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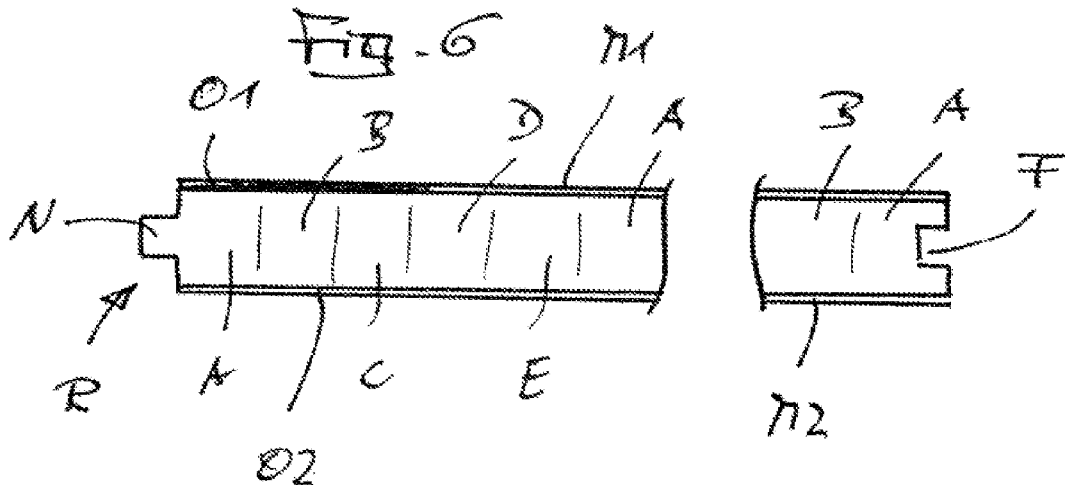
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(54) **Load-bearing structural building panel**

(57) A load-bearing structural building panel comprises at least one mineral wool core layer (K) sandwiched between first (M1) and second (M2) panels of

sheet material and the mineral wool core layer (K) comprises at least two different types of mineral fibre lamellas (A...E).



Description

[0001] This invention relates to a load-bearing structural element for building purposes. In particular, it relates to a board-like structural element comprising a core of mineral wool lamellas sandwiched between metal sheets.

[0002] Such structural elements are known, for example, the "Paroc Panel System" from Paroc GmbH, D-28816 Stuhr. The metal panels are glued to the mineral wool core layer. The outside surfaces are exposed surfaces.

[0003] These types of structural elements (panels) may be, for example, 6 m long and 1 m wide. They are generally mounted directly on a structural frame, for example a steel skeleton, often by being screwed on. They are used in particular for facade construction, but also for roofing.

[0004] The size of the elements requires high mechanical stability. The elements, which for example span a distance of 2 metres when installed on steel beams spaced every two metres, may be subject to considerable mechanical loading from wind load or from rain or snow if they are used for roofing. The mineral wool core layer provides a degree of mechanical stability and thermal insulation.

[0005] One aim of the invention is to optimise the mechanical and thermal properties of such types of building construction elements. It would be desirable to increase the stability of individual panels to improve installation reliability and/or to facilitate construction in which greater distances between fastening supports are possible. In particular, standardisation of the properties of the structural element is desirable.

[0006] According to one aspect the invention provides a supporting building structural element with a length that is preferably greater than 3-times its width having a core sandwiched between first and second metal panels, the core comprising a layer of mineral fibre lamellas, in which

- the mineral fibre lamellas are arranged one after the other and beside each other in the longitudinal direction of the structural element, or
- the mineral fibre lamellas are arranged perpendicular to the longitudinal direction of the structural element beside each other or beside each other and one behind the other, and
- the mineral fibre lamellas of the core layer consist of at least two different types of lamellas that differ by at least one of the following parameters: binding agent content, density, main fibre orientation, compressive strength perpendicular to the main surfaces of the core layer, shearing strength parallel to the main surfaces of the core layer, mean length of the mineral fibres, mean diameter of the mineral fibres, type of fibre, width in a plane parallel to the main surfaces of the mineral wool core layer.

