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

(11) EP 2 963 201 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
12.09.2018 Bulletin 2018/37

(51) Int Cl.:
E04B 5/02 *(2006.01)* ***E04C 2/36*** *(2006.01)*

(21) Application number: **15175326.6**

(22) Date of filing: **03.07.2015**

(54) **SELF-SUPPORTING SANDWICH PANEL FOR CONSTRUCTING A FLOOR PLACED ON A SUPPORT CONSTRUCTION**

SELBSTTRAGENDES SANDWICHPANEEL ZUR HERSTELLUNG EINES BODENS WELCHES AUF EINE TRAGKONSTRUKTION AUFGELEGT IST

PANNEAU AUTOPORTEUR POUR REALISER UN PLANCHER RESTANT SUR UNE CONSTRUCTION SUPPORTANT

(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

(30) Priority: **03.07.2014 NL 2013116**

(43) Date of publication of application:
06.01.2016 Bulletin 2016/01

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EP 2 963 201 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a self-supporting sandwich panel for constructing a floor placed on a support construction.

[0002] Self-supporting sandwich panels are known. Such a panel comprises a sandwich construction of two parallel skins which are mutually connected by means of a layer of core material. Because of this sandwich construction it is possible to provide a panel which has a relatively high bending stiffness and a relatively low weight compared to a solid panel. The relatively high bending stiffness and the relatively low weight of a sandwich panel make the sandwich panel suitable as self-supporting panel in building structures, i.e. as panel with which a span can be realized between two support points without supporting the panel between the support points.

[0003] Self-supporting sandwich panels are frequently applied in building structures as construction element for constructing walls and roofs, but not however as construction element for constructing a floor placed on a support construction.

[0004] When constructing a floor placed on a support construction, floor elements in the form of rectangular panels are generally applied which are each placed with two mutually opposite edges on the support construction. By laying a plurality of such floor elements adjacently of each other on the support construction, i.e. in each case with the long sides against each other and the short sides placed on the support construction, a floor placed on the support construction is obtained wherein each floor panel forms a part of the overall floor surface area. In such a floor construction allowance is made in the construction of each floor panel for a distributed load on the floor panel resulting from its own weight transversely of the floor surface. Allowance is additionally made for an external load resulting from the use as floor, in the form of an additional distributed load transversely of the floor surface. Each floor element is constructed here such that it can withstand the shear force and the bending moment occurring in the floor element as a result of the overall load.

[0005] Particularly because of the relatively great distance which has to be bridged by a floor element, also referred to as span, and the relatively great external load on a floor element transversely of the floor surface in the case of such a floor placed on a support construction, the shear force and the bending moment occurring in a floor element are relatively high compared to the shear force and the bending moment occurring in a wall element or roof element. US 6,085,485 discloses a self-supporting sandwich panel according to the preamble of claim 1. The present invention has for its object, among others, to provide a self-supporting sandwich panel which is particularly suitable for construction of such a floor placed on a support construction.

[0006] The self-supporting sandwich panel according to the invention as defined in independent claim 1 comprises for this purpose two parallel skins mutually connected by means of a layer of core material, wherein, for the purpose of placing the sandwich panel on the support construction, at least one of the edges of the sandwich panel is provided with at least one beam which mutually connects the two parallel skins and which extends in the layer of core material from the associated edge in the direction of an opposite edge over a part of the distance between the two opposite edges.

[0007] In the self-supporting sandwich panel according to the present invention use is made in unconventional manner of the properties of a self-supporting sandwich panel and the distribution of shear force and bending moment in a floor element in order to arrive at a self-supporting sandwich panel which is particularly suitable for construction of a floor placed on a support construction.

[0008] In order to withstand the relatively great bending moment which occurs in the sandwich panel according to the invention when it is applied as floor element use is made of the property of a sandwich panel that a relatively great increase in the bending stiffness, i.e. the resistance to bending moment occurring in the panel, can be realized with a relatively small increase in the thickness of the sandwich panel, i.e. with a relatively small increase in the thickness of the layer of core material and/or the thickness of the skins.

[0009] With a relatively small increase in the thickness of a sandwich panel the shear strength, i.e. the resistance to shear force occurring in the panel, will however only increase in small measure. As a result the thickness of the sandwich panel would have to increase to such an extent in order to withstand the relatively great shear force which occurs in the sandwich panel when applied as floor element that as a result of the weight and the thickness thereof the resulting panel would no longer be suitable as floor element.

[0010] In order to withstand the relatively great shear force occurring in the sandwich panel according to the invention when applied as floor element use is made of the beam which mutually connects the two parallel skins and which extends in the layer of core material from an edge of the panel in the direction of an opposite edge over a part of the distance between the two opposite edges. In the part of the sandwich panel in which it extends this beam transmits shear force occurring in the sandwich panel to the support construction on which the associated edge lies. In the area lying on either side in transverse direction of the beam, the beam draws toward it shear forces occurring in the skins and the core material so that in this area the skins and the core material are partially relieved of the shear force occurring there. In a sandwich panel according to the invention the beam extends over only a part of the distance between the two opposite edges. A part of this distance is therefore free of the beam. In the area free of the beam the skins and the layer of core material are not relieved of the shear force occurring in this area.

[0011] In the construction of a floor as described above, in the case of a distributed load the shear force occurring in the floor element decreases as the distance to the edge with which the floor element lies on the support construction increases. With a sandwich panel according to the invention it is possible by applying the beam which extends in the layer of core material to partially relieve the skins and layer of core material of shear force, over a distance from the edge with which the panel is placed in the direction of the opposite edge, in an area close to the placing position where the shear force is relatively high, and not to relieve the skins and layer of core material of shear force in an area which lies further away from the placing position and where the shear force is relatively low.

[0012] Because the beam does not extend over the whole distance between the two opposite edges, the weight increase resulting from the addition of the beam can remain small. Because the beam moreover draws to it the shear force occurring in the skins and the core material in the area lying on either side of the beam in transverse direction of the beam, it is possible with a single beam or a number of parallel beams positioned at a distance from each other to partially relieve the skins and the layer of core material close to the placing position over the whole width of the panel, i.e. over the whole distance transversely of the beam(s). This fact also contributes toward the weight increase resulting from the addition of the beam remaining small.

[0013] The measure of the at least one beam in the layer of core material in the sandwich panel according to the invention, with a small increase in the thickness of the panel and a small increase in the weight, thus makes the sandwich panel particularly suitable for construction of a floor placed on a support construction. The measure of the at least one beam can be implemented in simple manner here in the existing methods for manufacturing sandwich panels.

[0014] In a sandwich panel according to the invention the skins and the layer of core material are particularly connected by means of glueing.

[0015] In a sandwich panel according to the invention the at least one beam is preferably connected to the skins by means of glueing.

[0016] The sandwich panel according to the invention is preferably rectangular and at least one of the edges on the short side is provided with the at least one beam. From the associated edge the at least one beam then extends parallel to the edges on the long side in the direction of the opposite edge. The length of the beam is smaller than the length of the sandwich panel.

[0017] In a particularly suitable embodiment of the sandwich panel according to the invention two mutually opposite edges of the sandwich panel are each provided with at least one beam extending from the associated edge in the layer of core material in the direction of an opposite edge over a part of the distance between the two opposite edges. In the case of a uniformly distributed load, for which a floor element is generally designed, and when the sandwich panel is placed at two opposite edges on the support construction, the shear force occurring in the skins and the layer of core material decreases from the two edges in the direction of the opposite edge to zero in the centre between the two edges. By providing the two edges with at least one beam the sandwich panel is partially relieved of the shear force which occurs in the area close to the two edges and is relatively high there. In the area halfway between the two opposite edges, where the shear force which occurs is relatively low, the sandwich panel can then be free of the beams. The beams in that case extend from an associated edge in the layer of core material over a distance which is less than half the distance between the two edges lying opposite each other. In the case of an unevenly distributed load, for instance a distributed load with a centre of gravity at one of the placed edges, the shear force in the area close to the edge at which the centre of gravity lies will be higher than in the area close to the opposite edge. In such a case a sandwich panel according to the invention can be applied, wherein the panel is provided on only one of the opposite edges with the at least one beam which extends in the layer of core material.

[0018] The distance over which the beam extends in the layer of core material depends on the load which has to be taken into account, the associated distribution of the shear force and the shear strength of the skins and the layer of core material. The beam extends over a distance in the layer of core material such that the beam relieves the area close to the edge in which the shear strength of the skins and the layer of core material is too low to withstand the shear force occurring there. The beam preferably extends over a distance in the layer of core material such that the beam extends to some extent in the adjacent area in which the shear strength of the skins and the layer of core material is sufficient to withstand the shear force occurring there. It is thus possible to realize that close to the end of the beam remote from the edge the skins and the layer of core material have a shear strength which is sufficient to also withstand possible concentrations of stress occurring close to that end of the beam in addition to the shear force occurring there. In a favourable embodiment the distance over which the beam extends in the layer of core material is substantially 5% to substantially 15%, more preferably substantially 10% greater than the distance at which the end of the beam remote from the edge is situated at the location where the shear strength is precisely sufficient to withstand the shear force occurring there.

[0019] When determining the shear strength of the core material and the skins, account has to be taken of factors to be considered in accordance with current standards in the construction industry for safe use as floor element and for long-term behaviour,

[0020] In respect of long-term behaviour it is noted that the shear strength of the core material decreases by about 20% over the course of the first year, so from an

initial shear strength to a long-term shear strength. This latter value must be taken into account in determining the length of the beam in the layer of core material. It is noted by way of elucidating the aspect of long-term behaviour that an immediate deformation (sagging) will occur upon initial loading of the sandwich panel. If it remains under load for a long time, the sandwich panel will sag still further due to settling of the layer of core material. The effect of an additional permanent deformation occurring due to the longer load duration is referred to as creep.

