(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 594 425 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.01.2020 Bulletin 2020/03

(51) Int Cl.:
E04B 2/38 *(2006.01)* ***E04B 2/52*** *(2006.01)*
E04C 2/284 *(2006.01)*

(21) Application number: **19184950.4**

(22) Date of filing: **08.07.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **09.07.2018 FI 20185632**

(71) Applicant: **Finnfoam Oy**
24100 Salo (FI)

(72) Inventor: **Nieminen, Henri**
24130 Salo (FI)

(74) Representative: **Berggren Oy, Turku**
P.O. Box 99
Tykistökatu 2-4 B
20521 Turku (FI)

(54) **A LOAD-BEARING WALL STRUCTURE AND A METHOD FOR ITS MANUFACTURE**

(57) A load-bearing wall structure formed of wall elements (2) comprising an outer face (3), an inner face (4) and a core layer (5) of thermal insulation material between the face layers, and the wall structure comprising wall elements placed next to each other, wherein their vertical side edges (8a, 8b), placed against each other, are shaped to form a space for casting a beam at the joint between the wall elements. The wall structure comprises a load-bearing beam formed at a joint between wall elements by supplying casting compound in the space at the joint, wherein the beam extends substantially in the height of the entire wall structure.

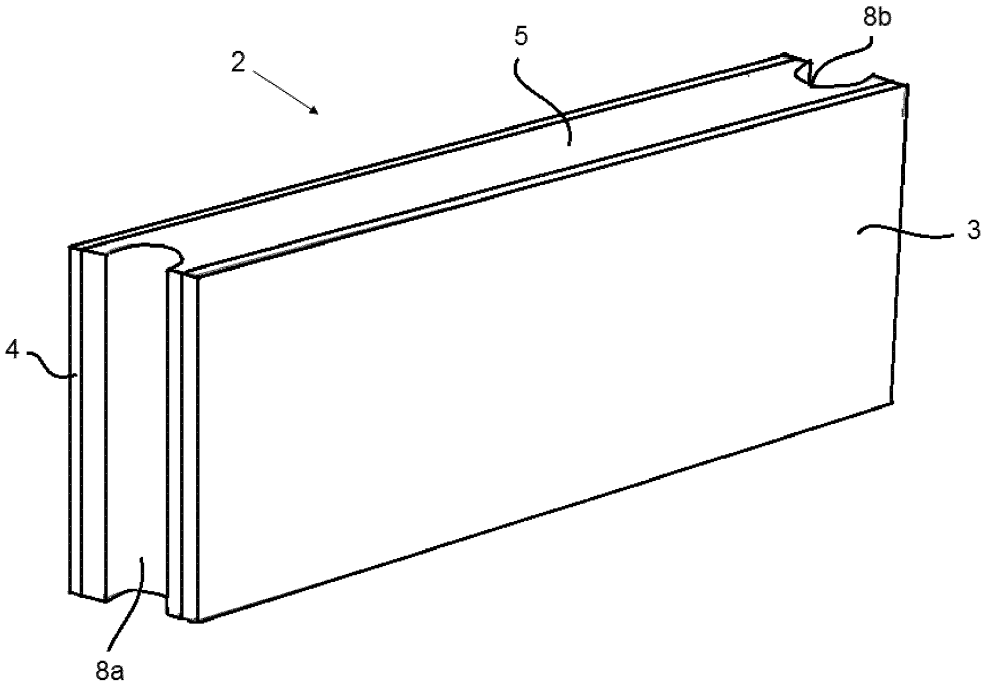

Fig. 1

EP 3 594 425 A1

Description

Field of the invention

[0001] The invention relates to a load-bearing wall structure, and a method for its manufacture, according to the appended independent claims.

Background of the invention

[0002] Load-bearing wall structures are built with e.g. cast blocks made of a thermal insulation material, such as expanded polystyrene (EPS). The blocks are provided with a central cavity for casting, to enable the filling of the blocks with a casting compound, such as concrete. A considerable amount of concrete is consumed in such a wall structure built of cast blocks, because the cast blocks need to be filled with concrete over the whole length of the wall. Moreover, the wall structure built with cast blocks has to be provided with a separate coating or lining as desired, which thus involves separate work steps.

Object and description of the invention

[0003] An object of the present invention is to reduce or even eliminate the above-mentioned problems present in prior art.

[0004] Another object of the present invention is to provide a wall element structure which enables a novel way of building a load-bearing wall structure.

[0005] In particular, an aim of the invention is to present a load-bearing wall structure which can be easily and rapidly built at the building site. In particular, an aim of the invention is to present a load-bearing wall structure which is formed of wall elements comprising thermal insulation material and which requires significantly less casting compound, such as concrete or another suitable casting compound, compared with *e.g.* cast block structures of prior art.

[0006] Yet another aim of the invention is to present a wall structure which makes it possible to build the wall structure easily and rapidly as well as in such a way that the wall structure to be made can have good flame retarding and sound insulation properties.

