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(54) BUILDING ELEMENT WITH FIRST AND SECOND COVER LAYERS AND INTERMEDIATE CORE HAVING TWO DIFFERENT MATERIALS

BAUELEMENT MIT ERSTEN UND ZWEITEN DECKSCHICHTEN SOWIE ZWISCHENKERN AUS ZWEI UNTERSCHIEDLICHEN MATERIALIEN

ÉLÉMENT DE CONSTRUCTION PRÉSENTANT PREMIÈRE ET SECONDE COUCHE DE COUVERTURE ET UN NOYAU INTERMÉDIAIRE EN DEUX MATÉRIAUX DIFFÉRENTS

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(56) References cited:
WO-A1-01/26899
WO-A1-2012/087294
WO-A2-2007/014340
DE-A1- 2 012 769
DE-A1- 2 729 232
DE-A1- 3 328 092
DE-A1- 4 122 964
DE-U1- 29 513 784
GB-A- 2 110 740
GB-A- 2 399 538
US-A1- 2011 147 358
US-B1- 6 182 407

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Description

TECHNICAL FIELD

[0001] The present invention relates to a building element which comprises at least a first cover layer and a second cover layer, which are connected to opposite sides of an intermediate core consisting of at least a first core material and a second core material. The building element can be used in load-bearing floor structures or walls in house construction, preferably in construction of smaller houses.

BACKGROUND OF THE INVENTION

[0002] Different types of building elements with so-called sandwich structure, for use in wall and roof structures, are previously known. One example is sandwich elements consisting of a core of polystyrene or polyurethane foam which has been provided with cover layers of metal sheeting on one or both sides by means of gluing. A disadvantage of this type of building elements is that they may rapidly lose their load-bearing ability if they are exposed to high temperatures in the event of fire, since the metal sheets start to buckle and the core material softens or even turns into gaseous state so that the sandwich structure collapses.

[0003] A building element intended to solve the above-mentioned problem of poor fire resistance is described in SE 450 020. This building element comprises a board-shaped insulating core of polystyrene or similar material, and two thin steel sheets covering the side surfaces of the insulation board. An additional board, in the form of a wood fibre or gypsum board, or the like, is disposed between at least one of the metal sheets and the insulation board. The additional board is intended to maintain the load-bearing ability of the element for a certain period of time when the element is subjected to external heat, and to prevent the formation of gaseous phase of the core material by insulating the board from the external heat supply and absorbing latent heat therefrom. This effect is achieved in that the board is partially carbonized when a wood fibre board is used, and by means of vaporization of crystal water when a gypsum board is used.

[0004] EP 1 253 257 describes a method for manufacturing a surface element, for a wall or a floor or a roof, having another type of sandwich structure. The described method is claimed to make production of surface elements of different sizes easier and cheaper and comprises that a plurality of sandwich plates are produced and wherein to produce a sandwich plate at least one insulating plate is placed on a lower cover plate and wherein an upper cover plate is placed on the insulating plate, wherein the individual sandwich plates are joined to one another by their lateral edges to a sandwich web, after which the sandwich web is cut up or sawn up into the individual surface elements. The cover plates in the surface elements manufactured according to EP 1 253 257 can be selected from the group gypsum panels, wood chip panels, vermiculite panels, whereas panels of expanded plastic, preferably expanded polystyrene, are used as insulating panels. According to EP 1 253 257, the cover plates can be joined to the insulating plates by means of an adhesive, which can be a polyurethane adhesive, and the insulating plates can be separated from each other by means of reinforcing ribs, preferably consisting of wood.

[0005] In addition to the above-mentioned problem of poor fire resistance, many of the previously known building elements with sandwich structure have the disadvantage that they do not have sufficient strength and load-bearing ability to be usable in load-bearing floor structures or walls, without using reinforcing ribs or intermediate girders of wood, supporting frameworks of metal, or other additional supporting structures. The use of such supporting structures of wood or metal increases the risk of structure-borne sound propagation in the finished building.

SUMMARY OF THE INVENTION

[0006] A first object of the present invention is therefore to provide a building element having an improved sandwich structure, which is bearing and not only self-supporting and which gives the building element sufficient strength and load-bearing ability to be usable in both load-bearing floor structures and bearing walls without any additional support structure, at the same time as the building element minimizes the risk of structure-borne sound propagation and meets the high demands for sound insulating ability and also heat insulating ability placed on the construction of modern houses.

[0007] This first object is achieved by means of a building element according to claim 1, comprising at least a first cover layer and a second cover layer, which are connected to opposite sides of an intermediate core consisting of at least a first core material and a second core material, wherein the first and/or the second cover layer comprises one or several stiffening layers having a thickness of at least 5 mm and a modulus of elasticity which is higher than 3000 MPa and higher than the moduli of elasticity of said core materials, wherein the first core material has a higher modulus of elasticity than the modulus of elasticity of the second core material, which has a modulus of elasticity lower than 10 MPa, wherein the intermediate core is constituted by one or several edge pieces of the first core material surrounding one or several intermediate pieces of the second core material, wherein said one or several intermediate pieces of the second core material covers/cover at least 60 % of the area delimited by said one or several edge pieces of the first core material, wherein the first and the second cover layer, respectively, exhibit outer edge regions which are connected in a shear-resistant manner to opposite sides of said one or several edge pieces of the first core material by means of a fire-resistant adhesive, and wherein said

fire-resistant adhesive covers at least 5 % of the area of the inwardly facing surface of the respective cover layer in order to provide a shear-resistant connection where the first and second cover layer are fixed at a distance from each other of at least 70 mm via the intermediate first core material which serves as a spacing element.

[0008] A second object of the present invention is to provide a building element which reduces the risk of a possible fire getting hold of the building element and spreading between different spaces in a building.

[0009] This second object is achieved by means of a building element according to claim 3, where at least the outwardly facing side of one of or both the cover layers in the building element exhibits a fire-resistant layer which has better fire resistance than the other material layers in said cover layer and/or better fire resistance than at least one of said core materials.

[0010] A third object of the present invention is to provide a building element which reduces the risk of the sandwich structure of the element collapsing due to the load-bearing material in the core softening, turning into gaseous state, or igniting during a fire.

[0011] This third object is achieved by means of a building element according to claim 8, where the first core material is a foam material with high fire resistance.

[0012] A fourth object of the present invention is to provide a building element which reduces the risk of sound and heat insulating material in the core igniting during a fire.

[0013] This fourth object is achieved by means of a building element according to claim 11, where the second core material consists of one or several fire-resistant or fire-inhibiting materials selected from the group consisting of glass wool, rock wool, or cellulose wool treated with flame-inhibiting agents.