[0021] A so-called partial material factor, a factor which is related to material parameters, will further have to be taken into account in determining the distance over which the beam extends in the layer of core material. Allowance is made in these safety factors for uncertainties in the behavioural properties of the core material.

[0022] The above stated factors for long-term behaviour and safety are stated in the relevant standards and Eurocodes. Standard NEN-EN 1990-Eurocode: 'Basis of structural design' thus determines the principles of requirements for safety, utility and durability of constructions, specifies the basis for their design, calculation and testing and provides guidelines for associated aspects of the structural reliability. Standard NEN-EN 14509 relates to self-supporting metal sandwich panels - factory-made products - specifications. The test procedure for determining the strength and stiffness properties of sandwich panels is described here.

[0023] As already described, in a sandwich panel according to the invention the beam draws to it shear forces occurring in the skins and the core material in transverse direction of the beam in the area lying on either side of the beam, so that in this area the skins and the core material are partially relieved of the shear force occurring there. The beam must have sufficiently great shear strength to be able to withstand the shear force drawn thereto. The use of two parallel beams positioned at a distance from each other instead of one beam in the same area realizes that the two beams draw to them a part of the same shear force. Each of the beams need then withstand less shear force, so that the shear strength of each of the beams can be smaller.

[0024] When a plurality of parallel beams lying at a distance from each other are provided along an edge of the sandwich panel, the beams can extend over the same distance in the layer of core material. It is alternatively possible for the beams to extend over a different distance in the layer of core material. It is thus possible for instance for a sandwich panel according to the invention to be provided on an edge thereof with three parallel beams lying at a distance from each other, wherein the central beam extends over a greater distance in the layer of core material from the edge than the beams on either side thereof. When such a sandwich panel is placed for the purpose of constructing a floor as described above, wherein two opposite edges of the panel lie on a support construction and allowance is made for a uniformly distributed load transversely of the floor surface, the skins and the layer of core material are then relieved by three beams in the area from the edge to the distance over which the outer two beams extend and where a higher shear force occurs, while the skins and the layer of core material are relieved by one beam in the adjoining area in which only the central beam extends and where a lower shear force occurs.

[0025] In a favourable embodiment of the sandwich panel according to the invention the layer of core material comprises a layer of rockwool. Rockwool is relatively lightweight and has good thermally insulating and fire-resistant properties. The layer of core material preferably comprises a layer of rockwool, the fibres of which extend transversely of the skins. A layer of rockwool with fibres which extend transversely of the skins makes possible a sandwich panel with exceptional bending stiffness, and thereby a sandwich panel suitable for withstanding the relatively high bending moment which occurs in the sandwich panel when the panel is applied for constructing a floor placed on a support construction. Such a layer of rockwool with fibres which extend transversely of the skins can be realized in particularly suitable manner by means of so-called rockwool lamellas. The layer of core material can be constructed from a plurality of sub-layers. Additionally or alternatively, the layer of core material can comprise a layer of hard foam, such as XPS (extruded hard polystyrene foam) or hard PVC foam.

[0026] In a favourable embodiment of the sandwich panel according to the invention the skins comprise a steel sheet. The skins can additionally or alternatively comprise sheets of stainless steel, aluminium, zinc or plastic composite. As with the layer of core material, it is the case that the skins themselves can consist of one layer of material, such as one steel sheet, or of a plurality of sub-layers, for instance a steel sheet in combination with a pressure-distributing layer of material.

[0027] A layer of pressure-distributing material in a skin, particularly in the skin forming a part of the floor surface in the construction of a floor using the sandwich panel, makes it possible to distribute point loads, which are exerted on the floor surface during use of the constructed floor, over the sandwich panel so that high local shear forces in the skins and the layer of core material are avoided. The layer of pressure-distributing material preferably comprises a layer of magnesium oxide in a binding agent or a layer of fibre-reinforced material.

[0028] In a further favourable embodiment of the sandwich panel according to the invention at least one of the skins has perforations, particularly perforations distributed uniformly over the surface of the associated skin. In combination with the layer of core material such perforations make sound-damping possible. A layer of core material with good sound-damping properties, such as rockwool, is preferably applied here. When a sandwich panel according to the invention is applied in the construction of a floor placed on a support construction, the skin which lies underneath after placing, if it remains ex-

posed to the space lying under the floor, can be provided in advantageous manner with the perforations in order to thus damp sound generated in the space lying under the floor.

[0029] In a favourable embodiment of the sandwich panel according to the invention a fire-resistant layer is arranged on at least one of the skins.

[0030] In a favourable embodiment of the sandwich panel according to the invention the sandwich panel comprises an additional skin which is connected by means of an additional layer of core material to one of the skins and extends parallel to the skins, wherein the skin to which the additional skin is connected by means of the additional layer of core material is free of the additional skin and the additional layer of core material along the at least one edge provided with the at least one beam. These measures make a particularly favourable sandwich panel possible which has an exceptionally high bending stiffness because of the additional skin and the additional layer of core material. This sandwich panel can be placed on a support construction with the additional skin facing downward, wherein along the edge provided with the at least one beam the sandwich panel does not lie with the additional skin on the support construction but with the skin on which the additional layer of core material and the additional skin are arranged. The at least one beam can then transmit shear forces to the support construction without the beam also extending in the additional layer of core material. In a sandwich panel according to the invention the bending stiffness can thus be further increased without modifying the beam.

[0031] According to the invention the beam is a profile beam. The profile beam is a beam comprising two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to one of the skins. This enables a particularly effective connection of the profile beam to the skins, wherein the orientation of the web relative to the plane in which the skins extend is guaranteed. Particularly suitable profile beams are an I-profile beam, U-profile beam and Z-profile beam.

[0032] In a further favourable embodiment of the sandwich panel according to the invention at least one edge of the sandwich panel other than the at least one edge provided with the at least one beam is configured to couple the sandwich panel to an adjacent sandwich panel. When constructing a floor placed on a support construction, wherein a plurality of rectangular sandwich panels are placed with the edges on the short side on the support construction and with the edges on the long side against each other, it is possible by coupling the adjacent sandwich panels along the long side thereof to realize that unequal sagging of the adjacent sandwich panels along the coupled edge is avoided in the case of unequal load on adjacent sandwich panels. The sandwich panel is preferably provided along the associated edge with a U-shaped recess in which a coupling element can be received for coupling the associated edge to an edge of an adjacent sandwich panel.

[0033] The present invention also relates to a floor construction according to claim 12 comprising a support construction and a sandwich panel according to the invention placed on the support construction, wherein the sandwich panel is placed on the support construction with the edge provided with the at least one beam.

[0034] The present invention also relates to a method for manufacturing a sandwich panel according to independent claim 13, comprising the steps of mutually connecting two parallel skins by means of a layer of core material, wherein at least one of the edges of the sandwich panel is provided with at least one beam which mutually connects the two parallel skins and which extends in the layer of core material from the associated edge in the direction of an opposite edge over a part of the distance between the two opposite edges.

[0035] The present invention also relates to a method for constructing a floor placed on a support construction and designed for a determined load transversely of the direction in which floor extends as defined in independent claim 14, comprising of providing at least one sandwich panel, in particular at least one self-supporting sandwich panel according to the invention as described above, which is placed at two opposite edges on the support construction in order to form the floor; wherein

- the sandwich panel comprises a sandwich construction of two parallel skins mutually connected by means of a layer of core material;
  wherein
- the sandwich construction is designed with a shear strength in the direction transversely of the plane in which the sandwich panel extends which, in a central part of the sandwich construction between the edges of the sandwich panel to be placed, is sufficient to withstand the shear force occurring in the sandwich construction as a result of the determined load transversely of the plane in which the floor for forming extends, and which close to the edges to be placed is insufficient to withstand said shear force;
  wherein
- the sandwich panel is provided along each of the two edges thereof to be placed with at least one beam which mutually connects the two parallel skins and which extends in the layer of core material from the associated edge in the direction of the opposite edge over a part of the distance between the two mutually opposite edges in order to increase the shear strength of the sandwich panel in the part of the sandwich construction in which said shear strength is insufficient to withstand said shear force;
  and wherein
- the beams do not extend in a central part of the sandwich construction between the edges of the sandwich panel to be placed.

[0036] In a favourable embodiment of this method according to the invention the beam is a profile beam. In a

preferred embodiment the profile beam is a beam comprising two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to one of the skins. Particularly suitable profile beams are an I-profile beam, U-profile beam and Z-profile beam.

[0037] The present invention also relates to a floor according to independent claim 15 comprising at least one sandwich panel, in particular at least one self-supporting sandwich panel according to the invention as described above, which is placed at two opposite edges on a support construction, the floor being designed for a determined load transversely of the direction in which the floor extends;
wherein

- the sandwich panel comprises a sandwich construction of two parallel skins which are mutually connected by means of a layer of core material;
  wherein
- the sandwich construction has a shear strength in the direction transversely of the plane in which the sandwich panel extends which, in a central part of the sandwich construction between the placed edges of the sandwich panel, is sufficient to withstand the shear force occurring in the sandwich construction as a result of the determined load transversely of the plane in which the floor extends, and which close to the edges to be placed is insufficient to withstand said shear force;
  wherein
- the sandwich panel is provided along each of the two edges thereof to be placed with at least one beam which mutually connects the two parallel skins and extends in the layer of core material from the associated edge in the direction of the opposite edge over a part of the distance between the two mutually opposite edges in order to increase the shear strength of the sandwich panel in the part of the sandwich construction in which said shear strength is insufficient to withstand said shear force;
  and wherein
- the beams do not extend in a central part of the sandwich construction between the edges of the sandwich panel to be placed.