[0007] To attain this aim, the load-bearing wall structure and the method for making a load-bearing wall structure according to the invention are primarily characterized in what will be presented in the characterizing parts of the appended independent claims.

[0008] The other, dependent claims will present some preferred embodiments of the invention.

[0009] In a typical load-bearing wall structure according to the invention, the wall structure is formed of wall elements comprising an outer face, an inner face, and a core layer made of thermal insulation material between the face layers, the thermal insulation material having a compressive strength of at least 50 kPa, and the outer face and the inner face of the wall elements comprise a structural layer which covers substantially the whole core layer on the outer face and inner face of the wall element, and comprises a mixture of casting compound and crushed foam insulation material, the mixture comprising 1 to 10 weight percent of crushed foam insulation material, calculated from the total mass of the mixture;
and the wall structure comprises wall elements placed next to each other, wherein their vertical side edges, placed against each other, are shaped to form a space for casting a beam at the joint between the wall elements, ; and the wall structure comprises a load-bearing beam formed at the joint between the wall elements by supplying casting compound in the space at the joint, wherein the beam extends substantially in the height direction of the entire wall structure.

[0010] A typical method according to the invention for manufacturing a load-bearing wall structure comprises at least the following steps:

- arranging wall elements next to each other in the width direction of the wall structure and on top of each other in the height direction of the wall structure, the wall elements comprising an outer face, an inner face, and a core layer of thermal insulation material between the face layers, the thermal insulation material having a compressive strength of at least 50 kPa, and the outer face and the inner face of the wall element comprise a structural layer comprising a mixture of casting compound and crushed foam insulation material, the mixture comprising 1 to 10 weight percent of crushed insulation material, calculated from the total mass of the mixture, wherein the wall structure comprises wall elements placed next to each other, their vertical side edges placed against each other being shaped to form a space for casting a beam at the joint between the wall elements,; and
- casting the beam with a casting compound into the space at the joint between the wall elements.

[0011] The load-bearing wall structure according to the invention is based on prefabricated sandwich-type wall elements which can be placed next to each other in the width direction of the wall structure and on top of each other in the height direction of the wall structure, the vertical side edges of the wall elements being shaped in such a way that a space is formed at the vertical joint between the wall elements, which space can be filled at the building site with a casting compound, such as concrete or another corresponding casting compound. Consequently, the load-bearing beams of the wall structure can be formed at the vertical joints between the wall elements in the wall structure, to extend substantially in the height direction of the entire wall structure. In particular, the load-bearing wall structure according to the invention is based on the fact that the thermal insulation material forming the core layer of the wall elements has good compressive strength, and the surface materials of

the wall elements have good tensile strength, wherein the load-bearing framework of the wall structure can be formed by casting merely at the joints between the wall elements, for building a load-bearing wall structure. With respect to the load-bearing capacity of the wall structure according to the invention, only the load-bearing beams need to be formed of casting compound, whereby considerably smaller amounts of casting compound, such as concrete or other corresponding casting compound, is needed for the wall structure according to the invention compared with, for example, a wall structure formed of insulated cast blocks. In the wall structure according to the invention, the strength of the thermal insulation material contributes to the strength of the wall structure, wherein the thermal insulation material constituting the core layer of the wall elements is formed as a solid layer between the face layers. In the wall elements used for the wall structure according to the invention, the inner face and the outer face comprise a structural layer formed of a mixture of casting compound and crushed foam insulation material. This coating of the core material layer provides the wall structure with good flame retarding and sound insulation properties.

[0012] The wall structure according to the invention may even be utilized in building high wall structures, because solid beams can be cast between the wall elements over the whole height of the wall structure.

[0013] In the finished wall structure according to the invention, the load-bearing beams are fully enclosed by the core layer formed of thermal insulation material. Consequently, after the casting of the beams, the load-bearing wall structure formed of the wall elements according to the invention is a finished wall structure and does not necessarily require the building of separate face layers. Because the load-bearing beams are fully encircled by the insulation material, the load-bearing wall structure according to the invention is substantially without thermal bridges.

[0014] Furthermore, the load-bearing wall structure according to the invention has the advantage of being fast to assemble. The wall elements are prefabricated, and only the assembly of the wall elements and the casting of the beams at the joints between the wall elements take place at the building site.

Brief description of the drawings

[0015] In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 shows the structure of a wall element for use in a wall structure according to an embodiment of the invention, and

Fig. 2 shows a load-bearing wall structure according to an embodiment of the invention, in a schematic top view.

Detailed description of the invention

[0016] A typical load-bearing wall structure according to the invention comprises load-bearing vertical beams whose height determines the height direction of the wall structure. The wall structure also comprises an outer face, an inner face, and a layer of thermal insulation material between the inner and outer faces. In the load-bearing wall structure according to the invention, wall elements are used which comprise a structural layer on the outer face, a structural layer on the inner face, and a core layer of thermal insulation material between these structural layers. The wall elements used in the wall structure according to the invention are so-called sandwich elements which are, as such, sufficiently rigid to stand wind loads and other loads to which the wall structure will be subjected.