[0014] A fifth object of the present invention is to provide a building element whose sandwich structure is capable of maintaining its load-bearing ability for a sufficiently long period of time during a fire.

[0015] This fifth object is achieved by means of a building element according to claim 12, where the fire-resistant adhesive providing the shear-resistant connection between the cover layers and the core material and/or between boards comprised in the cover layers is a fire-resistant adhesive with a shear strength of at least 5 MPa at 110 °C.

[0016] A sixth object of the present invention is to provide a building element having a sandwich structure which can be manufactured by a simple manufacturing process from easily available materials and at a relatively low total cost, but which still has sufficient strength and load-bearing ability to be used in load-bearing floor structures and walls and where it can provide very good sound insulating ability and small risk of structure-borne sound propagation, high heat insulating ability and good fire resistance.

[0017] This sixth object is achieved by means of a building element according to claim 19, where both the first and the second cover layer consist of double fibre-reinforced gypsum boards, where the first core material is provided in the form of ribs of a PET foam, where the second core material is provided in the form of mineral wool boards, and where the fibre-reinforced gypsum boards and the ribs of PET foam are glued together by a fire-resistant polyurethane adhesive containing at least 30 % by weight of chalk.

[0018] Further objects of the invention and the features enabling these objects to be achieved will become evident from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In the following, the invention will be described in a number of different embodiments with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a building element according to a preferred embodiment of the invention, in which different pieces of core material have been indicated with dashed lines;
Figure 2 is a schematic perspective view of the first and second cover layers, respectively, and the pieces of first and second core material, respectively, which are to be glued together in order to produce the building element according to the embodiment shown in Figure 1;
Figure 3 is a schematic plan view illustrating the positioning of the first and second core materials, respectively, inside the core of the building element according to the embodiment shown in Figure 1; and
Figure 4 is a cut sectional view of the building element according to the embodiment shown in Figure 1, as seen in the longitudinal direction of the building element, in which it can be seen that the cover layers outside the intermediate core consist of two stiffening layers of board material glued together.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0020] In the following, a number of embodiments of a building element according to the invention will be described in greater detail with reference to the accompanying Figures 1-4.

[0021] Figure 1 is a schematic perspective view of a building element according to a preferred embodiment of the invention, Figure 2 is a schematic perspective view of cover layers and pieces of first and second core material, respectively, which are to be glued together in order to form the building element, Figure 3 is a schematic plan view illustrating the positioning of the core materials inside the core, and Figure 4 is a cut sectional view, as seen in the longitudinal direction of the building element, in which it can be seen that the cover layers outside the core consist of two stiffening layers of board material glued together in the shown embodiment.

[0022] As is evident from the figures, the building element 10 according to the invention comprises at least a first cover layer 11 and a second cover layer 19, which are connected to opposite sides of an intermediate core consisting of at least a first core material 12, 13, 14, 15, 16 and a second core material 17, 18.

[0023] As is illustrated in Figure 4, the first 11 and/or the second cover layer 19 comprises one or several stiffening layers 11', 11"; 19'; 19" having a thickness of at least 5 mm and a modulus of elasticity which is higher than 3000 MPa and higher than the moduli of elasticity of the core materials 12, 13, 14, 15, 16; 17, 18.

The first core material 12, 13, 14, 15, 16 has a higher modulus of elasticity than the modulus of elasticity of the second core material 17, 18, which has a modulus of elasticity lower than 10 MPa. Accordingly, the first core material has a modulus of elasticity between the moduli of elasticity of the second core material and of the stiffening layers, respectively, and is intended to interact with the stiffening layers in order to give the building element high shear strength and load-bearing ability, whereas the second core material has a very low modulus of elasticity and is intended to give the building element good sound insulating and heat insulating ability.

As is evident from Figure 2, the intermediate core is constituted by one or several edge pieces 12, 13, 15, 16 of the first core material surrounding one or several intermediate pieces 17, 18 of the second core material, wherein said one or several intermediate pieces 17, 18 of the second core material cover at least 60 % of the area delimited by said one or several edge pieces 12, 13, 15, 16 of the first core material. It has been found that such a design of the core gives the building element good sound insulating ability and minimal propagation of structure-borne sound.

As is also evident from Figure 2, the first 11 and the second cover layer 19, respectively, exhibit outer edge regions 20, 21, 22, 23; 24, 25, 26, 27 which are connected in a shear-resistant manner to opposite sides of said one or several edge pieces 12, 13, 15, 16 of the first core material by means of a fire-resistant adhesive (not shown in the figures). The fire-resistant adhesive covers at least 5 % of the area of the inwardly facing surface of the outer edge regions 20, 21, 22, 23; 24, 25, 26, 27 of the respective cover layer 11, 19 in order to provide a shear-resistant connection where the first 11 and second cover layer 19 are fixed at a distance from each other of at least 70 mm via the intermediate first core material 12, 13, 15, 16 which serves as a spacing element. The first core material has, of course, to cover more than said 5 %. It has been found to be necessary that the fire-resistant adhesive covers at least 5 % of said area to enable the sandwich structure of the building element to maintain its load-bearing ability for a sufficiently long period time during a fire, and that a distance between the cover layers of at least 70 mm is required in order to give the sandwich structure of the building element sufficiently high shear strength and load-bearing ability for the intended use.

[0024] To give the building element 10 an even better load-bearing ability, it preferably comprises at least one, relative to said edge piece(s) 12, 13, 15, 16 and said cover layers 11, 19, inner piece 14 of the first core material which is disposed between at least two of said intermediate pieces 17, 18 of the second core material, as is evident from Figure 2, wherein said first 11 and said second cover layers 19, respectively, further exhibit, relative to said outer edge regions 20, 21, 22, 23; 24, 25, 26, 27, inner regions 28; 29 which are connected in a shear-resistant manner to opposite sides of said at least one intermediate piece 14 of the first core material by means of said fire-resistant adhesive. Accordingly, pieces or ribs of the first core material are preferably provided along the edges of the entire building element and inside the core, e.g. with a c-c distance of 600 mm, but also around any recesses in the building element for windows, doors or other purposes.

[0025] In a preferred embodiment, illustrated in Figure 4, at least the outwardly facing side of one of or both the cover layers 11, 19 in the building element 10 exhibits a fire-resistant layer 11', 19' which has better fire resistance than the other material layers in said cover layer and/or better fire resistance than at least one of said core materials 12, 13, 14, 15, 16. Such a design reduces the risk of a possible fire getting a hold of the building element.