[0038] In this floor according to the invention the beam is a profile beam. The profile beam is a beam comprising two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to one of the skins. Particularly suitable profile beams are an I-profile beam, U-profile beam and Z-profile beam.

[0039] The present invention is further elucidated hereinbelow on the basis of exemplary embodiments which are shown in the accompanying figures. These are non-limitative exemplary embodiments. In the figures:

Fig. 1 shows a top view of a floor element in the form of a self-supporting sandwich panel according to the invention in a first exemplary embodiment,
Fig. 2 shows a side view of the floor element according to fig. 1,
Fig. 3 shows a cross-section along line A-A in fig. 1,
Fig. 4 shows a top view of a floor element in the form of a self-supporting sandwich panel according to the invention in a second exemplary embodiment;
Fig. 5 shows a side view of the floor element according to fig. 4;
Fig. 6 shows a cross-section along line B-B in fig. 4;
Fig. 7 shows a side view of a floor element in the form of a self-supporting sandwich panel according to the invention in a third exemplary embodiment;
Fig. 8 shows a cross-section of the floor element of fig. 7.

[0040] Figures 1, 2 and 3 show a first exemplary embodiment of a floor element in the form of a self-supporting sandwich panel according to the invention in a first embodiment. As shown in fig. 1, this rectangular floor element 1 has a length l_1 and a width b_1. In the shown exemplary embodiment the length l_1 is about 4000 mm and a width b_1, is about 950 mm.

[0041] Such dimensions are typical for floor elements which are applied in house building and utility construction.

[0042] Floor element 1 has a first skin in the form of steel lower sheet 2 and a second skin in the form of a steel upper sheet 3. In the shown exemplary embodiment the thickness of lower sheet 2 is about 1 mm and the thickness of the steel upper sheet 3 is likewise about 1 mm. Arranged between the two sheets 2 and 3 is a layer of core material 4 which mutually connects the skins. In the shown exemplary embodiment the thickness of the layer of core material is about 140 mm, so that the total thickness d_1, as shown in figure 2, of floor element 1 amounts to about 142 mm. Lower sheet 2 and upper sheet 3 are glued to the layer of core material 4 with a suitable adhesive layer. Sheets 2 and 3 thus form a skin of the floor element.

[0043] Core material 4 consists of rockwool of a quality and density suitable for the relevant application, or of hard foam.

[0044] Upper sheet 3 can be provided on the upper side thereof with a layer of damping material or with a layer of pressure-distributing material. Lower sheet 1 can be provided on the underside thereof with a layer of fire-resistant material which can optionally serve as finishing layer.

[0045] Arranged in the layer of core material 4 between lower sheet 2 and upper sheet 3 are beams 5 which each extend in the layer of core material from an edge 1a, 1b of floor element 1 in the direction of the opposite edge. These beams 5 take the form of a U-shaped steel profile. In the shown exemplary embodiment the thickness of the parallel flanges and of the intermediate web of the U-profile beam is about 2 mm.

[0046] In the embodiment shown in figures 1-3 two U-

shaped profile beams 5 are glued between lower sheet 2 and upper sheet 3 on each short side of the elongate floor element 1, as shown in figure 3. The two beams 5 on each short side of floor element 1 extend in the layer of core material 4 over a part of the distance between the two mutually opposite edges 1a, 1b, i.e. over a part of the length l_1 of floor element 1. In the shown exemplary embodiment beams 5 extend transversely of the edges 1a, 1b on the short side of the rectangular floor element 1 and parallel to edges 1c, 1d on the long side of floor element 1.

[0047] As shown in figures 1-3, the length a_1 of each beam 5 is such that it extends from the associated edge 1a, 1b over only a part of the distance between the two opposite edges 1a, 1b. When floor element 1 is placed at edges 1a, 1b on the short side on a support construction embodied as supports 9, in the case of a uniformly distributed load the greatest shear force will occur transversely of upper sheet 3 close to the placing positions. The shear force will decrease to zero toward the centre of floor element 1, so halfway between the placing points. The danger of skins 2, 3 and core material 4 shearing when floor element 1 is loaded will then also decrease from the placing points to a position halfway between the placing points. Beams 5 are present in the area of floor element 1 where the shear force which occurs is greater than the maximum shear force which can be absorbed by skins 2, 3 and core material 4 before shearing. The length a_1 of each beam 5 follows from a calculation based on the shear strength of core material 4 and of skins 2, 3 on the one hand and the load occurring, including weight of floor element 1, on the other. In the central part of floor element 1, where the shear force which occurs is less than the shear force allowable on core material 4 and skins 2, 3, no beam 5 is necessary between lower sheet 2 and upper sheet 3.

[0048] In a realistic situation the length a_1 of the strengthening elements can amount to less than 800 mm in the case of a floor element 1 with a length l_1 of 4000 mm. Owing to the limited length of beams 5 the weight of floor element 1 will be relatively low. Owing to the light core material 4 applied, a weight of floor element 1 can also be realized of about 50 kg/m^2 with an allowable uniformly distributed load of 1.75 to 5.0 KN/m^2.

[0049] Floor element 1 is intended as floor element for application in dwellings and in utility construction. Formed in core material 4 in its longitudinal direction is a U-shaped recess 8 which runs along the whole length on both long sides 6 and 7. When a number of floor elements 1 are laid adjacently of each other in order to form a floor, U-shaped recesses 8 of mutually abutting floor elements 1 form a continuous channel in which can be received a resilient element, for instance in the form of a strip of fibre-reinforced material such as Permoxx, which ensures that adjoining floor elements 1 are coupled so as to achieve that no unequal sagging occurs in the boundary area between adjoining floor elements in the case of unequal load on adjoining floor elements 1.

[0050] Figures 4, 5 and 6 show a floor element 10 in the form of a second exemplary embodiment of a self-supporting sandwich panel according to the invention.

[0051] As shown in figure 4, this rectangular floor element 10 has a length l_2 and a width b_2. In the shown exemplary embodiment the length l_2 is about 7800 mm and a width b_2 about 950 mm. Such dimensions are typical for floor elements applied in the construction of parking garages.

[0052] Floor element 10 has a first skin constructed from a steel upper sheet 11 in combination with a pressure-distributing, fibre-reinforced layer 12, a second skin in the form of a steel lower sheet 14 and a layer of core material 13 which mutually connects the skins. The sheets and layers are connected to each other by means of glue layers. In this embodiment one of the skins is thus constructed from two layers, the steel upper sheet 11 and the pressure-distributing, fibre-reinforced layer 12.

[0053] In the shown exemplary embodiment the thickness of the steel upper sheet 11 is about 1.5 mm and the thickness of the steel lower sheet 14 about 0.9 mm. The pressure-distributing, fibre-reinforced layer 12 has a thickness of about 18 mm. A favourable material for this layer is known under the name Permoxx. The layer of core material 13 has a thickness of about 240 mm. The layer of core material is hard foam, for instance styrofoam or XPS. The overall thickness d_2 of floor element 10 thus amounts to about 260 mm.

[0054] Arranged in the layer of core material 13 between lower sheet 14 and the pressure-distributing, fibre-reinforced layer 12 are beams 15 which each extend in the layer of core material from an edge 10a, 10b of floor element 10 in the direction of the opposite edge. These beams 15 take the form of a U-shaped steel profile. In the exemplary embodiment shown in figures 4-6 two U-shaped profile beams 15 are glued between lower sheet 14 and the pressure-distributing, fibre-reinforced layer 12 on each short side of the elongate floor element 10. The two beams 15 on each short side of floor element 10 extend in core material 4 over a part of the distance between the two mutually opposite edges 10a, 10b, i.e. over a part of the length l_2 of floor element 10. In the shown exemplary embodiment beams 15 extend transversely of edges 10a, 10b on the short side of the rectangular floor element 10 and parallel to edges 10c, 10d on the long side of floor element 10.

[0055] As shown in figures 4-6, the length a_2 of each beam 15 is such that it extends from the associated edge 10a, 10b over only a part of the distance between the two opposite edges 10a, 10b. When floor element 10 is placed at edges 10a, 10b on the short side on a support construction embodied as supports 9, in the case of a uniformly distributed load the greatest shear force will occur transversely of upper sheet 11 close to the placing positions. The shear force will decrease to zero toward the centre of floor element 10, so halfway between the placing points. The danger of shearing of core material 13 and skins 11, 12, 14 when floor element 10 is loaded

will then also increase from the placing points to a position halfway between the placing points. Beams 15 are present in the area of floor element 10 where the shear force which occurs is greater than the maximum shear force which can be absorbed by core material 13 and skins 11, 12, 14 before shearing. The length a_2 of each beam 15 follows from a calculation based on the shear strength of core material 4 and skins 11, 12, 14 on the one hand and the load occurring, including weight of floor element 10, on the other. In the central part of floor element 10, where the shear force which occurs is less than the allowable shear force on core material 13 and skins 11, 12, 14, no beam 15 is necessary between lower sheet 14 and the pressure-distributing, fibre-reinforced layer 12.

[0056] In a realistic situation the length a_2 of beams 15 can be about 1600 mm in the case of a floor element 10 with a length l_2 of 7800 mm.

[0057] As in the exemplary embodiment shown in figures 1-3, a U-shaped recess 16 is formed on either side in core material 13 in the longitudinal direction thereof and runs along the whole length and serves to receive a spline for the purpose of moderating unequal bending of adjoining floor elements 10. Each floor element 10 supports with the edges on the short side thereof on supports 17.

[0058] The exemplary embodiment shown in figures 4-6 is particularly suitable for application as floor in a parking garage. The pressure-distributing layer 12 is important in this application, since it ensures that a point load, for instance when a vehicle is jacked up in case of breakdown, does not cause any strong local shear forces in the layer of core material 13.