[0017] The wall elements used in the wall structure typically have a rectangular shape. The wall elements comprise two large parallel planar surfaces which are delimited by parallel first and second long side edges and parallel first and second short side edges substantially perpendicular to the long side edges. The wall elements are typically arranged in the wall structure in such a way that the short side edges of the wall element are the vertical side edges, and the long side edges are the horizontal side edges in the wall structure. Thus, the long side edges of the wall elements placed on top of each other are against each other, and the short side edges of the wall elements placed next to each other in the width direction of the wall are against each other. However, the lengths of the side edges may vary freely, depending on the wall structure to be built. The height of the wall elements placed on top of each other determines the height of the wall structure.

[0018] The wall structure according to the invention comprises wall elements placed next to each other, wherein their vertical side edges placed against each other are shaped to form a space for casting a beam at the joint between the walls elements placed next to each other. A typical wall structure according to the invention comprises wall elements placed next to each other in the width direction of the wall structure, and on top of each other in the height direction of the wall structure. In an advantageous embodiment of the invention, the wall structure is formed by placing wall elements next to each other in the width direction of the wall structure and on top of each other in the height direction of the wall structure, wherein the vertical side edges of the wall elements, typically the short side edges, are designed to form a space between two wall elements placed next to each other in the width direction of the wall structure, for building the beams of the wall structure, extending in the height direction of the wall structure. However, the wall structure may also comprise wall elements whose side edges are not shaped, or wall elements with only one side edge shaped to form a space for casting a beam.

[0019] A beam is formed at a joint between wall ele-

ments placed next to each other, by filling the space at the joint with a casting compound, such as concrete, a casting compound comprising concrete, or a corresponding casting compound suitable for the purpose. Typically, the beams are formed to the whole length of the wall in the height direction, defined by the wall elements placed on top of each other. In an advantageous embodiment of the invention, the load-bearing beams are substantially continuous over the whole length in the height direction of the wall structure. However, a beam can be cast with casting compound either in parts, to a length defined by one or more wall elements, or to the full height of the wall structure in a single operation.

[0020] In the wall structure according to the invention, a beam is substantially enclosed by thermal insulation material forming the core layer of the wall elements, whereby the side edges of the wall elements are shaped to form a space at the joint between two adjacent wall elements, the space being substantially fully enclosed by the thermal insulation material. The shaping of the side edges of the wall elements, required for the beam, is provided in the thermal insulation material layer of the wall element. In an embodiment of the invention, the side edges of the wall elements are "open"; that is, the thermal insulation material is exposed. Alternatively, the side edges may also comprise structural layers on the thermal insulation material layer.

[0021] In an advantageous embodiment of the invention, a supporting structure is arranged in the space at the joint between the wall elements , and the casting compound is arranged within the supporting structure. The function of the supporting structure is to reinforce the structure. The supporting structure arranged in the space at the joint between the wall elements may be a pipe, a flexible dropchute, or a combination of these. In an embodiment, the supporting structure may be a flexible dropchute or a corresponding supporting structure made of a flexible material. The supporting structure has substantially the same shape as the space, whereby it is pressed against the wall of the side edges of the wall elements. The supporting structure is filled with a casting compound, such as concrete, a casting compound comprising concrete, or a corresponding casting compound suitable for the purpose. The load-bearing beams also comprise the reinforcement bars required for the load-bearing beams and embedded in the casting compound, according to the wall structure. Typically, the beams comprise reinforcement bars over substantially the whole length of the beam.

[0022] The supporting structure arranged to the space at the joint between wall elements may be a continuous structure extending over the whole length of the beam, or it may be composed of elements joined to each other. In an embodiment, for example, parts of supporting structure are arranged which correspond to the height of a wall element in the wall structure. The space at the joint between wall elements has a typical diameter of 100 mm to 450 mm, or 100 mm to 500 mm, which also corresponds to the diameter of the beam to be built with the casting compound. Thus, the diameter of a pipe or a flexible dropchute used as the supporting structure is substantially equal to the diameter of the space provided. It is also possible to use a combination of a pipe and a flexible dropchute as the supporting structure, in which case a stronger structure may be used in the lower part of the beam than in the upper part, because the lower part will be subjected to greater forces upon casting of the beams. In an embodiment of the invention, the supporting structure comprises a combination of a pipe and a flexible dropchute, wherein the pipe is placed at least partly underneath the flexible dropchute in the height direction of the wall structure; or the lower part of the supporting structure is formed of a combination of a pipe and a flexible dropchute, and the upper part is formed of the flexible dropchute only, in the height direction of the wall structure.

[0023] In a wall structure according to the invention, the load-bearing beams may be built with any casting compound suitable for the purpose, such as a concrete, a casting compound comprising concrete, or a ceramic based compound. The concrete may be any concrete mixture that is suitable for the purpose and comprises a binding agent. Typically, the concrete comprises binding agent and inorganic material. The concrete may be conventional concrete, fibre-reinforced concrete, porous concrete, or the like.

