4 connected by joists 5 in this manner.

A module further preferably comprises spars 6 and beams 7. The assembly forms an armoring for stiffening the building 2 constructed from at least one modular system 1 of this type. The beams may equally be supporting horizontal beams. As well as the construction of modules 3A, 3B, 3C, it is provided that at least two of them are assembled horizontally, in particular that two construction modules 3A and 3B are placed side by side and fixed together to form the timber-framed building 2.

The modules 3A, 3B thus assembled define a wall 8 between them. The wall 8 comprises a plurality of elements of the timber frame. Between the elements of the timber frame, in each module 3A, 3B, 3C a series of posts 4 which are continuous up the entire height of said module 3A, 3B, 3C are provided. Further, between the posts 4, there is at least one, preferably a plurality of wall posts 4a which are part of the formation of the wall 8.

The posts 4 and the spars 6 are vertical, fibered pieces of timber. The posts 4 preferentially, but not compulsorily, have a section less than that of the spars 6. The spars 6 may be used at angles and/or singular points, for example openings and ends of a module 3A, 3B, 3C, and the posts 4 may be used between the ends.

The joists 5 and the beams 7 are horizontal, fibered pieces of timber. The joists 5 preferentially, but not compulsorily, have a section less than that of the beams. For example, the joists 5 have a section of approximately 220 by 45 mm. The beams 7 may be used at angles and ends of a module 3A, 3B, and the joists 5 may be used between the ends. Wall reinforcements 5a may be provided in the wall 8. The wall reinforcement may be a wall cap, and may have a section similar to that of a joist.

According to the invention, at least the wall posts 4a are offset in a direction parallel to the wall 8 and overlap, at least in part, in a direction perpendicular to the corresponding wall 8. In particular, at least the wall uprights 4a of a first module 3A are offset with respect to the wall uprights 4a of a second module 3B horizontally adjacent to the first module 3A. Further, these wall posts 4a overlap with respect to one another. In other words, the wall posts 4a cover each other at least in part so as to have an at least partially horizontal alignment. More particularly, when the wall posts 4a are observed along the direction of the wall 8 independently of the other construction elements, the closest wall post 4a at least partially obscures the most distant wall post 4a.

The horizontally adjacent modules 3A, 3B thus form, in particular, a plurality of offset frameworks nested in one another at the wall 8.

5 Advantageously, the arrangement of at least the wall posts 4a makes it possible to limit the thickness of the wall 8 in accordance with the overlap of the posts, without affecting the mechanical properties of the wall, since the number of posts 4 is in particular not significantly reduced.

10 In a variant, the system comprises at least one post bracing means that allows said overlap. In the context of the invention, the "bracing means" is in particular a piece for maintaining a gap between the posts 4 or between a post and an end or a beam. The absence of a wall cap or bottom plate also allows said overlap.

15 Thus, the invention makes possible an arrangement which is advantageous over the prior art, where bracing means external to the wall posts are provided. These bracing means, which are external or at the top and/or bottom of the wall posts, do not allow the overlap of the wall posts in the prior art, unlike in the subject matter of the invention.

20 More particularly, the bracing means that can be used in the invention consist of elements that are internal to the wall posts 4a, or to the side thereof and substantially internal. These elements make it possible to leave a gap at least between the wall posts 4a for the overlap of at least the wall posts 4a of the horizontally adjacent module.

25 The bracing means preferably comprise at least one wall reinforcement 5a that is internal to said wall post 4a of the corresponding module. The bracing can thus be provided by beams 7.

30 In a variant, the bracing means of the posts 4 comprise at least one wind-bracing panel 9 and/or one or more joists 5, preferably forming a framework with the posts, defining each module. The wind-bracing panel 9 may be an OSB panel, which may for example measure 12 mm in thickness.

35 Advantageously, this novel framework arrangement makes it possible to provide novel modes of assembly between modules. In particular, a means may be provided for fixing between, on the one hand, said wall post 4a and/or said bracing means of a first module 3A

and, on the other hand, said wall post 4a and/or said bracing means of a second module 3B arranged horizontally with respect to the first module 3A. In other words, the arrangement according to the invention makes it possible to provide that the posts of a first module 3A are assembled with the posts of a second module 3B or with the wall of the second module 3B to provide assemblies between modules 3A, 3B. Advantageously, the overlap at least of the wall posts 4a makes it possible to provide fixing at the overlap, for example by way of cross pieces or by adhesion. A different fixing system may be provided.