[0059] Floor element 10 has a weight of about 58 kg/m^2 and is hereby much lighter than a similar metal/concrete floor for parking garages which is no lighter than 180-280 kg/m^2, as described in the periodical Bouwwereld (Construction World) 8 of 26 May 2009.

[0060] Figures 7 and 8 show respectively a side view and a cross-sectional view of a floor element 100 in the form of a self-supporting sandwich panel according to the invention in a third exemplary embodiment.

[0061] Floor element 100 shown in figures 7 and 8 is substantially the same as the floor element 1 as shown in figures 1-3. The difference is that an additional skin in the form of steel sheet 101 is connected to lower sheet 2 by means of an additional layer of core material 102. As shown, along the edges with which floor element 100 lies on supports 9 lower sheet 2 is free of the steel sheet 101 and the additional layer of core material 102. Lower sheet 2 hereby lies on supports 9.

[0062] The values stated in the above figure description in respect of dimensions, weights and loads are intended solely for the purpose of illustration and are by no means intended as limitative measure in the relevant exemplary embodiment.

[0063] The present invention is not limited to the above described exemplary embodiments. The rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

[0064] It is particularly noted that in the described exemplary embodiments two beams extend in each case in the layer of core material from two opposite edges. In the case of a load other than a uniformly distributed load it is alternatively possible for beams to extend in the layer of core material from only one edge in the direction of the opposite edge. It is additionally or alternatively also possible that only one beam extends in the layer of core material from an edge, or that more than two parallel beams lying at a mutual distance extend in the layer of core material from an edge.

Claims

1. Self-supporting sandwich panel (1; 10; 100) for construction of a floor placed on a support construction (9; 17), comprising:

   - two parallel skins (2, 3; 11, 12, 14) mutually connected by means of a layer of core material (4; 13);

   wherein

   - for the purpose of placing the sandwich panel on the support construction at least one of the edges (1a, 1b; 10a, 10b) of the sandwich panel is provided with at least one beam (5) which mutually connects the two parallel skins and which extends in the longitudinal direction of the panel in the layer of core material from the associated edge in the direction of an opposite edge;

   wherein

   - the beam (5) is a profile beam that comprises two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to a respective one of the skins (2, 3; 11, 12, 14);

   characterized in that

   - the length (a1; a2) of the beam is smaller than the distance (11; 12) between the opposite edges, such that the beam extends over a part of the distance between the two opposite edges.

2. Self-supporting sandwich panel as claimed in claim 1,
   wherein

   - the sandwich panel is rectangular and the at least one edge of the sandwich panel provided with at least one beam is an edge on the short side of the sandwich panel.

3. Self-supporting sandwich panel as claimed in claim 1 or 2,
   wherein

- two mutually opposite edges of the sandwich panel are each provided with at least one beam which mutually connects the two parallel skins and which extends in the layer of core material from the associated edge in the direction of an opposite edge over a part of the distance between the two opposite edges.

4. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- the layer of core material is a layer of rockwool, preferably a layer of rockwool lamellas, or a layer of hard foam.

5. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- the parallel skins comprise steel sheets.

6. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- at least one of the parallel skins comprises a layer (12) of pressure-distributing material, wherein the layer of pressure-distributing material is preferably a layer of magnesium oxide in a binding agent or is a layer of fibre-reinforced material.

7. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- the sandwich panel comprises an additional skin (101) which is connected by means of an additional layer of core material (102) to one (2) of the skins and extends parallel to the skins, wherein the skin (2) to which the additional skin (101) is connected by means of the additional layer of core material (102) is free of the additional skin and the additional layer of core material along the at least one edge provided with the at least one beam.

8. Self-supporting sandwich panel as claimed in any of claims 1 to 7, wherein the profile beam is more preferably one of an I-profile, U-profile (5) and Z-profile.

9. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- an edge (6, 7) of the sandwich panel other than the at least one edge (1a, 1b) provided with the at least one beam is configured to couple the sandwich panel to an adjacent sandwich panel, wherein the sandwich panel is preferably provided along the associated edge with a U-shaped recess (8) in which a coupling element can be received for coupling the associated edge to an edge of an adjacent sandwich panel.

10. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- at least one of the skins has perforations, particularly perforations distributed uniformly over the surface of the associated skin.

11. Self-supporting sandwich panel as claimed in any of the foregoing claims, wherein

- a fire-resistant layer is arranged on at least one of the skins.

12. Floor construction, comprising:

- a support construction (9, 17); and
- a self-supporting sandwich panel (1, 10, 100) as claimed in any of the foregoing claims placed on the support construction, wherein the sandwich panel is placed on the support construction with an edge (1a, 1b) provided with the at least one beam.

13. Method for manufacturing a self-supporting sandwich panel (1, 10, 100), comprising the steps of:

- mutually connecting two parallel skins (2, 3; 11, 12, 14) by means of a layer of core material (4, 13), wherein at least one of the edges (1a, 1b) of the sandwich panel is provided with at least one beam (5) which mutually connects the two parallel skins and which extends longitudinally in the layer of core material from the associated edge in the direction of an opposite edge; wherein
- the beam is a profile beam that comprises two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to a respective one of the skins;

characterized in that

- the length (a1; a2) of the beam is smaller than the distance (l1, l2) between the opposite edges, such that the beam extends over a part of the distance between the two opposite edges.

14. Method for constructing a floor placed on a support

construction (9; 17) and designed for a determined load transversely of the direction in which floor extends, comprising of providing at least one sandwich panel (1; 10; 100) which is placed at two opposite edges (1a, 1b) on the support construction in order to form the floor;
wherein

- the sandwich panel comprises a sandwich construction of two parallel skins (2, 3; 11, 12, 14) mutually connected by means of a layer of core material (4; 13);

wherein

- the sandwich construction is designed with a shear strength in the direction transversely of the plane in which the sandwich panel extends which, in a central part of the sandwich construction between the edges (1a, 1b) of the sandwich panel to be placed, is sufficient to withstand the shear force occurring in the sandwich construction as a result of the determined load transversely of the plane in which the floor for forming extends, and which close to the edges to be placed is insufficient to withstand said shear force;

wherein

- the sandwich panel is provided along each of the two edges (1a, 1b) thereof to be placed with at least one beam (5) which mutually connects the two parallel skins and which extends longitudinally in the layer of core material from the associated edge in the direction of the opposite edge in order to increase the shear strength of the sandwich panel;

wherein

- the beams are profile beams that each comprise two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to a respective one of the skins;

wherein

- the length (a1; a2) of the beams is smaller than the distance (l1; l2) between the opposite edges, such that the beams extends over a part of the distance between the two mutually opposite edges in order to increase the shear strength of the sandwich panel in the part of the sandwich construction in which said shear strength is insufficient to withstand said shear force;

and wherein

- the beams do not extend in at least a part of the central part of the sandwich construction between the edges of the sandwich panel to be placed , such that in at least part of the sandwich construction in which said shear strength is sufficient to withstand said shear force the sandwich panel is free of a beam which mutually connects the two parallel skins and which extends longitudinally in the layer of core material between the opposite edges.

15. Floor, comprising at least one sandwich panel (1; 10; 100) which is placed at two opposite edges (1a, 1b) on a support construction, the floor being designed for a determined load transversely of the direction in which the floor extends; wherein

- the sandwich panel comprises a sandwich construction of two parallel skins (2, 3; 11, 12, 14) which are mutually connected by means of a layer of core material (4; 13);

wherein

- the sandwich construction has a shear strength in the direction transversely of the plane in which the sandwich panel extends which, in a central part of the sandwich construction between the placed edges of the sandwich panel, is sufficient to withstand the shear force occurring in the sandwich construction as a result of the determined load transversely of the plane in which the floor extends, and which close to the edges to be placed is insufficient to withstand said shear force;

wherein

- the sandwich panel is provided along each of the two edges thereof to be placed with at least one beam (5) which mutually connects the two parallel skins and extends longitudinally in the layer of core material from the associated edge in the direction of the opposite edge in order to increase the shear strength of the sandwich panel;

wherein

- the beams are profile beams that each comprise two parallel flanges which are mutually connected by means of a web, wherein each flange is fixed to a respective one of the skins;

wherein

- the length (a1; a2) of the beams is smaller than the distance (l1; l2) between the opposite edges,

such that the beams extend over a part of the distance between the two mutually opposite edges in order to increase the shear strength of the sandwich panel in the part of the sandwich construction in which said shear strength is insufficient to withstand said shear force;

and wherein

- the beams do not extend in at least a part of the central part of the sandwich construction between the edges of the sandwich panel to be placed, such that in at least part of the sandwich construction in which said shear strength is sufficient to withstand said shear force the sandwich panel is free of a beam which mutually connects the two parallel skins and which extends longitudinally in the layer of core material between the opposite edges.

Patentansprüche

1. Selbsttragendes Sandwichpaneel (1; 10; 100) zur Herstellung eines Bodens, welches auf eine Tragekonstruktion (9; 17) platziert ist, umfassend:

- zwei parallele Außenhäute (2, 3; 11, 12, 14), die über eine Schicht aus Kernmaterial (4; 13) miteinander verbunden sind;

wobei

- zum Zwecke des Platzierens des Sandwichpaneels auf der Tragekonstruktion wenigstens eine der Kanten (1a, 1b; 10a, 10b) des Sandwichpaneels mit wenigstens einem Träger (5) versehen ist, der die beiden parallelen Außenhäute miteinander verbindet und der sich in Längsrichtung des Paneels in der Schicht aus Kernmaterial von der dazugehörigen Kante in der Richtung einer gegenüberliegenden Kante erstreckt;

wobei

- der Träger (5) ein Profilträger ist, der zwei parallele Flansche umfasst, die über einen Steg miteinander verbunden sind, wobei jeder Flansch an einer jeweiligen der Außenhäute (2, 3; 11, 12, 14) fixiert ist;

dadurch gekennzeichnet, dass

- die Länge (a1; a2) des Trägers kleiner ist als die Distanz (l1; l2) zwischen den gegenüberliegenden Kanten, derart, dass sich der Träger über einen Teil der Distanz zwischen den beiden gegenüberliegenden Kanten erstreckt.