[0024] In the wall elements for a load-bearing wall structure according to the invention, the thermal insulation material constituting the core layer may be any suitable insulation material with sufficient compressive strength properties for the use. The compressive strength of the thermal insulation material should be at least 50 kPa (according to the standard EN 826), to provide the wall elements with sufficient stiffness and strength properties. Typically, the compressive strength of the thermal insulation material is between 50 and 1000 kPa. In an advantageous embodiment of the invention, the core layer is made of extruded polystyrene (XPS), expanded polystyrene (EPS), polyurethane (PUR/PIR), or phenolic foam. In an advantageous embodiment of the invention, expanded polystyrene (EPS) is used in the wall elements, to provide good thermal insulation properties in a cost efficient way.

[0025] The wall elements are sandwich board elements comprising an outer face and an inner face, the core layer being formed therebetween. The core layer is arranged so that the thermal insulation material forming the core layer fills substantially the whole space between the face layers; only at the side edge/edges of the wall element the core material is shaped to provide a space for a beam. In an embodiment of the invention, the outer face of the wall element comprises a structural layer forming a planar surface for the wall element and covering substantially the whole core layer on the outer face of the wall element. The structural layer is typically arranged directly on the surface of the thermal insulation material

forming the core layer. The outer face of the wall element according to the invention comprises a structural layer which covers substantially the whole core layer on the outer face of the wall element and comprises a mixture of a casting compound and crushed foam insulation material. In an embodiment of the invention, the structural layer of the outer face of the wall element may further comprise concrete, a casting compound comprising concrete, foam concrete, mortar, or another corresponding casting compound which comprises a binding agent; and/or the structural layer of the outer face comprises one or more sheets which may consist of e.g. metal, sheet metal, or reinforced plastic. In an embodiment of the invention, the concrete, mortar or corresponding casting compound layer may also comprise reinforcement layers, such as reinforcing fibre matting or the like. The fibre matting can be made of glass fibres, carbon fibres or other material having a good tensile strength. The structural layer of the outer face may be formed of one or more thin sheets or corresponding sheets. The outer face of the wall elements may comprise one or more structural layers, depending on the desired properties and the requirements for the use.

[0026] In an embodiment of the invention, the inner face of the wall elements comprises a structural layer which forms the planar surface of the wall element and covers substantially the whole core layer on the inner face of the wall element. The structural layer of the inner face is typically arranged directly on the surface of the insulation material forming the core layer. The inner face of the wall element according to the invention comprises a structural layer which covers substantially the whole core layer on the inner face of the wall element and comprises a mixture of casting compound and crushed foam insulation material. In an embodiment of the invention, the structural layer on the inner face of the wall element may also comprise concrete, a casting compound which comprises concrete, mortar, or another corresponding casting compound which comprises a binding agent; and/or the structural layer on the inner face comprises one or more sheets which may consist of, for example, metal, sheet metal, or reinforced plastic. In an embodiment of the invention, the concrete, mortar or corresponding casting compound layer may also comprise reinforcement layers, such as reinforcing fibre matting or the like. The fibre matting can be made of glass fibres, carbon fibres or other material having a good tensile strength. The structural layer on the inner face may be formed of one or more thin sheets or corresponding sheets. The inner face of the wall elements may comprise one or more structural layers, depending on the desired properties and the requirements for the use. Typically, the material of the structural layer on the inner face is selected so that the inner face of the wall element is a finished inner face which thus does not require any separate coating on the inside of the wall structure. This accelerates the construction and lowers the costs.

[0027] The inner face and the outer face of the wall element according to the invention comprise a structural layer comprising a mixture of a casting compound and crushed foam insulation material. The foam insulation material may be extruded polystyrene (XPS), expanded polystyrene (EPS), polyurethane (PUR/PIR), and/or phenolic foam. The foam insulation material and the casting compound vary, depending on the properties desired. In an embodiment of the invention, the casting compound may be concrete, a casting compound that comprises concrete, or any casting compound suitable for the purpose. In an embodiment of the invention, a ceramic binding agent comprising materials based on glass, cement and concrete may be used in the casting compound for the structural layers of the inner and outer faces. In an embodiment of the invention, the binding agent comprises cement, blast furnace slag, fly ash, and/or gypsum. In an embodiment of the invention, the binding agent comprises cement which may be calcium carbonate, magnesium oxide, and/or zinc oxide based cement. The cement-based binding agent according to the invention may be used as such by mixing it in to form an aqueous compound. A concrete-based binding agent typically comprises an aggregate in addition to water and cement. The binding agent compositions according to the invention may also comprise other possible additives and components. The structural layer on the inner face and the outer face of the wall element is formed of a mixture of casting compound and crushed foam insulation material. Typically, the structural layer forms a planar surface of the wall element and covers substantially the whole core layer on the inner and outer faces of the wall element. Alternatively, the structural layer formed of a mixture of casting compound and crushed foam insulation material is arranged on another structural layer in the wall element. The crushed foam insulation material comprises pieces of foam insulation material with a typical diameter of e.g. 1 to 10 mm or 1 to 5 mm. The crushed foam insulation material may be, for example, recycled foam insulation material. In an embodiment of the invention, the mixture of concrete and crushed foam insulation material comprises 1 to 10 weight percent of crushed foam insulation material, calculated from the total mass of the mixture. Calculated in volume percent, the mixture of concrete and crushed foam insulation material may comprise more than 50 % of crushed foam insulation material. Mixing crushed foam insulation material into the casting compound provides the entire wall element with good flame retarding and sound insulation properties. The structural layer formed of the mixture of casting compound and crushed foam insulation material is typically almost incombustible material which, arranged on the surface of the insulation material layer, will protect the structures in a fire situation. To achieve the desired sound insulation and flame retarding properties, the structural layer formed of a mixture of casting compound and crushed foam insulation material is arranged on both the inner face and the outer face of the wall element. The inner face and/or the outer face of the wall element may also