[0026] The first 11 and/or second cover layer 19 advantageously consist(s) of several boards 11', 11"; 19', 19" of identical or different board materials glued to each other in a shear-resistant manner. Such a design provides an opportunity to optimize the characteristics of the building element for different applications, and to use cheaper board materials in one of or both the cover layers when the building element is intended for less demanding applications.

[0027] In a preferred embodiment, the outwardly facing side 11'; 19' of the first 11 and/or second cover layer 19 in the building element 10 consists of a board material selected from the group consisting of gypsum boards, fibre-reinforced gypsum boards and fibre cement boards. Such a choice of material gives the building element good fire resistance.

[0028] In one advantageous embodiment, the outwardly facing side 11'; 19' of the first 11 and/or second cover layer 19 in the building element 10 consists of a board material containing only inorganic matter. Such a choice of material reduces the risk of mould growth if the building element is to be used in humid spaces.

[0029] In another embodiment, the inwardly facing side 11"; 19" of the first 11 and/or second cover layer 19 in the building element 10 consists of a board material selected from the group consisting of gypsum boards, fibre-reinforced gypsum boards, fibre cement boards, wood fibre boards or plywood. This embodiment makes it possible to manufacture building elements with different characteristics and material costs using easily available board materials.

[0030] In a preferred embodiment of the building ele-

ment 10 according to the invention, the first core material 12, 13, 14, 15, 16 is a foam material with high fire resistance. Such a choice of material reduces the risk of the sandwich structure of the element collapsing due to the load-bearing material in the core softening, turning into gaseous state, or igniting during a fire. The first core material 12, 13, 14, 15, 16 preferably consists of one or several materials selected from the group consisting of PET foams, PVC foams and glass foams. Such materials are commercially available.

[0031] In the building element 10 according to the invention, the second core material 17, 18 preferably consists of one or several porous materials of loose or loosely bonded organic and/or inorganic fibres. In a preferred embodiment, the second core material 17, 18 consists of one or several fire-resistant or fire-inhibiting materials selected from the group consisting of glass wool, rock wool, or cellulose wool treated with flame-inhibiting agents. Such a choice of material reduces the risk of the sound and heat insulating material in the core igniting during a fire.

[0032] In a preferred embodiment of the building element 10 according to the invention, the fire-resistant adhesive providing the shear-resistant connection between the cover layers 11; 19 and the core material 12, 13, 14, 15, 16 and/or between boards 11', 11"; 19', 19" comprised in the cover layers is a fire-resistant adhesive with a shear strength of at least 5 MPa at 110 °C. Such a choice of adhesive provides a building element whose sandwich structure is capable of maintaining its load-bearing ability for a sufficiently long period of time during a fire. In an even more advantageous embodiment, the fire-resistant adhesive is a fire-resistant adhesive which retains a shear strength of at least 2 MPa up to at least 130 °C.

[0033] The fire-resistant adhesive providing the shear-resistant connection between the cover layers 11; 19 and the core material 12, 13, 14, 15, 16 and/or between boards 11', 11"; 19', 19" comprised in the cover layers is preferably a fire-resistant adhesive selected from the group consisting of polyurethane adhesives with flame-retarding filler and cement-based adhesives. In a preferred embodiment, the fire-resistant adhesive is a fire-resistant polyurethane adhesive containing at least 30 % by weight of flame-retarding filler, ever more advantageously at least 50 % by weight of flame-retarding filler. The flame-retarding filler is preferably calcium carbonate, particularly advantageously in the form of chalk, or calcium sulphate in the form of gypsum which has a fire-retarding ability owing to crystal water, but also other fire-retarding fillers are conceivable, such as talc, sand, etc.

[0034] In a first particularly advantageous embodiment of the invention, the first 11 cover layer, the intermediate core material 12, 13, 14, 15, 16, the second cover layer 19, and the intermediate shear-resistant, fire-resistant adhesive layers give the building element 10 a total thickness of at least 100 mm, for use as a wall element.

[0035] In a second particularly advantageous embodiment of the invention, the first 11 cover layer, the intermediate core material 12, 13, 14, 15, 16, the second cover layer 19, and the intermediate shear-resistant, fire-resistant adhesive layers give the building element 10 a total thickness of at least 150 mm, for use as a floor structure element.

[0036] In particularly preferred embodiment of the building element according to the invention, both the first 11 and the second cover layer 19 consist of double fibre-reinforced gypsum boards 11', 11"; 19', 19". The first core material is provided in the form of ribs 12, 13, 14, 15, 16 of a PET foam, whereas the second core material is provided in the form of mineral wool boards 17, 18. The fibre-reinforced gypsum boards 11', 11"; 19', 19" and the ribs 12, 13, 14, 15, 16 of PET foam are glued together by a fire-resistant polyurethane adhesive containing at least 30 % by weight of chalk. Such a building element has a sandwich structure which can be manufactured by a simple manufacturing process with only a few process steps. For example, in its most simple design, the process can comprise cutting-up of cover layers and pieces of core material starting from commercially available board materials and foam materials, respectively, laying-out of first cover layer, application of fire-resistant adhesive, laying-out of pieces of first and second core materials, respectively, in a desired pattern, adhesive application, application of second cover layer, drying/curing of the fire-resistant adhesive, and possibly trimming or other finishing of the building element. The process steps may be substantially manual or automated to desired degree. The sandwich structure according to the invention consists of easily available materials, which together result in a relatively low total cost, but still give the building element a sufficient strength and load-bearing ability to be used in load-bearing floor structures or walls, and where it can provide very good sound insulating ability and small risk of structure-borne sound propagation, high heat insulating ability, and good fire resistance.

[0037] In the foregoing, the present invention has been described with the aid of a number of different embodiments and with reference to the accompanying drawings. It should be understood, however, that the invention is not limited to the described embodiments and to what is shown in drawings, but that also other embodiments are conceivable within the scope of the invention as it is defined by the following claims.

Claims

1. A building element (10), comprising at least a first cover layer (11) and a second cover layer (19), which are connected to opposite sides of an intermediate core consisting of at least a first core material (12, 13, 14, 15, 16) and a second core material (17, 18), wherein the first (11) and/or the second cover layer (19) comprise(s) one or several stiffening layers (11', 11"; 19'; 19") having a thickness of at least 5 mm

and a modulus of elasticity which is higher than 3000 MPa and higher than the moduli of elasticity of said core materials (12, 13, 14, 15, 16; 17, 18),
the first core material (12, 13, 14, 15, 16) has a higher modulus of elasticity than the modulus of elasticity of the second core material (17, 18), which has a modulus of elasticity lower than 10 MPa,
the intermediate core is constituted by one or several edge pieces (12, 13, 15, 16) of the first core material surrounding one or several intermediate pieces (17, 18) of the second core material, wherein said one or several intermediate pieces (17, 18) of the second core material cover at least 60 % of the area delimited by said one or several edge pieces (12, 13, 15, 16) of the first core material,
the first (11) and the second cover layer (19), respectively, exhibit outer edge regions (20, 21, 22, 23; 24, 25, 26, 27) which are connected in a shear-resistant manner to opposite sides of said one or several edge pieces (12, 13, 15, 16) of the first core material by means of a fire-resistant adhesive, and
said fire-resistant adhesive covers at least 5 % of the area of the inwardly facing surface of the outer edge regions (20, 21, 22, 23; 24, 25, 26, 27) of the respective cover layer (11, 19) in order to provide a shear-resistant connection where the first (11) and second cover layer (19) are fixed at a distance from each other of at least 70 mm via the intermediate first core material (12, 13, 15, 16) which serves as a spacing element.