2. Selbsttragendes Sandwichpaneel nach Anspruch 1, wobei

- das Sandwichpaneel rechtwinklig ist und die wenigstens eine mit dem wenigstens einen Träger versehene Kante des Sandwichpaneels eine Kante an der kurzen Seite des Sandwichpaneels ist.

3. Selbsttragendes Sandwichpaneel nach Anspruch 1 oder 2, wobei

- zwei einander gegenüberliegende Kanten des Sandwichpaneels jeweils mit wenigstens einem Träger versehen sind, der die beiden parallelen Außenhäute miteinander verbindet und der sich in der Schicht aus Kernmaterial von der dazugehörigen Kante in der Richtung einer gegenüberliegenden Kante um einen Teil der Distanz zwischen den beiden gegenüberliegenden Kanten erstreckt.

4. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- die Schicht aus Kernmaterial eine Schicht aus Steinwolle, vorzugsweise eine Schicht aus Steinwolle-Lamellen oder eine Schicht aus Hartschaumstoff ist.

5. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- die parallelen Außenhäute Stahlbleche umfassen.

6. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- wenigstens eine der parallelen Außenhäute eine Schicht (12) aus Druck verteilendem Material umfasst, wobei die Schicht aus Druck verteilendem Material vorzugsweise eine Schicht aus Magnesiumoxid in einem Bindemittel oder eine Schicht aus faserverstärktem Material ist.

7. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- das Sandwichpaneel eine zusätzliche Außenhaut (101) umfasst, die mit Hilfe einer zusätzlichen Schicht aus Kernmaterial (102) mit einer (2) der Außenhäute verbunden ist und sich parallel zu den Außenhäuten erstreckt, wobei die Außenhaut (2), mit der die über die zusätzliche Schicht aus Kernmaterial (102) zusätzliche Au-

ßenhaut (101) verbunden ist, frei von der zusätzlichen Außenhaut ist, sowie der zusätzlichen Schicht aus Kernmaterial, entlang der wenigstens einen Kante, die mit dem wenigstens einem Träger versehen ist.

8. Selbsttragendes Sandwichpaneel nach einem der Ansprüche 1 bis 7, wobei der Profilträger bevorzugter einer aus einem I-Profil, U-Profil (5) oder Z-Profil ist.

9. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- eine Kante (6, 7) des Sandwichpaneels, die nicht die wenigstens eine mit dem wenigstens einen Träger versehene Kante (1a, 1b) ist, derart ausgestaltet ist, dass sie das Sandwichpaneel mit einem benachbarten Sandwichpaneel koppelt, wobei das Sandwichpaneel vorzugsweise entlang der dazugehörigen Kante mit einer U-förmigen Ausnehmung (8) versehen ist, in der ein Kopplungselement aufnehmbar ist zum Koppeln der dazugehörigen Kante mit einer Kante eines benachbarten Sandwichpaneels.

10. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- wenigstens eine der Außenhäute Perforationen hat, insbesondere Perforationen, die gleichmäßig über die Oberfläche der dazugehörigen Außenhaut verteilt sind.

11. Selbsttragendes Sandwichpaneel nach einem der vorstehenden Ansprüche, wobei

- eine feuerbeständige Schicht an wenigstens einer der Außenhäute angeordnet ist.

12. Bodenkonstruktion, umfassend:

- eine Tragekonstruktion (9, 17); und
- ein selbsttragendes Sandwichpaneel (1, 10, 100) nach einem der vorstehenden Ansprüche, das auf der Tragekonstruktion platziert ist, wobei das Sandwichpaneel auf der Tragekonstruktion platziert ist mit einer Kante (1a, 1b), die mit dem wenigstens einem Träger versehen ist.

13. Verfahren zur Herstellung eines selbsttragenden Sandwichpaneels (1, 10, 100), umfassend die Schritte:

- miteinander Verbinden zweier paralleler Außenhäute (2, 3; 11, 12, 14) mit Hilfe einer Schicht aus Kernmaterial (4, 13), wobei wenigstens eine der Kanten (1a, 1b) des Sandwichpaneels mit wenigstens einem Träger (5) versehen ist, der die beiden Außenhäute miteinander verbindet und der sich in Längsrichtung in der Schicht aus Kernmaterial von der dazugehörigen Kante in der Richtung einer gegenüberliegenden Kante erstreckt;

wobei

- der Träger ein Profilträger ist, der zwei parallele Flansche umfasst, die mit Hilfe eines Stegs miteinander verbunden sind, wobei jeder Flansch an einer jeweiligen der Außenhäute fixiert ist;

dadurch gekennzeichnet, dass

- die Länge (a1; a2) des Trägers kleiner ist als die Distanz (11,12) zwischen den gegenüberliegenden Kanten, derart, dass sich der Träger über einen Teil der Distanz zwischen den beiden gegenüberliegenden Kanten erstreckt.

14. Verfahren zur Herstellung eines Bodens, der auf einer Trägerkonstruktion (9; 17) platziert und ausgestaltet ist für eine vorbestimmte Last, transversal zu der Richtung, in der sich der Boden erstreckt, umfassend das Vorsehen von wenigstens einem Sandwichpaneel (1; 10; 100), das an zwei gegenüberliegenden Kanten (1a, 1b) auf der Tragekonstruktion platziert ist, um den Boden auszubilden;
wobei

- das Sandwichpaneel eine Sandwichkonstruktion umfasst aus zwei parallelen Außenhäuten (2, 3; 11, 12, 14), die über eine Schicht aus Kernmaterial (4; 13) miteinander verbunden sind;

wobei

- die Sandwichkonstruktion ausgestaltet ist mit einer Scherfestigkeit in der Richtung transversal zur Ebene, in der sich das Sandwichpaneel erstreckt, die in einem zentralen Teil der Sandwichkonstruktion zwischen den Kanten (1a, 1b) des zu platzierenden Sandwichpaneels ausreichend ist, um der Scherkraft zu widerstehen, die in der Sandwichkonstruktion auftritt in Folge der vorbestimmten Last transversal zur Ebene, in der sich der auszubildende Boden erstreckt und die nahe der zu platzierenden Kanten unzureichend ist, um der Scherkraft zu widerstehen;

wobei

- das Sandwichpaneel entlang jeder seiner beiden zu platzierenden Kanten (1a, 1b) mit wenigstens einem Träger (5) versehen ist, der die beiden parallelen Außenhäute miteinander ver-

bindet und der sich in Längsrichtung in der Schicht aus Kernmaterial von der dazugehörigen Kante in der Richtung der gegenüberliegenden Kante erstreckt, um die Scherfestigkeit des Sandwichpaneels zu erhöhen;

wobei

- die Träger Profilträger sind, die jeweils zwei parallele Flansche umfassen, die über einen Steg miteinander verbunden sind, wobei jeder Flansch an einer jeweiligen der Außenhäute befestigt ist;

wobei

- die Länge (a1; a2) der Träger kleiner ist als die Distanz (l1; l2) zwischen den gegenüberliegenden Kanten derart, dass die Träger sich über einen Teil der Distanz zwischen den beiden einander gegenüberliegenden Kanten erstreckt, um die Scherfestigkeit des Sandwichpaneels mit dem Teil der Sandwichkonstruktion zu erhöhen, in dem die Scherfestigkeit nicht ausreichend ist, um der Scherkraft zu widerstehen;

und wobei

- die Träger sich nicht in wenigstens einen Teil des zentralen Teils der Sandwichkonstruktion zwischen den Kanten des zu platzierenden Sandwichpaneels erstrecken, derart, dass in wenigstens einem Teil der Sandwichkonstruktion, in dem die Scherfestigkeit nicht ausreichend ist, um der Scherkraft zu widerstehen, das Sandwichpaneel frei von einem Träger ist, der die beiden parallelen Außenhäute miteinander verbindet und der sich in Längsrichtung in der Schicht aus Kernmaterial zwischen den gegenüberliegenden Kanten erstreckt.