comprise other structural layers, as described above. In an embodiment of the invention, the outer face and the inner face of the wall element comprise a first structural layer formed of a mixture of casting compound and crushed foam insulation material, typically on the thermal insulation material, and furthermore, the inner face and/or the outer face of the wall element comprise a second structural layer arranged on top of the first structural layer and formed of concrete, mortar or a corresponding casting compound which comprises binding agent and inorganic material. In this way, the wall element is provided with the desired sound insulation and/or flame retarding properties by the mixture of the casting compound and the crushed foam insulation material; and furthermore, the second layer of casting compound enables the forming of a more finished outer or inner face.

[0028] In an embodiment of the invention, the casting compound layer or the structural layer formed of a mixture of casting compound and crushed foam insulation material on the inner face and the outer face of the wall element may have a thickness of e.g. 1 to 50 mm or 1 to 20 mm, to provide the desired flame retarding and sound insulation properties.

[0029] The materials of the wall elements according to the invention, comprising the core layer, the outer face and the inner face, vary depending on the desired properties and the use. In an embodiment of the invention, the outer face and/or the inner face of the wall element comprise one or more thin metal sheets forming the outer face and/or the inner face of the wall element. The thin metal sheet may be, for example, sheet steel. In an advantageous embodiment, the core material of the wall element is expanded polystyrene (EPS), and the inner and outer faces comprise a structural layer formed of a mixture of casting compound and crushed foam insulation material, as well as a thin metal sheet layer, such as sheet steel. This kind of a sandwich element is, as such, sufficiently strong and rigid, and suitable for use in a load-bearing wall structure according to the invention.

[0030] The core layer of the wall elements may comprise grooves on the core layer, for example in the longitudinal and/or width directions on the core layer which is against the inner face and/or outer face. The grooves may also be arranged in another way, for example diagonally. More typically, the grooving is provided against the outer face of the wall element. Such a grooved structure of the core layer makes ventilation grooves possible in the wall structure, if these are required.

[0031] The thickness and the size of the wall elements used in the wall structure according to the invention vary according to the use. In an embodiment, the thickness of the wall elements may be, for example, 300 to 500 mm. The wall element usually has a rectangular shape, comprising two large parallel planar surfaces (the outer face and the inner face) delimited by first and second parallel long side edges and parallel first and second short side edges, which are perpendicular to the long side edges. Typically, the short side edges are shaped to form a space for building load-bearing beams when the short side edges of two wall elements are placed against each other. The length of the side edges may vary, depending on the use. The wall structure according to the invention can be formed of wall elements in such a way that load-bearing beams are arranged at intervals of *e.g.* 2000 to 6000 mm or 4000 to 6000 mm in the width direction of the wall structure, measured center-to-centre of two adjacent beams. In the wall structure according to the invention, the wall element between two beams is typically uniform. Consequently, the length of e.g. the long side edges of the wall element may vary between 2000 and 4000 mm. The long edge sides of the wall elements extend in the width direction of the wall structure and substantially transversely to the load-bearing beams. In the height direction, the wall structure can be made as high as 6 to 8 m; typically, the height of a single wall element is, for example, 1000 mm or 1200 mm. The above-mentioned lengths are merely exemplary and do not limit the invention.

[0032] In an advantageous embodiment of the invention, a tongue-and-groove joint or the like is provided between wall elements placed on top of each other in the height direction of the wall structure, to enable the assembly of the wall structure and the placement of the wall elements tightly against each other. Typically, the insulation material layers of the wall elements comprise a groove or a tongue or another corresponding shaping on the side edge, to enable the placement and fastening of the wall elements tightly against each other.

[0033] The load-bearing wall structure according to the invention can be built on the site. In addition to the wall elements according to the invention and the beams to be cast on the site, the wall structure comprises the necessary horizontal supporting structures at the upper and lower ends of the wall structure, as well as possible fastenings and supporting structures for fastening to other structures, depending on the construction works.