In a variant, the modular system 1 comprises at least one insulator 10, in particular one or more insulation elements, between two horizontally adjacent modules 3A, 3B. This insulator 10 is arranged between the exterior of said wall post 4a of a module 3A and the exterior of a wind-bracing panel 9 of the second module 3B. In particular, the insulator 10 may be a heat and/or sound insulation element. The insulator may, for example, measure 40 mm in thickness. It may be in the form of a plate or of a substance to be poured into the wall.

More generally, to improve the insulation, in particular sound insulation, of the building 2, the system comprises a gap between, on the one hand, said wall post 4a and/or said bracing means of a first module 3A and, on the other hand, said wall post 4a and/or said bracing means of a second module 3B assembled horizontally with respect to the first module 3A. In particular, during the construction of the building 2, contact between particular elements of the frames of the horizontally adjacent modules is prevented, greatly improving the sound insulation. More particularly, it could be provided that the wall posts 4a of a first module 3A are not in contact with the wall posts 4a and/or the internal wind-bracing panel 9 of a second module 3B.

The system further comprises at least two vertically assembled timber frame modules 3A, 3C. The Applicant has already proposed a significant improvement to the vertical solidity of a timber frame in application WO 2014/140479 A1. In particular, the posts 4 of an upper module 3C rest on the posts 4 of a lower module 3A directly or indirectly, but without the interposition of horizontal, fibered timber of a compressible nature.

Thus, a layer of an incompressible material, such as a metal sheet, a plastics material film, a vapor barrier film, in particular bituminous, etc., may be interposed between the posts that are superposed in substantially the same alignment.

The surprising advantage of the invention, that of nesting adjacent module wall posts and of vertical holding by direct superposition of the posts of superposed modules without interposition of compressible material, involves a synergy of these features, which leads to greatly improved three-dimensional solidity of a multi-story building 2.

5

In a variant, the system comprises at least an angle spar 6 or an intermediate spar for each of the two horizontally arranged modules, associated with at least one beam 7 fixed to a preferably lower end of the spar 6.

- 10 The spars 6 of adjacent modules 3A, 3B may equally be offset and overlap, at least partially, in the same way as the wall posts 4a. This configuration may be illustrated by Fig. 5A.

In a variant, the angle spar 6 or the intermediate spar is housed in an at least partial recess in said beam 7 and/or said beam 7 is housed in an at least partial recess in said spar 6. The same arrangement with a joist instead of a beam 7 is conceivable. In particular, the angle spars 6 and the intermediate spars, as applicable, may be provided along a joist or a beam. In this case, these spars 6 may face one another, being integrated into the low beam 7 that will be fully or partly recessed at the site of the spar 6. This configuration may be illustrated by Fig. 5B.

20

Alternatively or in combination, for example at other spars 6, these may be fully or partly recessed so as to be arranged against the low beam 7. This configuration may be illustrated by Fig. 5C.

- 25 Alternatively or in combination, for example at other spars 6, these may be assembled in halved joints with the joist or the beam 7 with partial recessing of the spar and of the beam or joist 7.

More particularly, the angle spars 6 or the intermediate spars, as applicable, may be machined in variable shapes so as to keep sufficient section while making it possible to reduce the wall 8. The spars 6 could therefore be assembled along one another by way of complementary shapes. This configuration may be illustrated by Fig. 5D.

35 The invention further relates to a timber-framed building comprising at least one modular system as described above.

The creation of a timber-framed building 2 of this type comprises at least a step of constructing at least three timber-framed modules 3A, 3B, 3C comprising a series of posts 4 which are continuous up the entire height of said module. At least one wall post 4a is provided between these posts 4.

Subsequently, at least two modules 3A and 3B are assembled horizontally, while offsetting the wall posts 4a in a direction parallel to that of the corresponding wall 8, while causing them to overlap, at least in part, in a direction perpendicular to that of the corresponding wall 8.

More particularly, the process is based on assembling the modules 3A, 3B horizontally, while offsetting the wall posts 4a with respect to one another, in a direction parallel to that of the corresponding wall 8, while causing them to overlap, at least in part, with respect to one another in a direction perpendicular to that of the corresponding wall 8.

Further, the process comprises a step of constructing at least one wall 8 comprising said wall posts 4a.

Example

The walls of the timber-framed modules obtained according to the invention are in particular in accordance with standard DTU 31.2, in other words solid timber posts 4a of variable section juxtaposed at a regular or irregular interval but often at 30, 40 or 60 cm.

These posts 4a are wind-braced by a panel 9 (for example reconstituted long-strip, gypsum fiberboard, wood agglomerate panels, etc.)

This panel 9 may equally well be placed on the exterior of the wall 8 or on the interior side, for example of a living room.