15. Boden, umfassend wenigstens ein Sandwichpaneel (1; 10; 100), das an zwei gegenüberliegenden Kanten (1a, 1b) auf einer Trägerkonstruktion platziert ist, wobei der Boden ausgestaltet ist für eine vorbestimme Last, transversal zu der Richtung, in der sich der Boden erstreckt;
wobei

- das Sandwichpaneel eine Sandwichkonstruktion aus zwei parallelen Außenhäuten (2, 3; 11, 12, 14) umfasst, die mit Hilfe einer Schicht aus Kernmaterial (4; 13) miteinander verbunden sind;

wobei

- die Sandwichkonstruktion eine Scherfestigkeit in der Richtung transversal zu der Ebene hat, in der sich das Sandwichpaneel erstreckt, die in einem zentralen Teil der Sandwichkonstruktion zwischen den platzierten Kanten des Sandwichpaneels ausreichend ist, um der Scherkraft zu widerstehen, die in der Sandwichkonstruktion auftritt als Folge der vorbestimmten Last transversal zu der Ebene, in der sich der Boden erstreckt und die in der Nähe der zu platzierenden Kanten nicht ausreichend ist, um der Scherkraft zu widerstehen;

wobei

- das Sandwichpaneel entlang jeder seiner beiden zu platzierenden Kanten mit wenigstens einem Träger (5) versehen ist, der die beiden parallelen Außenhäute miteinander verbindet und sich in Längsrichtung in der Schicht aus Kernmaterial von der dazugehörigen Kante in der Richtung der gegenüberliegenden Kante erstreckt, um die Scherfestigkeit des Sandwichpaneels zu erhöhen;

wobei

- die Träger Profilträger sind, von denen jeder zwei parallele Flansche umfasst, die mit Hilfe eines Stegs miteinander verbunden sind, wobei jeder Flansch an einer jeweiligen der Außenhäute fixiert ist;

wobei

- die Länge (a1; a2) der Träger kleiner ist als die Distanz (l1; l2) zwischen den gegenüberliegenden Kanten, derart, dass sich die Träger über einen Teil der Distanz zwischen den beiden einander gegenüberliegenden Kanten erstrecken, um die Scherfestigkeit des Sandwichpaneels in dem Teil der Sandwichkonstruktion zu erhöhen, in dem die Scherfestigkeit nicht ausreichend ist, um der Scherkraft zu widerstehen;

und wobei

- die Träger sich nicht in wenigstens einem Teil des zentralen Teils der Sandwichkonstruktion zwischen den Kanten des zu platzierenden Sandwichpaneels erstrecken, derart, dass in wenigstens einem Teil der Sandwichkonstruktion, in dem die Scherfestigkeit ausreichend ist, um der Scherkraft zu widerstehen, das Sandwichpaneel frei von einem Träger ist, der die beiden parallelen Außenhäute miteinander verbindet und der sich in Längsrichtung in der Schicht aus Kernmaterial zwischen den gegenüberliegenden Kanten erstreckt.

Revendications

1. Panneau sandwich autoporteur (1 ; 10 ; 100) pour la construction d'un plancher posé sur une structure de support (9 ; 17), comprenant :

- deux peaux parallèles (2, 3 ; 11, 12, 14) mutuellement reliées au moyen d'une couche de matériau d'âme (4 ; 13) ;

dans lequel

- dans le but de poser le panneau sandwich sur la structure de support, au moins un des bords (1a, 1b ; 10a, 10b) du panneau sandwich est pourvu d'au moins une poutre (5) qui relie mutuellement les deux peaux et qui s'étend dans la direction longitudinale du panneau dans la couche de matériau d'âme à partir du bord associé dans la direction d'un bord opposé ;

dans lequel

- la poutre (5) est une poutre de profilé qui comprend deux brides parallèles qui sont mutuellement reliées au moyen d'une âme, dans lequel chaque bride est fixée à l'une respective des peaux (2, 3 ; 11, 12, 14) ;

caractérisé en ce que

- la longueur (a1 ; a2) de la poutre est inférieure à la distance (11 ; 12) entre les bords opposés, de telle sorte que la poutre s'étend sur une partie de la distance entre les deux bords opposés.

2. Panneau sandwich autoporteur selon la revendication 1, dans lequel

- le panneau sandwich est rectangulaire et l'au moins un bord du panneau sandwich pourvu d'au moins une poutre est un bord sur le côté court du panneau sandwich.

3. Panneau sandwich autoporteur selon la revendication 1 ou 2, dans lequel

- deux bords mutuellement opposés du panneau sandwich sont pourvus chacun d'au moins une poutre qui relie mutuellement les deux peaux parallèles et qui s'étend dans la couche de matériau d'âme à partir du bord associé dans la direction d'un bord opposé sur une partie de la distance entre les deux bords opposés.

4. Panneau sandwich autoporteur selon l'une quelconque des revendications précédentes, dans lequel

- la couche de matériau d'âme est une couche de laine de roche, de préférence une couche de lamelles de laine de roche, ou une couche de mousse dure.

5. Panneau sandwich autoporteur selon l'une quelconque des revendications précédentes, dans lequel

- les peaux parallèles comprennent des tôles d'acier.

6. Panneau sandwich autoporteur selon l'une quelconque des revendications précédentes, dans lequel

- au moins une des peaux parallèles comprend une couche (12) de matériau de répartition de la pression, dans lequel la couche de matériau de répartition de la pression est de préférence une couche d'oxyde de magnésium dans un agent liant ou est une couche de matériau renforcé de fibres.

7. Panneau sandwich autoporteur selon l'une quelconque des revendications précédentes, dans lequel

- le panneau sandwich comprend une peau supplémentaire (101) qui est reliée au moyen d'une couche supplémentaire de matériau d'âme (102) à l'une (2) des peaux et s'étend parallèlement aux peaux, dans lequel la peau (2) à laquelle la peau supplémentaire (101) est reliée au moyen de la couche supplémentaire de matériau d'âme (102) est exempte de la peau supplémentaire et de la couche supplémentaire de matériau d'âme le long de l'au moins un bord pourvu de l'au moins une poutre.

8. Panneau sandwich autoporteur selon l'une quelconque des revendications 1 à 7, dans lequel la poutre de profilé est de manière davantage préférée l'un parmi un profilé en I, un profilé en U (5) et un profilé en Z.

9. Panneau sandwich autoporteur selon l'une quelconque des revendications précédentes, dans lequel

- un bord (6, 7) du panneau sandwich autre que l'au moins un bord (1a, 1b) pourvu de l'au moins une poutre est configuré pour coupler le panneau sandwich à un panneau sandwich adjacent, dans lequel le panneau sandwich est de préférence pourvu le long du bord associé d'un évidement en forme de U (8) dans lequel un élément d'accouplement peut être reçu pour accoupler le bord associé à un bord d'un panneau sandwich adjacent.

10. Panneau sandwich autoporteur selon l'une quelcon-

que des revendications précédentes, dans lequel

- au moins une des peaux présente des perforations, en particulier des perforations réparties uniformément sur la surface de la peau associée.

11. Panneau sandwich autoporteur selon l'une quelconque des revendications précédentes, dans lequel

- une couche ignifuge est agencée sur au moins une des peaux.

12. Structure de plancher, comprenant :

- une structure de support (9, 17) ; et
- un panneau sandwich autoporteur (1, 10, 100) selon l'une quelconque des revendications précédentes, posé sur la structure de support, dans lequel le panneau sandwich est posé sur la structure de support avec un bord (1a, 1b) pourvu de l'eau moins une poutre.

13. Procédé de fabrication d'un panneau sandwich autoporteur (1, 10, 100), comprenant les étapes de :

- la liaison mutuelle de deux peaux parallèles (2, 3 ; 11, 12, 14) au moyen d'une couche de matériau d'âme (4, 13), dans lequel au moine un des bords (1a, 1b) du panneau sandwich est pourvu d'au moins une poutre (5) qui relie mutuellement les deux peaux parallèles et qui s'étend longitudinalement dans la couche de matériau d'âme à partir du bord associé dans la direction d'un bord opposé ;

dans lequel

- la poutre est une poutre de profilé qui comprend deux brides respectives qui sont mutuellement reliées au moyen d'une âme, dans lequel chaque bride est fixée à l'une respective des peaux ;

caractérisé en ce que
la longueur (a1 ; a2) de la poutre est inférieure à la distance (11, 12) entre les bords opposés, de telle sorte que la poutre s'étend sur une partie de la distance entre les bords opposés.

14. Procédé de construction d'un plancher posé sur une structure de support (9 ; 17) et conçu pour une charge déterminée transversalement à la direction dans laquelle s'étend le plancher, comprenant la fourniture d'au moins un panneau sandwich (1 ; 10 ; 100) qui est posé au niveau de deux bords opposés (1a, 1b) sur la structure de support afin de former le plancher ;
dans lequel

- le panneau sandwich comprend une structure en sandwich de deux peaux parallèles (2, 3 ; 11, 12, 14) mutuellement reliées au moyen d'une couche de matériau d'âme (4 ; 13) ;

dans lequel

- la structure en sandwich est conçue avec une résistance au cisaillement dans la direction transversale au plan dans lequel s'étend le panneau sandwich, laquelle, dans une partie centrale de la structure en sandwich entre les bords (1a, 1b) du panneau sandwich à poser, est suffisante pour supporter la force de cisaillement se produisant dans la structure en sandwich en résultat de la charge déterminée transversalement au plan dans lequel s'étend le plancher à former, et laquelle, à proximité des bords à poser, est insuffisante pour supporter ladite force de cisaillement ;

dans lequel

- le panneau sandwich est doté le long de chacun des deux bords (1a, 1b) de celui-ci à poser, d'au moins une poutre (5), laquelle relie mutuellement les deux peaux parallèles et qui s'étend longitudinalement dans la couche de matériau d'âme à partir du bord associé dans la direction du bord opposé afin d'accroître la résistance au cisaillement du panneau sandwich ;

dans lequel

- les poutres sont des poutres de profilé dont chacune comprend deux brides parallèles qui sont mutuellement reliées au moyen d'une âme, dans lequel chaque bride est fixée à l'une respective des peaux ;

dans lequel

- la longueur (a1 ; a2) des poutres est inférieure à la distance (11 ; 12) entre les bords opposés, de telle sorte que les poutres s'étendent sur une partie de la distance entre les deux bords mutuellement opposés afin d'accroître la résistance au cisaillement du panneau sandwich dans la partie de la structure en sandwich dans laquelle ladite résistance au cisaillement est insuffisante pour supporter ladite force de cisaillement ;

et dans lequel

- les poutres ne s'étendent pas dans au moins une partie de la partie centrale de la structure en sandwich entre les bords du panneau sand-

wich à poser, de telle sorte que dans au moins une partie de la structure en sandwich dans laquelle la résistance au cisaillement est suffisante pour supporter ladite force de cisaillement, le panneau sandwich est exempt d'une poutre qui relie mutuellement les deux peaux parallèles et qui s'étend longitudinalement dans la couche de matériau d'âme entre les bords opposés.