[0034] In the method according to the invention, the above described wall elements are placed next to each other in the width direction of the wall structure and on top of each other in the height direction of the wall structure, so that a space for the casting of beams is formed at the joint between the wall elements placed next to each other in the width direction of the wall structure. The beams are cast with casting compound into the space at the joint between the wall elements. Before the casting, the reinforcement bars required for the beams are arranged within the supporting structure.

[0035] In an embodiment of the invention, a supporting structure is arranged in the space at the joint between the wall elements of the wall structure, whereby the casting compound is arranged within the supporting structure. In an embodiment of the invention, the supporting structure is arranged over substantially the whole length of the wall structure in the height direction. A supporting structure may be installed to extend over the full height of the wall structure at the final stage, or it may be ar-

ranged tier by tier when assembling wall elements on top of each other.

In a typical embodiment, the wall structure according to the invention is formed of wall elements on a foundation. The foundation may be continuous along the whole length of the wall structure, or alternatively a pillar foundation. The foundation is provided with the necessary dowel bars for forming the lowermost tier. Typically, the wall elements constituting the lowermost tier of the wall structure are fastened to the foundation or a corresponding basement by a suitable compound, such as adhesive, mortar, or the like. A supporting structure may be arranged in the space formed between the wall elements. If a flexible dropchute is used as the supporting structure, it may be fastened to the bottom of the space reserved for the beams by a small amount of mortar or the like, to keep the flexible dropchute in place.

Detailed description of the drawings

[0036]

Figure 1 shows the structure of a wall element 2 according to an embodiment of the invention, comprising an outer face 3, an inner face 4, and a core layer 5 of thermal insulation material between the face layers. The vertical side edges 8a, 8b of the wall element 2 are shaped to provide a space for casting beams at the joint between wall elements placed next to each other in the width direction of the wall structure. The shaping is made in the thermal insulation material of the core layer. The outer face 3 and the inner face 4 may comprise one or more structural layers.

Figure 2 shows a top view of a load-bearing wall structure 1 according to an embodiment of the invention. The wall structure 1 has been made by arranging wall elements 2, 2' next to each other in the width direction of the wall structure and on top of each other in the height direction. The wall structure 1 comprises load-bearing beams 6, 6', 6" formed at joints between wall elements, which joints are, due to the shaping of the vertical side edges 8a, 8b of the wall elements 2, 2' to be placed against each other, provided with a space which enables the casting of the beams 6, 6', 6". Furthermore, a supporting structure 7, such as a pipe and/or a flexible dropchute, is arranged to the space between the wall elements 2, 2', which supporting structure is placed tightly against the edges formed by the core layer 5 of the wall element. Casting compound is arranged into the supporting structure 7, whereby the cast beam 6, 6', 6" can be formed to extend over substantially the whole height of the wall structure. In the finished wall structure, the beams 6, 6', 6" are fully enclosed by the wall elements 2, 2', wherein the outer face 3 and the inner face 4 of the wall elements 2, 2' constitute uniform finished surfaces for the wall structure.

Claims

1. A load-bearing wall structure (1), **characterized in that** the wall structure (1) is formed of wall elements (2, 2') comprising an outer face (3), an inner face (4) and a core layer (5) made of thermal insulation material between the face layers, the thermal insulation material having a compressive strength of at least 50 kPa, and the outer face (3) and the inner face (4) of the wall elements comprise a structural layer which covers substantially the whole core layer on the outer face and the inner face of the wall element and comprises a mixture of casting compound and crushed foam insulation material, the mixture comprising 1 to 10 weight percent of crushed foam insulation material, calculated from the total mass of the mixture, and the wall structure (1) comprises wall elements (2, 2') placed next to each other, wherein their vertical side edges (8a, 8b), placed against each other, are shaped to form a space for casting a beam (6, 6', 6") at the joint between the wall elements; and
the wall structure (1) comprises a load-bearing beam (6, 6', 6") formed at the joint between the wall elements by supplying casting compound in the space at the joint, wherein the beam (6, 6', 6") extends substantially in the height direction of the entire wall structure.

2. A load-bearing wall structure according to claim 1, **characterized in that** the core layer (5) of the wall element (2, 2') is made of extruded polystyrene (XPS), expanded polystyrene (EPS), polyurethane (PUR/PIR), or phenolic foam.

3. A load-bearing wall structure according to claim 1 or 2, **characterized in that** a supporting structure (7) is arranged in the space at the joint between the wall elements (2, 2'), and the casting compound is arranged within the supporting structure.

4. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the supporting structure (7) arranged in the space at the joint between the wall elements (2, 2') is a pipe, a flexible dropchute, or a combination of these.

5. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the outer face (3) of the wall element (2, 2') comprises a structural layer comprising

   - concrete, mortar or a corresponding casting compound which comprises a binding agent and inorganic material, and/or

- one or more sheets.

6. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the inner face (4) of the wall element (2, 2') comprises a structural layer comprising

- concrete, mortar or a corresponding casting compound which comprises a binding agent and inorganic material, and/or
- one or more sheets.

7. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the outer face and/or the inner face of the wall element (2, 2') comprises a first structural layer formed of a mixture of a casting compound and crushed foam insulation material, and a second layer on top of the first structural layer, the second layer being formed of concrete, mortar or a corresponding casting compound which comprises a binding agent.

8. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the outer face (3) and/or the inner face (4) of the wall element (2, 2') comprise one or more thin metal sheets.

9. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the load-bearing beams (6, 6', 6") are substantially enclosed by the thermal insulation material forming the core layer (5).

10. A load-bearing wall structure according to any of the preceding claims, **characterized in that** the wall structure (1) comprises wall elements (2, 2') arranged next to each other in the width direction of the wall structure and on top of each other in the height direction of the wall structure.

11. A method for manufacturing a load-bearing wall structure (1), **characterized in that** the method comprises

- arranging wall elements (2, 2') next to each other in the width direction of the wall structure and on top of each other in the height direction of the wall structure, the wall elements (2, 2') comprising an outer face (3), an inner face (4) and a core layer (5) of thermal insulation material between the face layers, the thermal insulation material having a compressive strength of at least 50 kPa, and the outer face (3) and the inner face (4) of the wall elements comprise a structural layer comprising a mixture of a casting compound and crushed foam insulation material, the mixture comprising 1 to 10 weight percent of crushed foam insulation material, calculated from the total mass of the mixture, wherein the wall structure comprises wall elements (2, 2') placed next to each other, their vertical side edges (8a, 8b) placed against each other are being shaped to form a space for casting a beam (6, 6', 6") at the joint between the wall elements; and
- casting the beam (6, 6', 6") with a casting compound into the space at the joint between the wall elements.

12. The method according to claim 11, **characterized in** arranging a supporting structure (7) in the space at the joint between the wall elements (2, 2'), wherein the casting compound is arranged within the supporting structure.

13. The method according to claim 11 or 12, **characterized in that** the supporting structure is arranged over substantially the whole length of the wall structure in the height direction.