2. The building element (10) according to claim 1, **characterized in that** said building element (10) further comprises at least one, relative to said edge piece(s) (12, 13, 15, 16) and said cover layers (11, 19), inner piece (14) of the first core material which is disposed between at least two of said intermediate pieces (17, 18) of the second core material, and that said first (11) and said second cover layers (19), respectively, further exhibit, relative to said outer edge regions (20, 21, 22, 23; 24, 25, 26, 27), inner regions (28; 29) which are connected in a shear-resistant manner to opposite sides of said at least one intermediate piece (14) of the first core material by means of said fire-resistant adhesive.

3. The building element (10) according to claim 1 or 2, **characterized in that** at least the outwardly facing side of one of or both the cover layers (11, 19) in the building element (10) exhibits a fire-resistant layer (11', 19') which has better fire resistance than the other material layers in said cover layer and/or better fire resistance than at least one of said core materials (12, 13, 14, 15, 16).

4. The building element (10) according to any one of the preceding claims, **characterized in that** the first (11) and/or second cover layer (19) consists of several boards (11', 11"; 19', 19") of identical or different board materials glued to each other in a shear-resistant manner.

5. The building element (10) according to any one of the preceding claims, **characterized in that** the outwardly facing side (11'; 19') of the first (11) and/or second cover layer (19) in the building element (10) consists of a board material selected from the group consisting of gypsum boards, fibre-reinforced gypsum boards and fibre cement boards.

6. The building element (10) according to any one of the preceding claims, **characterized in that** the outwardly facing side (11'; 19') of the first (11) and/or second cover layer (19) in the building element (10) consists of a board material containing only inorganic matter.

7. The building element (10) according to any one of the preceding claims, **characterized in that** the inwardly facing side (11"; 19") of the first (11) and/or second cover layer (19) in the building element (10) consists of a board material selected from the group consisting of gypsum boards, fibre-reinforced gypsum boards, fibre cement boards, wood fibre boards or plywood.

8. The building element (10) according to any one of the preceding claims, **characterized in that** the first core material (12, 13, 14, 15, 16) is a foam material with high fire resistance.

9. The building element (10) according to any one of the preceding claims, **characterized in that** the first core material (12, 13, 14, 15, 16) consists of one or several materials selected from the group consisting of PET foams, PVC foams and glass foams.

10. The building element (10) according to any one of the preceding claims, **characterized in that** the second core material (17, 18) consists of one or several porous materials of loose or loosely bonded organic and/or inorganic fibres.

11. The building element (10) according to any one of the preceding claims, **characterized in that** the second core material (17, 18) consists of one or several fire-resistant or fire-inhibiting materials selected from the group consisting of glass wool, rock wool, or cellulose wool treated with flame-inhibiting agents.

12. The building element (10) according to any one of

the preceding claims,
characterized in that the fire-resistant adhesive providing the shear-resistant connection between the cover layers (11; 19) and the core material (12, 13, 14, 15, 16) and/or between boards (11', 11"; 19', 19") comprised in the cover layers is a fire-resistant adhesive with a shear strength of at least 5 MPa at 110 °C.

13. The building element (10) according to any one of the preceding claims,
characterized in that the fire-resistant adhesive providing the shear-resistant connection between the cover layers (11; 19) and the core material (12, 13, 14, 15, 16) and/or between boards (11', 11"; 19', 19") comprised in the cover layers is a fire-resistant adhesive which retains a shear strength of at least 2 MPa up to at least 130 °C.

14. The building element (10) according to any one of the preceding claims,
characterized in that the fire-resistant adhesive providing the shear-resistant connection between the cover layers (11; 19) and the core material (12, 13, 14, 15, 16) and/or between boards (11', 11"; 19', 19") comprised in the cover layers is a fire-resistant adhesive selected from the group consisting of polyurethane adhesives with flame-retarding filler and cement-based adhesives.

15. The building element (10) according to claim 14,
characterized in that the fire-resistant adhesive is a polyurethane adhesive containing at least 30 % by weight of flame-retarding filler.

16. The building element (10) according to claim 14 or 15,
characterized in that the fire-resistant adhesive is a polyurethane adhesive containing at least 50 % by weight of flame-retarding filler, preferably in the form of chalk.

17. The building element (10) according to any one of the claims 1-16,
characterized in that the first cover layer (11), the intermediate core material (12, 13, 14, 15, 16), the second cover layer (19), and the intermediate shear-resistant fire-resistant adhesive layers give the building element (10) a total thickness of at least 100 mm, for use as a wall element.

18. The building element (10) according to any one of the claims 1-16,
characterized in that the first cover layer (11), the intermediate core material (12, 13, 14, 15, 16), the second cover layer (19), and the intermediate shear-resistant, fire-resistant adhesive layers give the building element (10) a total thickness of at least 150 mm, for use as a floor structure element.

19. The building element (10) according to any one of the preceding claims,
characterized in
that both the first (11) and the second cover layer (19) consist of double fibre-reinforced gypsum boards (11', 11"; 19', 19"),
that the first core material is provided in the form of ribs (12, 13, 14, 15, 16) of a PET foam,
that the second core material is provided in the form of mineral wool boards (17, 18), and
that the fibre-reinforced gypsum boards (11', 11"; 19', 19") and the ribs (12, 13, 14, 15, 16) of PET foam are glued together by a fire-resistant polyurethane adhesive containing at least 30 % by weight of chalk.