15. Plancher, comprenant au moins un panneau sandwich (1 ; 10 ; 100) qui est posé au niveau de deux bords opposés (1a, 1b) sur une structure de support, le plancher étant conçu pour une charge prédéterminée transversalement à la direction dans laquelle s'étend le plancher ; dans lequel

- le panneau sandwich comprend une structure en sandwich de deux peaux parallèles (2, 3 ; 11, 12, 14) qui sont mutuellement reliées au moyen d'une couche de matériau d'âme (4 ; 13) ;

dans lequel

- la structure en sandwich présente une résistance au cisaillement dans la direction transversalement au plan dans lequel s'étend le panneau sandwich, laquelle dans une partie centrale de la structure en sandwich entre les bords posés du panneau sandwich, est suffisante pour supporter la force de cisaillement se produisant dans la structure en sandwich en résultat de la charge déterminée transversalement au plan dans lequel s'étend le panneau sandwich, et laquelle à proximité des bords à poser est insuffisante pour supporter ladite force de cisaillement ;

dans lequel

- le panneau sandwich est pourvu le long de chacun de ses deux bords à poser d'au moins une poutre (5) qui relie mutuellement les deux peaux parallèles et s'étend longitudinalement dans la couche de matériau d'âme à partir du bord associé dans la direction du bord opposé afin d'accroître la résistance au cisaillement du panneau sandwich ;

dans lequel

- les poutres sont des poutres de profilé dont chacune comprend deux brides parallèles qui sont mutuellement reliées au moyen d'une âme, dans lequel chaque bride est fixée à une respective des peaux ;

dans lequel

- la longueur (a1 ; a2) des poutres est inférieure à la distance (11 ; 12) entre les bords opposés, de telle sorte que les poutres s'étendent sur une partie de la distance entre les deux bords mutuellement opposés de sorte à accroître la résistance au cisaillement du panneau sandwich dans la partie de la structure en sandwich dans laquelle ladite résistance au cisaillement est insuffisante pour supporter ladite force de cisaillement ;

et dans lequel

- les poutres ne s'étendent pas dans au moins une partie de la partie centrale de la structure en sandwich entre les bords du panneau sandwich à poser, de telle sorte que dans au moins une partie de la structure en sandwich dans laquelle ladite résistance au cisaillement est suffisante pour supporter ladite force de cisaillement, le panneau sandwich est exempt d'une poutre qui relie mutuellement les deux peaux parallèles et qui s'étend longitudinalement dans la couche de matériau d'âme entre les bords opposés.