[0007] In known panels, the mineral wool core layer consists of mineral wool lamellas that are built-up the same way and arranged beside each other. However, in panels according to at least one aspect of the invention the mineral wool core layer has different lamellas, i.e. lamellas with different properties. Here, the formation of the individual mineral fibre lamellas is such that, depending on the application, the desired properties of the structural element are optimised for the panel as a whole.

[0008] Mineral fibre lamellas with a fibre orientation that is mainly perpendicular to the large main surfaces (here perpendicular to the covering metal panels) generally have high compressive strength (in a direction perpendicular to the metal panels); the shearing strength between adjacent mineral fibre lamellas within such structural elements, however, is often quite low.

[0009] According to the invention, lamellas with high compressive strength may be combined with lamellas having high shearing strength. For example, the mineral wool core layer may be constructed as follows, whereby A lamellas have high compressive strength and B lamellas have high shearing strength:

ABABABABABAB

or

ABBAABBAABBA.

[0010] Alternatively and/or additionally, other different mineral fibre lamellas may be built into such a structural element.

[0011] Other types of lamella may include:

- C: lamellas with a density that is significantly higher than the density of adjacent lamellas and consequently having greater compressive strength
- D: lamellas in which the mean mineral fibre length is greater than that of adjacent lamellas resulting in a structure that is less dense on the whole but has improved shearing strength
- E: lamellas made of high-temperature resistant mineral fibres (which may be ceramic fibres), in order to improve the fire protection properties of the structural element.

[0012] One example of such lamella arrangement within a structural element is in the combination:
EABBECDCEBBAE.

[0013] The number of different lamellas within a structural element is not limited. It is just as possible to place several of the same lamellas beside each other. To this extent, the invention is not subject to any restrictions at all, although regular lamella placements are favourable to the extent that the resulting structural element has regular, extensively equivalent properties over the entire surface and the entire volume respectively.

[0014] Possible variations include:

- A structural element in which mineral fibre lamellas of different lamella types (especially glass fibres, rock fibres, slag fibres, or even ceramic fibres) alternate or are combined, either regularly or irregularly.
- A structural element in which one or more mineral fibre lamellas with high compressive strength and low shearing strength run beside one or more mineral fibre lamellas with high shearing strength and low compressive strength (the terms "high" and "low" are understood to be compared to the adjacent lamellas).
- A structural element in which mineral fibre lamellas of a mineral wool core layer running at a distance from each other have at least one intermediate running mineral fibre lamella protruding in the direction of one opposite metal panel, and the metal panel is designed such that it follows the shape of the main surface of the mineral wool core layer. In other words, every second, third or other lamella is higher than the lamella(s) lying in-between; the upper, lower or both main surfaces of the core layer can therefore have a staggered profile. For example, at least two adjacent mineral fibre lamellas (A...E) of the mineral wool core layer (K) may have different heights (as measured between the main surfaces of the structural element) and the first (M1) and second (M2) panels of sheet material may follow the profile created by the heights of the adjacent mineral fibre lamellas (A...E).

[0015] That way, the property, for example the compressive strength of the respective lamella, can be set through a greater thickness of individual mineral fibre lamellas. Simultaneously, different dimensions of the lamellas create the possibility of optically designing the structural element generally such that the top has a staggered or crenulated profile, for example.

[0016] The length of the structural elements in accordance with the invention may be greater or equal to 3 m; it may be less than or equal to 15 m. The width of the structural elements may be greater than or equal to 0.5 m; it may be less than or equal to 2 m. Generally, the length would be in the range 6 to 12 m and the width between 0.7 and 1.2 m. The thickness of a structural element is generally at least 0.05 m; it may be less than or equal to 0.3m.