Patentansprüche

1. Bauelement (10), das mindestens eine erste Deckschicht (11) und eine zweite Deckschicht (19) umfasst, die mit gegenüberliegenden Seiten eines Zwischenkerns verbunden sind, der aus mindestens einem ersten Kernmaterial (12, 13, 14, 15, 16) und einem zweiten Kernmaterial (17, 18) besteht, wobei die erste (11) und/oder die zweite Deckschicht (19) eine oder mehrere Versteifungsschichten (11', 11"; 19'; 19") mit einer Dicke von mindestens 5 mm und einem Elastizitätsmodul umfasst bzw. umfassen, der über 3000 MPa beträgt und höher ist als die Elastizitätsmoduln der Kernmaterialien (12, 13, 14, 15, 16; 17, 18),
das erste Kernmaterial (12, 13, 14, 15, 16) ein höheres Elastizitätsmodul als das Elastizitätsmodul des zweiten Kernmaterials (17, 18) aufweist, das ein Elastizitätsmodul von weniger als 10 MPa aufweist, der Zwischenkern von einem oder mehreren Randteilen (12, 13, 15, 16) aus dem ersten Kernmaterial gebildet ist, die ein oder mehrere Zwischenteile (17, 18) aus dem zweiten Kernmaterial umgeben, wobei das eine oder die mehreren Zwischenteile (17, 18) aus dem zweiten Kernmaterial mindestens 60 % der Fläche bedecken, die von dem einen oder den mehreren Randteilen (12, 13, 15, 16) aus dem ersten Kernmaterial begrenzt ist,
die erste (11) beziehungsweise die zweite Deckschicht (19) Außenrandbereiche (20, 21, 22, 23; 24, 25, 26, 27) aufweisen, die schubfest mit gegenüberliegenden Seiten des einen oder der mehreren Randteile (12, 13, 15, 16) aus dem ersten Kernmaterial über einen feuerfesten Klebstoff verbunden sind, und
der feuerfeste Klebstoff mindestens 5 % der Fläche der nach innen weisenden Fläche der Außenrandbereiche (20, 21, 22, 23; 24, 25, 26, 27) der jeweiligen Deckschicht (11, 19) bedeckt, damit eine schubfeste Verbindung dort vorgesehen ist, wo die erste

(11) und die zweite Deckschicht (19) in einem Abstand voneinander von mindestens 70 mm über das erste Zwischenkernmaterial (12, 13, 15, 16) fixiert sind, das als Abstandselement dient.

2. Bauelement (10) nach Anspruch 1,
dadurch gekennzeichnet, dass das Bauelement (10) ferner mindestens ein, bezogen auf das bzw. die Randteil(e) (12, 13, 15, 16) und die Deckschichten (11, 19), inneres Teil (14) aus dem ersten Kernmaterial umfasst, das zwischen mindestens zwei der Zwischenteile (17, 18) aus dem zweiten Kernmaterial angeordnet ist, und dass die erste (11) beziehungsweise die zweite Deckschicht (19) ferner bezogen auf die Außenrandbereiche (20, 21, 22, 23; 24, 25, 26, 27) innere Bereiche (28; 29) aufweisen, die schubfest mit gegenüberliegenden Seiten des mindestens einen Zwischenteils (14) aus dem ersten Kernmaterial über den feuerfesten Klebstoff verbunden sind.

3. Bauelement (10) nach Anspruch 1 oder 2,
dadurch gekennzeichnet, dass zumindest die nach außen weisenden Seite von einer Deckschicht oder beiden Deckschichten (11, 19) im Bauelement (10) eine feuerfeste Schicht (11', 19') aufweist, die eine bessere Feuerbeständigkeit aufweist als die anderen Materialschichten in der Deckschicht und/oder eine bessere Feuerbeständigkeit als zumindest eins der Kernmaterialien (12, 13, 14, 15, 16).

4. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass die erste (11) und/oder zweite Deckschicht (19) aus mehreren Platten (11', 11"; 19', 19") aus identischem oder unterschiedlichem Plattenmaterial besteht bzw. bestehen, die schubfest aneinander geklebt sind.

5. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass die nach außen weisende Seite (11'; 19') der ersten (11) und/oder zweiten Deckschicht (19) in dem Bauelement (10) aus einem Plattenmaterial besteht, das aus der Gruppe bestehend aus Gipsplatten, faserverstärkten Gipsplatten und Faserzementplatten ausgewählt ist.

6. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass die nach außen weisende Seite (11'; 19') der ersten (11) und/oder zweiten Deckschicht (19) in dem Bauelement (10) aus einem Plattenmaterial besteht, das lediglich anorganisches Material enthält.

7. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass die nach innen weisende Seite (11"; 19") der ersten (11) und/oder zweiten Deckschicht (19) in dem Bauelement (10) aus einem Plattenmaterial besteht, das aus der Gruppe bestehend aus Gipsplatten, faserverstärkten Gipsplatten, Faserzementplatten, Holzfaserplatten oder Sperrholz ausgewählt ist.

8. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass das erste Kernmaterial (12, 13, 14, 15, 16) ein Schaumstoff mit hoher Feuerbeständigkeit ist.

9. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass das erste Kernmaterial (12, 13, 14, 15, 16) aus einem oder mehreren Materialien besteht, die aus der Gruppe bestehend aus PET-Schäumen, PVC-Schäumen und Glasschäumen ausgewählt sind.

10. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass das zweite Kernmaterial (17, 18) aus einem oder mehreren porösen Materialien aus losen oder lose gebundenen organischen und/oder anorganischen Fasern besteht.

11. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass das zweite Kernmaterial (17, 18) aus einem oder mehreren feuerbeständigen oder feuerhemmenden Materialien besteht, die aus der Gruppe bestehend aus Glaswolle, Steinwolle oder Zellwolle ausgewählt sind, die mit flammwidrigen Mittel behandelt sind.

12. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass der feuerfeste Klebstoff, der für die schubfeste Verbindung zwischen den Deckschichten (11; 19) und dem Kernmaterial (12, 13, 14, 15, 16) und/oder zwischen Platten (11', 11"; 19', 19") sorgt, die in den Deckschichten enthalten sind, ein feuerfester Klebstoff mit einer Scherfestigkeit von mindestens 5 MPa bei 110 °C ist.

13. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass der feuerfeste Klebstoff, der für die schubfeste Verbindung zwischen den Deckschichten (11; 19) und dem Kernmaterial (12, 13, 14, 15, 16) und/oder zwischen Platten (11', 11"; 19', 19") sorgt, die in den Deckschichten enthalten sind, ein feuerfester Klebstoff ist, der eine Scherfestigkeit von mindestens 2 MPa bei bis zu

mindestens 130 °C beibehält.

14. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass der feuerfeste Klebstoff, der für die schubfeste Verbindung zwischen den Deckschichten (11; 19) und dem Kernmaterial (12, 13, 14, 15, 16) und/oder zwischen Platten (11', 11"; 19', 19") sorgt, die in den Deckschichten enthalten sind, ein feuerfester Klebstoff ist, der aus der Gruppe bestehend aus Polyurethanklebstoffen mit einem flammhemmenden Füllstoff und Klebstoffen auf Basis von Zement ausgewählt ist.