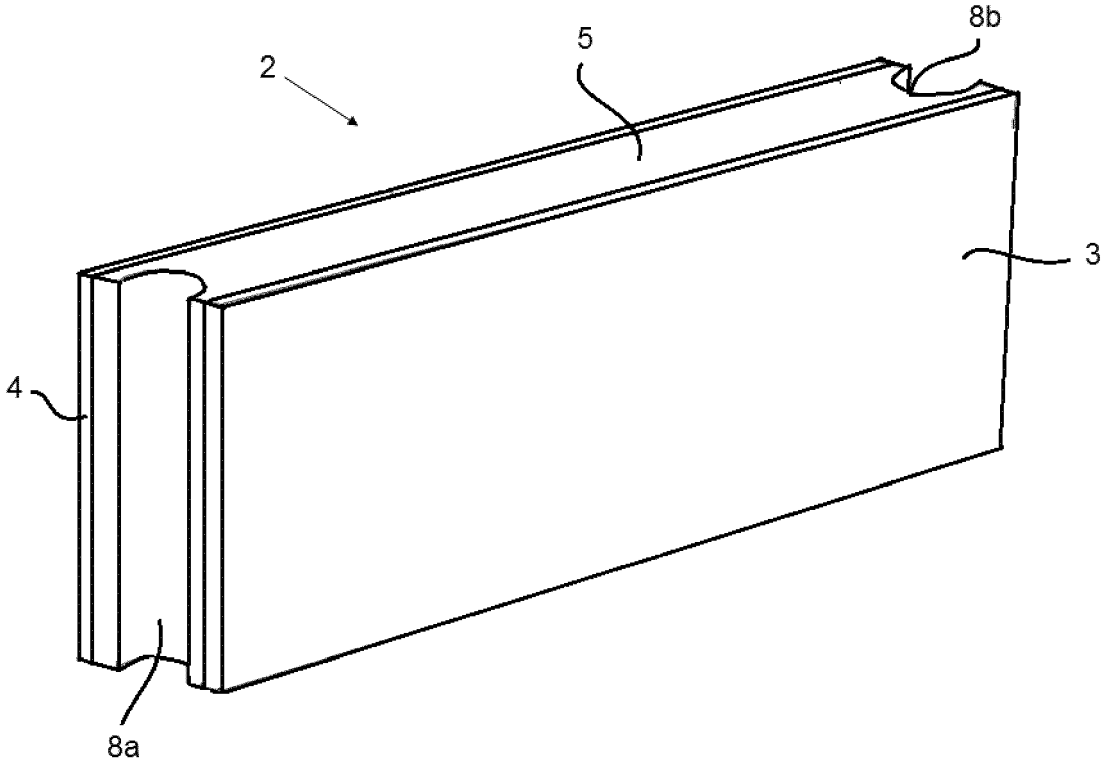

Fig. 1

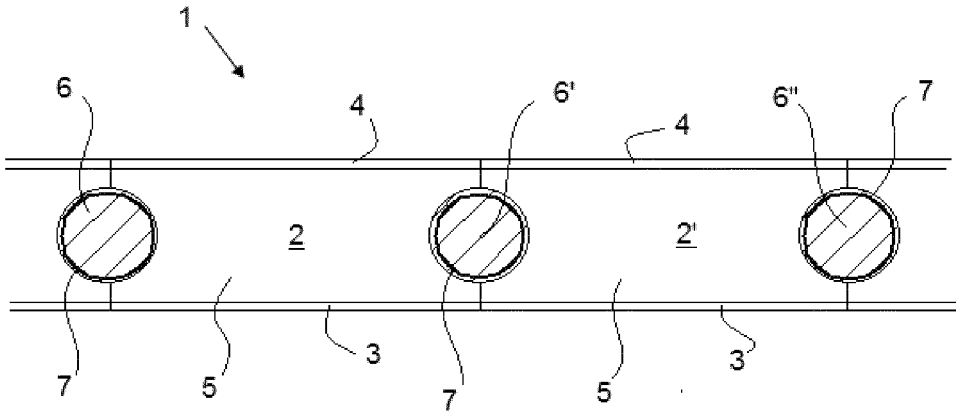

Fig. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 18 4950

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 01/73239 A1 (MARTELLA VINCENT [CA]; CALDERAN ROBERTO [CA]) 4 October 2001 (2001-10-04) * page 6, line 29 - page 7, line 27 * * page 8, lines 19-31 * * page 10, lines 22-24; figures 1,2,3,4,6,9,11,12 *	1-3,5,6, 9,11-13	INV. E04B2/38 E04B2/52 E04C2/284
A	WO 2011/100854 A1 (WYW BLOCK AG [LI]; ANTAL ISTVAN [HU]) 25 August 2011 (2011-08-25) * page 8, paragraph 2 - page 9, paragraph 3 *	1,11	
A	JP H05 280123 A (JAPAN METALS & CHEM) 26 October 1993 (1993-10-26) * figures *	1,11	
A	WO 2015/106357 A1 (UNIV MANITOBA [CA]) 23 July 2015 (2015-07-23) * figures *	1,11	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2 269 018 A (GUIGNON JR EMILE S) 6 January 1942 (1942-01-06) * page 1, right-hand column, lines 11-25; figures *	1,11	E04B E04C
A	WO 2016/003267 A1 (KANTERS JOHANNES ADRIAAN MARTINUS [NL]) 7 January 2016 (2016-01-07) * claim 11; figures 1,2 *	1,11	
A	US 2 134 941 A (GUIGNON JR EMILE S) 1 November 1938 (1938-11-01) * the whole document *	1,11	
A	US 5 765 333 A (CUNNINGHAM DALE W [US]) 16 June 1998 (1998-06-16) * the whole document *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 November 2019	Stern, Claudio

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 18 4950

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-11-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0173239 A1	04-10-2001	AU 4399101 A	08-10-2001
		CA 2302137 A1	27-09-2001
		US 2004020147 A1	05-02-2004
		WO 0173239 A1	04-10-2001
WO 2011100854 A1	25-08-2011	AP 3035 A	30-11-2014
		AU 2011217713 A1	13-09-2012
		BR 112012020627 A2	20-03-2018
		CA 2789787 A1	25-08-2011
		CN 102782228 A	14-11-2012
		DK 2536891 T3	17-11-2014
		EA 201201151 A1	29-03-2013
		EP 2536891 A1	26-12-2012
		EP 2848746 A1	18-03-2015
		ES 2522936 T3	19-11-2014
		HR P20141082 T1	02-01-2015
		HU 228968 B1	29-07-2013
		IL 221464 A	31-05-2016
		JP 5759486 B2	05-08-2015
		JP 2013527888 A	04-07-2013
		KR 20130001243 A	03-01-2013
		NZ 601813 A	20-12-2013
		PT 2536891 E	03-12-2014
		SG 183323 A1	27-09-2012
		SI 2536891 T1	27-02-2015
		UA 106116 C2	25-07-2014
		US 2012311953 A1	13-12-2012
		WO 2011100854 A1	25-08-2011
JP H05280123 A	26-10-1993	NONE	
WO 2015106357 A1	23-07-2015	CA 2934733 A1	23-07-2015
		US 2017016228 A1	19-01-2017
		WO 2015106357 A1	23-07-2015
US 2269018 A	06-01-1942	NONE	
WO 2016003267 A1	07-01-2016	EP 3161220 A1	03-05-2017
		WO 2016003267 A1	07-01-2016
		ZA 201700464 B	29-08-2018
US 2134941 A	01-11-1938	NONE	
US 5765333 A	16-06-1998	AU 2606397 A	22-10-1997
		US 5765333 A	16-06-1998
		WO 9737090 A1	09-10-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 18 4950

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-11-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
----------			

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82