The creation of the modules 3A, 3B according to the invention with conventional posts 4a and panels 9 leads to a type of composition, excluding lining, which may be a successive adjoining of:

For a first module 3A:

- a panel 9 of 12 mm thickness;
- a post 4a of section 120×45 mm (120 mm thickness);

Then a play of 10 mm;

- a sound insulator 10 of 40 mm thickness;

5 Then for a second module 3B:

- a post 4a (of 120 mm thickness) completely or partially covering the post of the first module; and
- a panel 9 of 12 mm thickness.

10 This leads to a total of 194 mm excluding lining, which can be brought to 154 mm without the sound insulator 10.

The wall posts 4a may cover one another completely if there is no sound insulator.

15 Advantageously, the arrangement according to the invention makes it possible to integrate insulators 10 or lining plates into the walls 8 without increasing the thickness, but rather while actually decreasing it.

Other combinations are then possible, for example with thicker posts conventionally of 145
20 mm or 180 mm, preferably with two lining plates that may be 15 mm.

Likewise, advantageously, the arrangement according to the invention makes it possible to increase the size of the posts 4a of the walls 8 without increasing the thickness thereof, but rather while actually decreasing it.

25

The process of constructing a building according to the invention also provides superposition of at least two modules 3A, 3C in such a way that the respective posts 4 of these modules are superposed.

30 More precisely, each post 4 of the upper module 3C comes to rest 1 on a post 4 of a lower module 3A, directly or at the very least without interposition of a compressible element, in particular without interposition of a timber element of which the fibers would be oriented horizontally and that would therefore be compressible.

Thus, between these posts, a layer of an incompressible material could be interposed, such as a metal sheet and/or a film of synthetic or else bituminous material, a vapor barrier, so as to create a water-resistive barrier, for example.

CLAIMS

1. Modular system (1) for constructing a timber-framed building (2), comprising a plurality of timber-framed modules (3A, 3B, 3C) which have a rectangular parallelepipedal cross-section and are composed of vertical posts (4) which are continuous up the entire height thereof and are interconnected in pairs by at least two horizontal joists (5), including at least two modules (3A, 3B) which are assembled horizontally, thereby defining a wall (8) between said modules (3A, 3B), and at least two timber-framed modules (3A, 3C) which are assembled vertically, at least one wall post (4a) being provided between said vertical posts (4),
- characterized in that:
- at least said wall posts (4a) of horizontally adjacent modules (3A, 3B) are offset and overlap, at least in part, with respect to one another;
 - and the posts (4) of an upper module (3C) rest on the posts (4) of a lower module (3A), directly or indirectly by means of a layer of non-compressible material. The invention further relates to a timber-framed building, comprising at least one modular system of this type.
2. Modular system (1) according to the preceding claim, comprising at least one post bracing means that allows said overlap, between which at least one wall reinforcement (5a) is preferably provided, said wall reinforcement (5a) being internal to said wall post (4a) of the corresponding module.
3. Modular system (1) according to the preceding claim, wherein the bracing means of the posts comprise at least an internal wind-bracing panel (9) and/or one or more joists (5) that preferably form a framework with the post (4), defining each module.
4. Modular system (1) according to the preceding claim, comprising at least one insulator (10) between two horizontally assembled modules, the insulator (10) being arranged between the exterior of said post (4a) of a module and the exterior of a wind-bracing panel (9) of the second module.
6. Modular system (1) according to any of the preceding claims, comprising at least one spar (6) for each of two horizontally arranged modules (3A, 3B), which is associated with at least one joist (7) fixed to the end of the spar (6), said spar (6) being housed in an at least

partial recess in said beam (7) and/or said beam (7) being housed in an at least partial recess in said spar (6).

7. Modular system (1) according to any of the preceding claims, comprising at least one
5 spar (6) for each of two horizontally arranged modules (3A, 3B), said spars (6) being offset and overlapping, at least in part, with respect to one another.

8. Modular system (1) according to any of the preceding claims, comprising a gap
10 between, on the one hand, said post (4a) and/or said bracing means (9, 5a, 7) of a first module (3A) and, on the other hand, said post (4a) and/or said bracing means (9, 5a, 7) of a second module (3C) arranged horizontally with respect to the first module (3A).

9. Modular system (1) according to any of the preceding claims, comprising a means for
15 fixing between, on the one hand, said post (4a) and/or said bracing means (9, 5a, 7) of a first module (3A) and, on the other hand, said post (4a) and/or said bracing means (9, 5a, 7) of a second module arranged horizontally with respect to the first module.

10. Timber-framed building (2) comprising at least one modular system (1) according to
any of the preceding claims.