15. Bauelement (10) nach Anspruch 14,
dadurch gekennzeichnet, dass der feuerfeste Klebstoff ein Polyurethan-Klebstoff ist, der mindestens 30 Gewichts-% flammhemmenden Füllstoff enthält.

16. Bauelement (10) nach Anspruch 14 oder 15,
dadurch gekennzeichnet, dass der feuerfeste Klebstoff ein Polyurethan-Klebstoff ist, der mindestens 50 Gewichts-% flammhemmenden Füllstoff enthält, vorzugsweise in Form von Kalk.

17. Bauelement (10) nach einem der Ansprüche 1 bis 16,
dadurch gekennzeichnet, dass die erste Deckschicht (11), das Zwischenkernmaterial (12, 13, 14, 15, 16), die zweite Deckschicht (19) und die schubfesten Zwischenschichten aus feuerfestem Klebstoff dem Bauelement (10) eine Gesamtdicke von mindestens 100 mm zur Verwendung als Wandelement verleihen.

18. Bauelement (10) nach einem der Ansprüche 1 bis 16,
dadurch gekennzeichnet, dass die erste Deckschicht (11), das Zwischenkernmaterial (12, 13, 14, 15, 16), die zweite Deckschicht (19) und die schubfesten Zwischenschichten aus feuerfestem Klebstoff dem Bauelement (10) eine Gesamtdicke von mindestens 150 mm zur Verwendung als Bodenkonstruktionselement verleihen.

19. Bauelement (10) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
dass sowohl die erste (11) als auch die zweite Deckschicht (19) aus doppelt faserverstärkten Gipsplatten (11', 11"; 19', 19") bestehen,
dass das erste Kernmaterial in Form von Rippen (12, 13, 14, 15, 16) aus einem PET-Schaum vorgesehen ist,
dass das zweite Kernmaterial in Form von Mineralwolleplatten (17, 18) vorgesehen ist, und
dass die faserverstärkten Gipsplatten (11', 11"; 19', 19") und die Rippen (12, 13, 14, 15, 16) aus PET-Schaum über einen feuerfesten Polyurethan-Klebstoff miteinander verklebt sind, der mindestens 30 Gewichts-% Kalk enthält.

Revendications

1. Élément de construction (10), comprenant au moins une première couche de couverture (11) et une seconde couche de couverture (19), liées à des faces opposées d'une âme intermédiaire composée d'au moins un premier matériau d'âme (12, 13, 14, 15, 16) et un second matériau d'âme (17, 18), dans lequel la première (11) et/ou la seconde (19) couche de couverture comprennent une ou plusieurs couches (11', 11" ; 19', 19") de raidissement, présentant une épaisseur d'au moins 5 mm et un module d'élasticité supérieur à 3000 MPa et supérieur aux modules d'élasticité desdits matériaux d'âme (12, 13, 14, 15, 16 ; 17, 18),
le premier matériau d'âme (12, 13, 14, 15, 16) présente un module d'élasticité supérieur à celui du second matériau d'âme (17, 18), dont le module d'élasticité est inférieur à 10 MPa,
l'âme intermédiaire est constituée d'une ou de plusieurs pièces périphériques (12, 13, 15, 16) faites du premier matériau d'âme et qui entourent une ou plusieurs pièces intermédiaires (17, 18) faites du second matériau d'âme, lesdites une ou plusieurs pièces intermédiaires (17, 18) faites du second matériau d'âme couvrant au moins 60 % de la zone délimitée par lesdites une ou plusieurs pièces périphériques (12, 13, 15, 16) faites du premier matériau d'âme,
la première (11) et la seconde (19) couche de couverture présentent respectivement des régions périphériques (20, 21, 22, 23 ; 24, 25, 26, 27) liées, de manière résistante au cisaillement et au moyen d'un adhésif résistant au feu, aux faces opposées desdites une ou plusieurs pièces périphériques (12, 13, 15, 16) faites du premier matériau d'âme, et
ledit adhésif résistant au feu couvre au moins 5 % de la zone de la surface intérieure des régions périphériques (20, 21, 22, 23 ; 24, 25, 26, 27) de la couche de couverture (11, 19) respective, afin de former une liaison résistante au cisaillement là où la première (11) et la seconde (19) couche de couverture sont fixées à une distance l'une de l'autre d'au moins 70 mm par le biais du premier matériau d'âme (12, 13, 14, 15, 16) intermédiaire qui sert d'élément d'espacement.

2. Élément de construction (10) selon la revendication 1,
caractérisé en ce que ledit élément de construction (10) comprend en outre au moins une pièce intérieure (14), par rapport à ladite ou auxdites pièces péri-

phériques (12, 13, 15, 16) et auxdites couches de couverture (11, 19), faite du premier matériau d'âme et disposée entre au moins deux desdites pièces intermédiaires (17, 18) faites du second matériau d'âme, et **en ce que** lesdites première (11) et seconde (19) couches de couverture présentent respectivement en outre des régions intérieures (28 ; 29), par rapport auxdites régions périphériques (20, 21, 22, 23 ; 24, 25, 26, 27), liées, de manière résistante au cisaillement et au moyen d'un adhésif résistant au feu, aux faces opposées de ladite au moins une pièce intérieure (14) faite du premier matériau d'âme.

3. Élément de construction (10) selon la revendication 1 ou 2,
caractérisé en ce qu'au moins la face extérieure de l'une ou des deux couches de couverture (11, 19) de l'élément de construction (10) présente une couche résistante au feu (11' ; 19') dont la résistance au feu est meilleure que celle des autres couches de matériau de ladite couche de couverture et/ou meilleure que celle d'au moins un desdits matériaux d'âme (12, 13, 14, 15, 16).

4. Élément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la première (11) et/ou la seconde (19) couche de couverture est constituée de plusieurs plaques (11', 11" ; 19', 19") de matériau identique ou différent, collées l'une à l'autre de manière résistante au cisaillement.

5. Élément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la face extérieure (11' ; 19') de la première (11) et/ou de la seconde (19) couche de couverture de l'élément de construction (10) est constituée d'un matériau en plaque choisi dans le groupe des plaques de gypse, des plaques de gypse renforcées de fibres et des plaques de fibrociment.

6. Élément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la face extérieure (11' ; 19') de la première (11) et/ou de la seconde (19) couche de couverture de l'élément de construction (10) est constituée d'un matériau en plaque contenant uniquement des matières inorganiques.