[0017] Generally, only the main surfaces are covered with the said metal panels. The edges of the structural elements can be designed with a tongue and groove system, for example, which means two adjacent joining edges have a tongue and the two others have a groove.

[0018] That way, adjacent structural elements can be connected without joints. Only around the outer surfaces (outside edges), for example in the corner area of facades, is it necessary to construct an additional edge seal, for example with a metal panel, similar to the one on the main surfaces.

[0019] It is possible to arrange a second mineral wool core layer between the metal panels or also to construct different types of intermediate layers. This, however, has cost disadvantages. In addition, there is also the risk that the optimisation of the mechanical characteristics of the overall element achieved in accordance with the invention will be lost.

[0020] Instead of metal panels, panels of other materials may be used as covering elements, for example panels made of plastic. The surface of the covering(s) may be flat, rippled, profiled, or designed some other way. This applies to both the surface of the metal panels that point in the direction of the mineral wool core layer, as well as the surface of the metal panel, which has a free outer surface and therefore is the exposed surface.

[0021] The structural element may have a fire resistance class of at least EI 60 (for a panel thickness of 80 mm for example) in accordance with EN 1364-1 and/or EN 13501-2. The structural element may have a fire protection class of EI 180, for example with a panel thickness of 200 mm or more.

[0022] The sound absorption (dB) may be greater than 32 in accordance with EN ISO 140-3.

[0023] Embodiments of the invention are described below with reference to:

Figure 1: a perspective view of mineral fibre lamellas of a mineral wool core layer of a structural element

Figure 2: a view in accordance with Figure 1 of a second embodiment,

Figure 3: a view of one part of a mineral wool core layer for a structural element in a third embodiment

Figure 4: a view of one part of a mineral wool core layer for a structural element in a fourth embodiment

Figure 5: a view of one part of a mineral wool core layer for a structural element in a fifth embodiment

EP 2 141 303 A2

Figure 6: a longitudinal cut through a construction element comprising a metal panel on each main surfaces of the mineral wool core layer

Figure 7: the element from Figure 6 fastened on a supporting framework.

[0024] Components that are the same or equivalent are shown in the figures with the same reference numbers.

[0025] The individual mineral fibre lamellas have the following characteristics:

	Lamella type				
	A	B	C	D	E
Material	stone wool	stone wool	stone wool	stone wool	stone wool
Density (kg/m ³)	100	100	130	80	90
Possible range of compressive strength (kPa)	40-100	30-90	90-150	40-100	30-90
Compressive strength (kPa) as per EN 826 (example)	71	60	112	68	58
Possible range of tensile strength (kPa)	60-130	50-120	90-160	60-130	50-120
Tensile strength (kPa) as per EN 1607 (example)	109	92	134	112	86
Possible range of the shearing strength (kPa)	30-90	40-100	60-120	30-90	40-100
Shearing strength (Pa) as per EN 12090 (example)	50	64	85	53	61
Binding agent content (M-%), related to the entire mineral wool lamella	4.0	4.0	3.8	4.4	3.0
Possible range of fibre length (l ₅₀) in cm	0.1-5	0.1-5	0.1-5	0.1-5	0.1-5
Mean fibre length (l ₅₀) in cm (-)(example)	4	4	4	6	4
Possible range of fibre diameter (d ₅₀) in µm	2-15	2-15	2-15	2-15	2-15
Mean fibre diameter (d ₅₀) in µm (example)	6	6	6	5	6
Fe ₂ O ₃ content of fibres (by weight)	6.0	6.0	6.1	5.9	9.2

[0026] The metal panels shown as covering layers are made of galvanised sheet steel with a thickness of 3 mm.

[0027] The mineral wool core layer K as per Figure 1 is constructed symmetrically. Lamella A follows lamella B, and then another lamella A and so on. All lamellas are the same size. The illustrated core layer as a whole has normal compressive and tensile strength for stone wool lamellas and a comparably high shearing strength. The panel is particularly well suited for installation in roof structures where the highest shearing strength possible is desired.