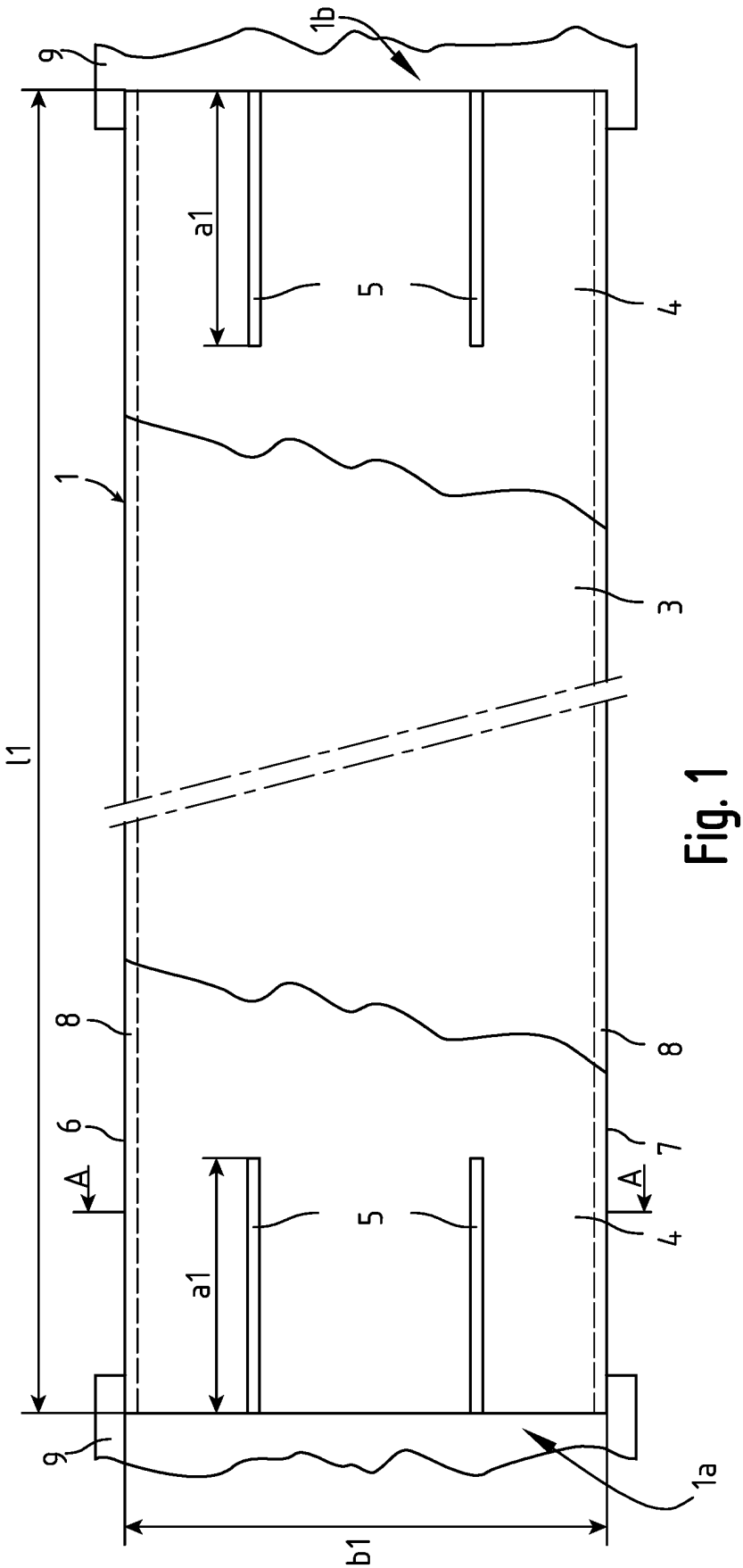

Fig. 1

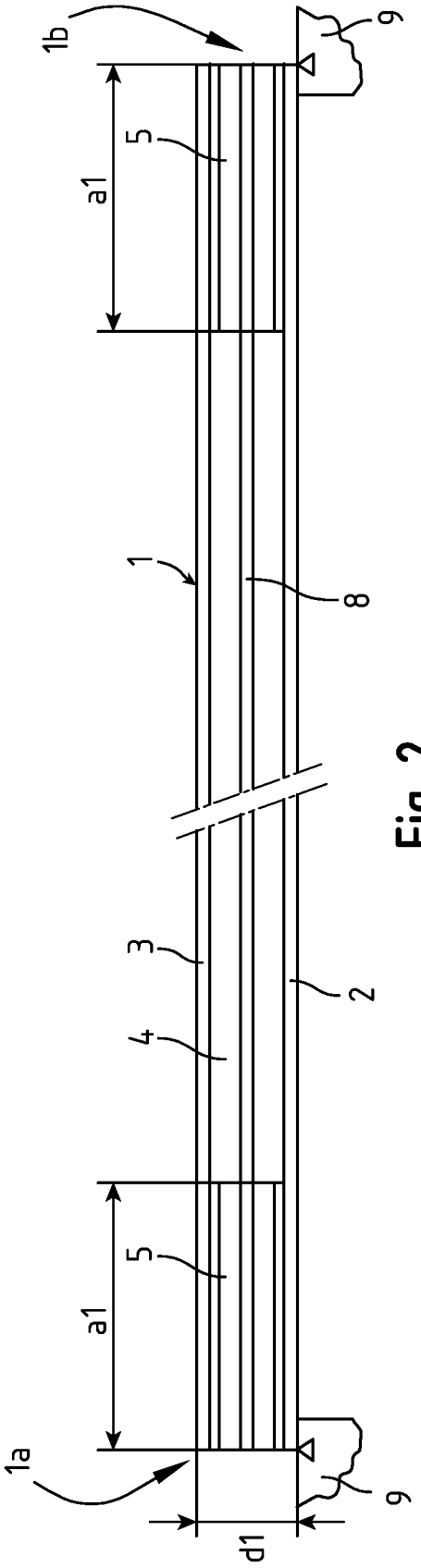

Fig. 2

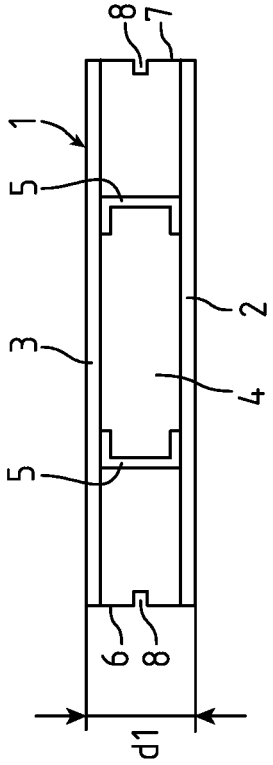

Fig. 3

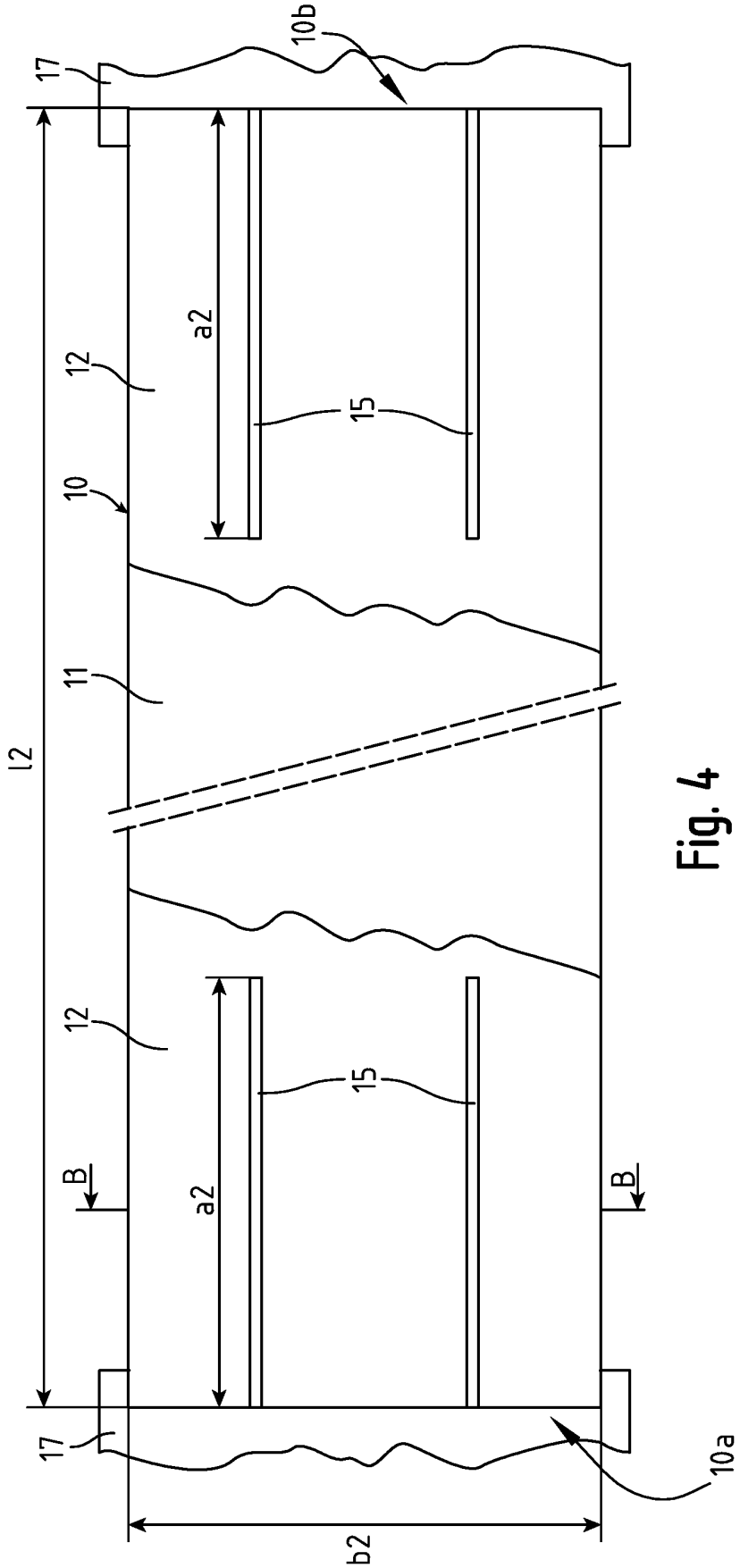

Fig. 4

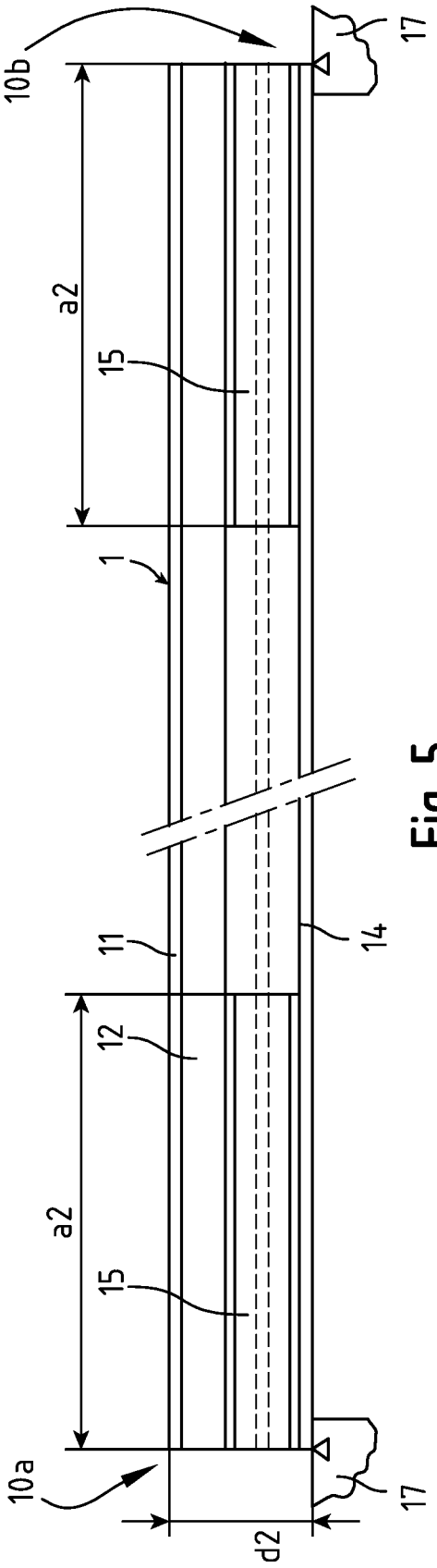

Fig. 5

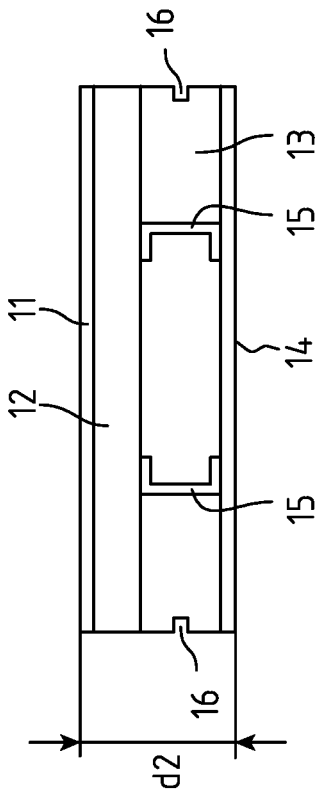

Fig. 6

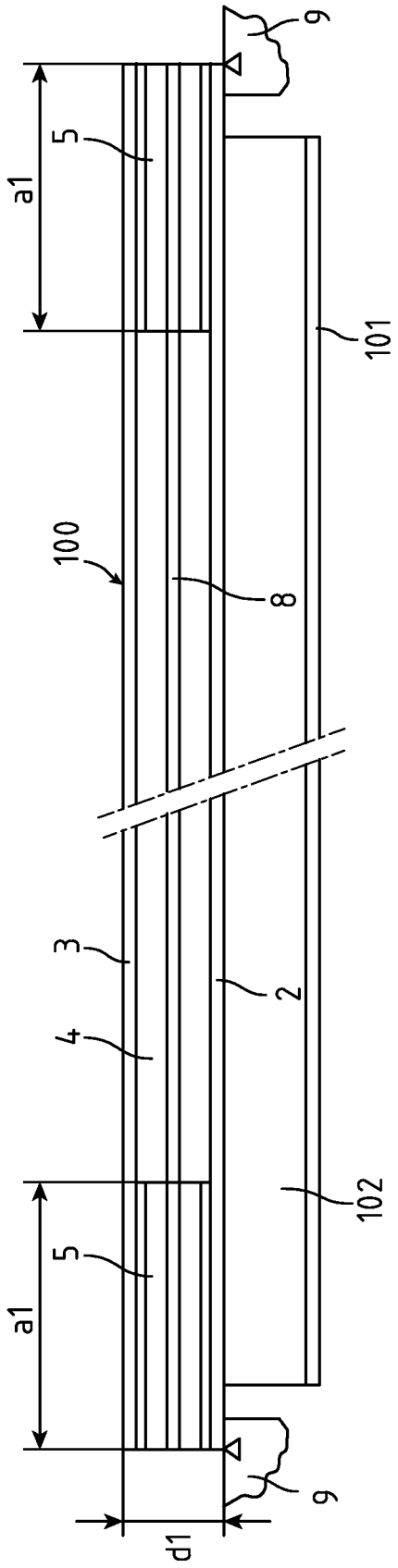

Fig. 7

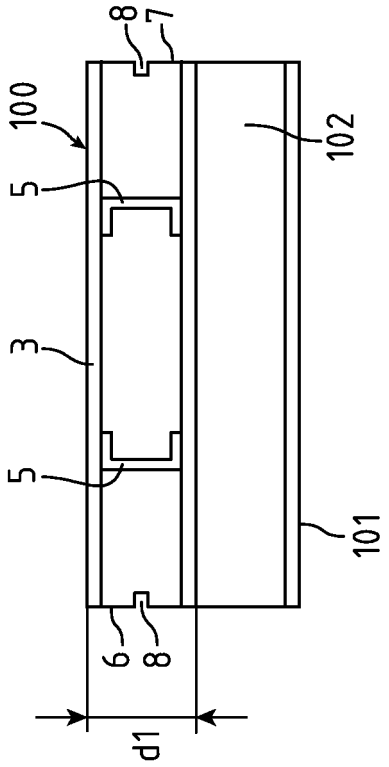

Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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