7. Élément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la face intérieure (11" ; 19") de la première (11) et/ou de la seconde (19) couche de couverture de l'élément de construction (10) est constituée d'un matériau en plaque choisi dans le groupe des plaques de gypse, des plaques de gypse renforcées de fibres, des plaques de fibrociment, des plaques de fibres de bois ou du contreplaqué.

8. Élément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le premier matériau d'âme (12, 13, 14, 15, 16) est une mousse de grande résistance au feu.

9. Elément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le premier matériau d'âme (12, 13, 14, 15, 16) est constitué d'un ou de plusieurs matériaux choisis dans le groupe des mousses PET, des mousses PVC et du verre cellulaire.

10. Elément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le second matériau d'âme (17, 18) est constitué d'un ou de plusieurs matériaux poreux à base de fibres organiques et/ou inorganiques libres ou faiblement cohésives.

11. Elément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le second matériau d'âme (17, 18) est constitué d'un ou de plusieurs matériaux résistants au feu ou ignifuges choisis dans le groupe des laines de verre, de roche ou de cellulose traitées avec des agents ignifuges.

12. Elément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'adhésif résistant au feu assurant la liaison résistante au cisaillement entre les couches de couverture (11 ; 19) et le matériau d'âme (12, 13, 14, 15, 16) et/ou entre les plaques (11', 11" ; 19', 19") composant les couches de couverture est un adhésif résistant au feu dont la résistance au cisaillement est d'au moins 5 MPa à 110 °C.

13. Elément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'adhésif résistant au feu assurant la liaison résistante au cisaillement entre les couches de couverture (11 ; 19) et le matériau d'âme (12, 13, 14, 15, 16) et/ou entre les plaques (11', 11" ; 19', 19") composant les couches de couverture est un adhésif résistant au feu qui conserve une résistance au cisaillement d'au moins 2 MPa jusqu'à au moins 130 °C.

14. Elément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'adhésif résistant au feu assurant la liaison résistante au cisaillement entre les couches de couverture (11 ; 19) et le matériau d'âme (12, 13, 14, 15, 16) et/ou entre les plaques (11', 11" ; 19', 19") composant les couches de couverture est un adhésif résistant au feu choisi dans le groupe des adhésifs

polyuréthane à charge ignifuge et des adhésifs à base de ciment.

15. Élément de construction (10) selon la revendication 14,
caractérisé en ce que l'adhésif résistant au feu est un adhésif polyuréthane contenant au moins 30 % en poids de charge ignifuge.

16. Élément de construction (10) selon la revendication 14 ou 15,
caractérisé en ce que l'adhésif résistant au feu est un adhésif polyuréthane contenant au moins 50 % en poids de charge ignifuge, de préférence sous la forme de craie.

17. Élément de construction (10) selon l'une quelconque des revendications 1 à 16, **caractérisé en ce que** la première couche de couverture (11), le matériau d'âme (12, 13, 14, 15, 16) intermédiaire, la seconde couche de couverture (19) et les couches intermédiaires d'adhésif résistant au feu résistantes au cisaillement confèrent à l'élément de construction (10) une épaisseur totale d'au moins 100 mm, permettant de l'utiliser comme élément mural.

18. Élément de construction (10) selon l'une quelconque des revendications 1 à 16, **caractérisé en ce que** la première couche de couverture (11), le matériau d'âme (12, 13, 14, 15, 16) intermédiaire, la seconde couche de couverture (19) et les couches intermédiaires d'adhésif résistant au feu résistantes au cisaillement confèrent à l'élément de construction (10) une épaisseur totale d'au moins 150 mm, permettant de l'utiliser comme élément structurel de plancher.

19. Élément de construction (10) selon l'une quelconque des revendications précédentes, **caractérisé en ce que**
la première (11) et la seconde (19) couche de couverture sont constituées de deux plaques de gypse renforcé de fibres (11', 11"; 19', 19"),
en ce que le premier matériau d'âme est fourni sous la forme de nervures (12, 13, 14, 15, 16) en mousse de PET,
en ce que le second matériau d'âme est fourni sous la forme de plaques de laine minérale (17, 18), et
en ce que les plaques de gypse renforcé de fibres (11', 11" ; 19', 19") et les nervures (12, 13, 14, 15, 16) en mousse de PET sont collées ensemble par un adhésif polyuréthane résistant au feu contenant au moins 30 % en poids de craie.