[0028] In the construction example in Figure 2, layers B are twice as wide as layers A. This increases the shearing strength further, while the compressive and tensile strength is reduced somewhat. Such mineral wool core layers are used in panels where there is a great need for high shearing strength (large distances between the supports of the structural framework, and panels with extreme shearing loads).

[0029] The individual lamellas may run throughout the entire width (of 1 m for example) of a structural element. However, they can also be placed one behind the other and beside each other in the longitudinal direction of the structural element as shown in Figures 3 to 5. The different types of lamellas are each marked. Preferably, the lamellas are arranged so that their lengths are in the same direction as the length of the building panel.

[0030] In Figure 6, it can be seen that the mineral wool core layer of mineral fibre lamellas A...E is covered with metal panels M1, M2 on both main surfaces (01,02), whereby the metal panels M1, M2 are glued to the mineral wool core layer.

[0031] In the edge area (R), the respective lamellas (here A, B) are designed with a groove N or alternatively a tongue F.

[0032] A sample installation is shown in Figure 7. A steel frame S with metal supports T can be seen. Individual structural elements KE (ie load-bearing structural building panels) are mounted directly on support T (screwed on) and are directly beside each other resulting in a continuous exposed façade.

Claims

1. Load-bearing structural building panel comprising at least one mineral wool core layer (K) sandwiched between first (M1) and second (M2) panels of sheet material, **characterised in that** the at least one mineral wool core layer (K) comprises at least two different types of mineral fibre lamellas (A...E) that differ by at least one of the following parameters: binding agent content, density, main fibre orientation, compressive strength perpendicular to the main surfaces of the core layer, shearing strength parallel to the main surfaces of building panel, mean length of the mineral fibres, mean diameter of the mineral fibres, type of fibre, width in one plane parallel to the main surfaces (01, 02) of the building panel.
2. Load-bearing structural building panel according to claim 1 in which the mineral fibre lamellas (A...E) of different types alternate regularly.
3. Load-bearing structural building panel according to claim 1 or claim 2 in which the at least one mineral wool core layer (K) comprises (i) a plurality of mineral fibre lamellas (A...E) arranged between the first (M1) and second (M2) panels of sheet material which provide high compressive strength and low shearing strength and (ii) a plurality of mineral fibre lamellas (A...E) arranged between the first (M1) and second (M2) panels of sheet material which provide higher shearing strength and lower compressive strength.
4. Load-bearing structural building panel according to any preceding claim in which at least two adjacent mineral fibre lamellas (A...E) of the mineral wool core layer (K) have different heights and the first (M1) and second (M2) panels of sheet material follow the profile created by the heights of the adjacent mineral fibre lamellas (A...E).
5. Load-bearing structural building panel according to any preceding claim in which different types of mineral fibre lamellas (A...E) of the mineral wool core layer (K) comprises (i) a first type of lamella having a first density in the range 70-120 kg/m³ and (ii) a second type of lamella having a second density which differs from the first density by at least 5 kg/m³, and is in the range 70-120 kg/m³.
6. Load-bearing structural building panel according to claim 5, in which the first type of lamella have a density in the range 70-90 kg/m³ and the second type of lamella have a density in the range 100-120 kg/m³.
7. Load-bearing structural building panel according to any preceding claim in which the first (M1) and second (M2) panels of sheet material are metal sheets.
8. Load-bearing structural building panel according to any preceding claim in which the first (M1) and second (M2) panels of sheet material are adhered to the mineral wool core layer (K).
9. Load-bearing structural building panel according to any preceding claim having a length between 3 and 15 m and a width between 0.5 and 2 m.
10. Load-bearing structural building panel according to any preceding claim having a length between 6 and 12 m and a width between 0.7 and 1.2 m.
11. Load-bearing structural building panel according to any preceding claim having a thickness between 0.05 and 0.3 m.
12. Load-bearing structural building panel according to any preceding claim having a length that is greater than three times its width.