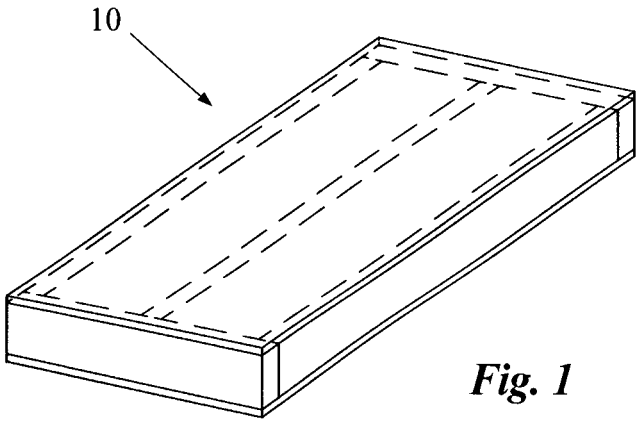


Fig. 1

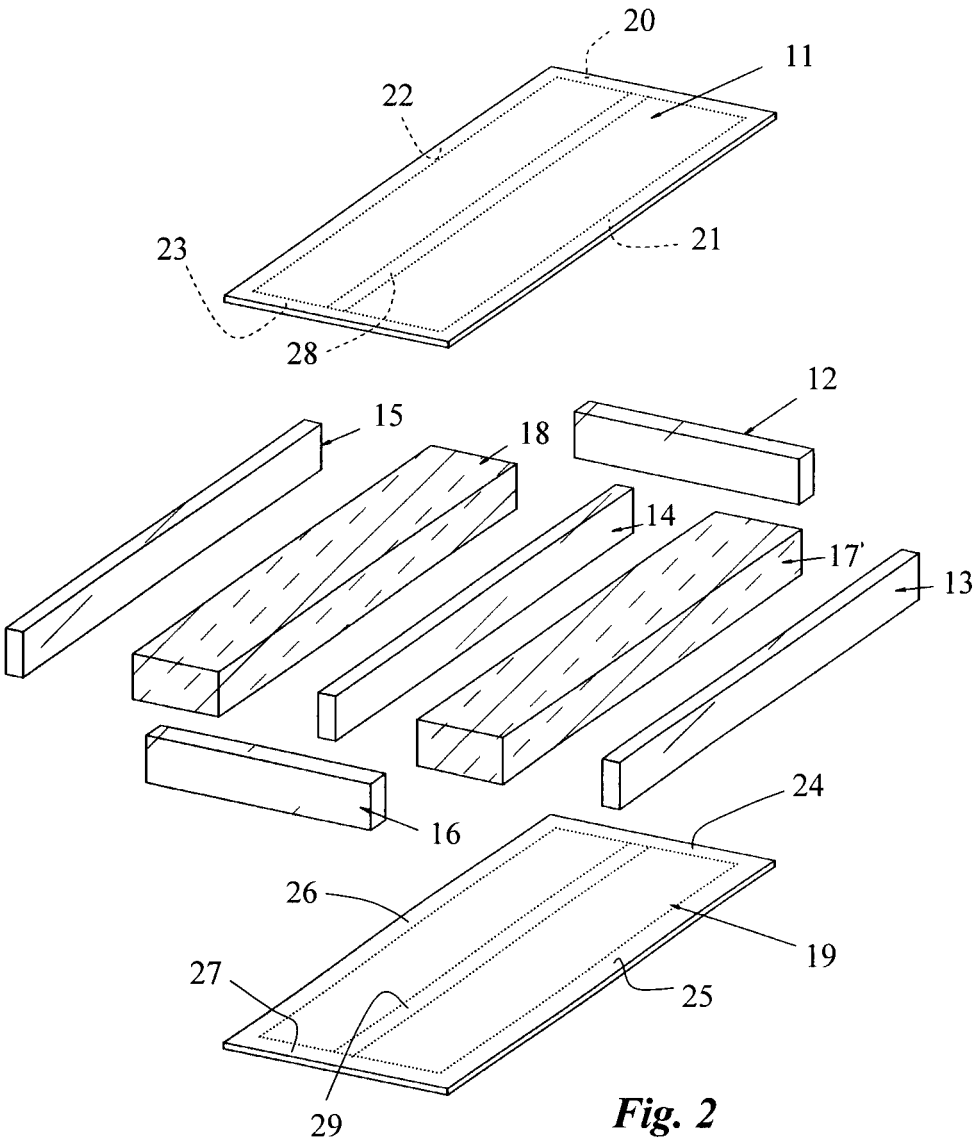


Fig. 2

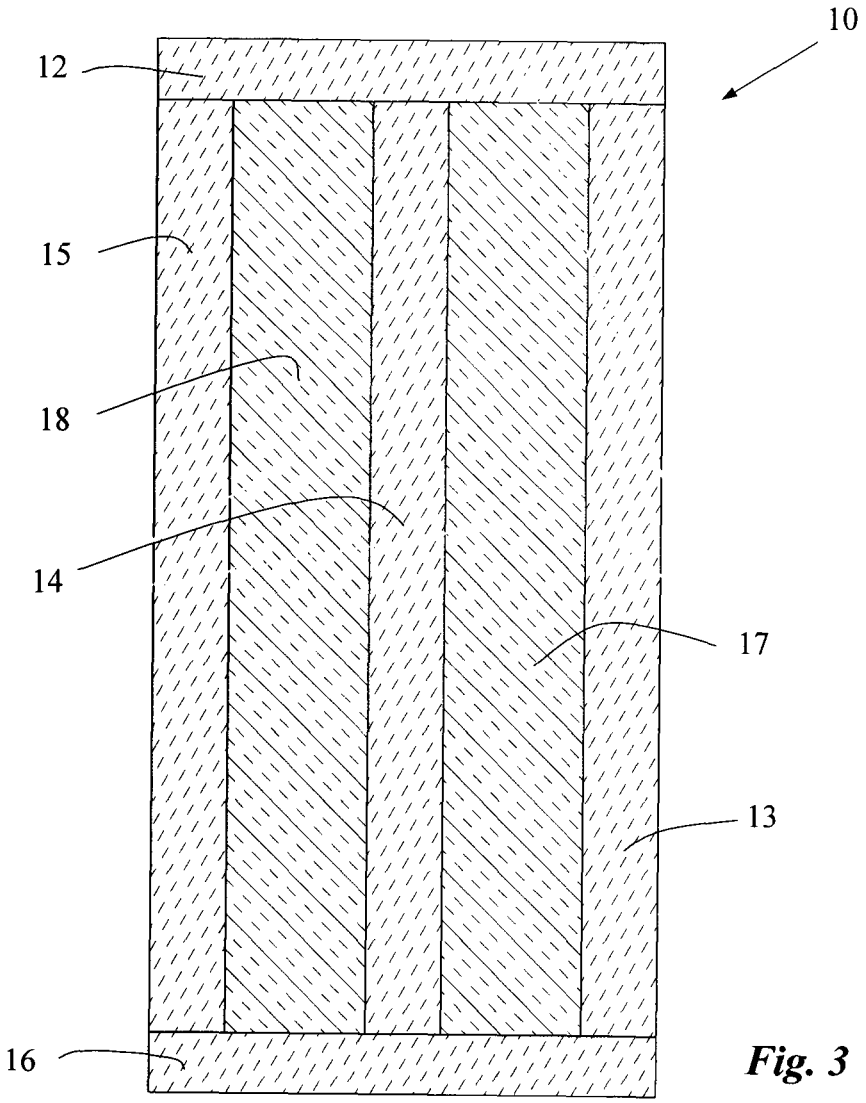


Fig. 3

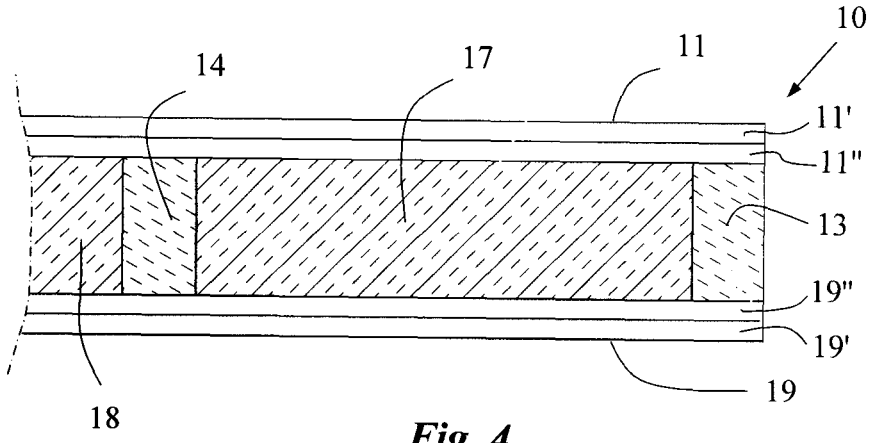


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- SE 450020 **[0003]**
- EP 1253257 A **[0004]**