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(54) INSULATING WALL ELEMENT FOR LOAD BEARING WALLS

(57) The invention relates to an insulating wall element (1) for load-bearing walls of buildings, wherein said insulated wall element (1) comprises an inner, rigid insulating core (2) of a foam insulation material which rigid insulating core (2) has opposing side surfaces (11, 12), and a first support arrangement (10a) and a second support arrangement (10b) arranged at each their opposite side surfaces (11, 12) of said insulating core (2). Each of said support arrangements (10a, 10b) comprises a plurality of substantially vertical support beams (3) arranged with a mutual distance, thereby providing one or more spaces (7) between said plurality of support beams (3), and a rigid intermediate foam insulation material (4) arranged in each space (7) between two adjoining support beams (3) of said support arrangement (10a, 10b), which intermediate foam insulation material (4) borders the support beams (3) providing said one or more spaces (7). The invention moreover relates to a building and a method of producing an insulating wall element.

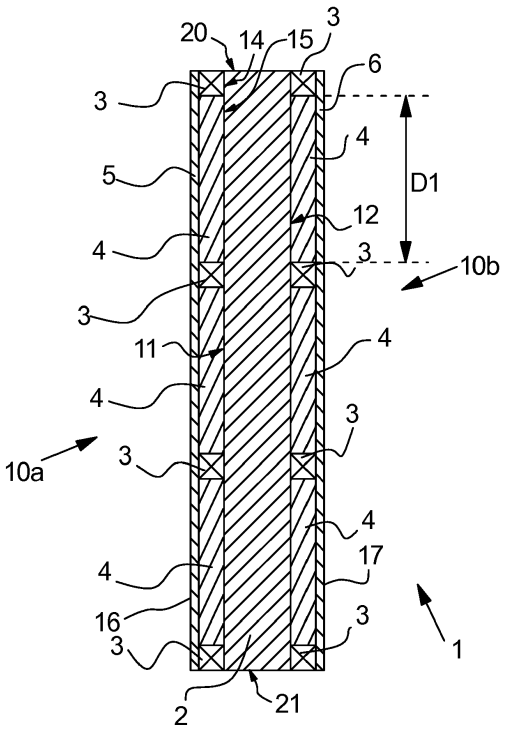


Fig. 1

EP 3 115 524 A1

Description

[0001] The present invention relates to an insulating wall element for load-bearing walls of building, a building comprising outer walls made from wall elements, and a method of producing an insulating wall element.

Background

[0002] Different types of insulated, prefabricated wall elements are known. These may comprise cover plates arranged at opposing sides of an insulation layer. For example, EP 2 369 084 A2 discloses a wall panel for construction of a building. The panel comprises a frame structure and an insulating core arranged between face sheets, where the face sheets have fireproofing properties.

[0003] Such wall elements however suffer from drawbacks as they may often be rather complex in nature and thus cost expensive and time consuming to produce, and may moreover demand increased skills of the persons erecting/installing the wall elements.

[0004] Moreover, the load-bearing capacity of known prefabricated wall elements is limited or is obtained at the cost of undesirable insulation properties and/or increase in wall thickness and/or other drawbacks.

[0005] Also, the fire-resistance of prefabricated load bearing wall elements may be at a low level which provides significant drawbacks due to safety issues.

[0006] WO 95/34721 discloses another type of wall elements. This wall element comprises load bearing studs arranged in grooves in a cellular plastic board, where the studs are fixed by means of through-going nails or the like to an element on the other side of the plastic board.

[0007] NO151251B discloses a building element having thin cover elements and an intermediate insulating core, where load bearing pillars are casted or glued to the inner surface of plates.

[0008] The above mentioned disclosed solutions may e.g. suffer from drawbacks in relation to fire-resistance, in relation to strength of the element, and/or in relation to insulation properties.

[0009] It is an object of the invention to provide an insulated wall element solving e.g. one or more of the above mentioned issues.

The invention

[0010] The invention relates to an insulating wall element for load-bearing walls of buildings, wherein said insulated wall element comprises:

an inner, rigid insulating core of a foam insulation material which rigid insulating core has opposing side surfaces, and a first support arrangement and a second support arrangement arranged at each their opposite side surfaces of said insulating core, wherein each of said support arrangements comprises:

a plurality of substantially vertical support beams arranged with a mutual distance, thereby providing one or more spaces between said plurality of support beams, and

a rigid intermediate foam insulation material arranged in each space between two adjoining support beams of said support arrangement, which intermediate foam insulation material borders the support beams providing said one or more spaces,

wherein said support beams are attached to said insulating core.

[0011] In preferred aspects of the invention, the support beams are attached to said insulating core, by means of an adhesive layer. This may in advantageous aspects of the invention e.g. be provided by an adhesive layer of a glue applied between the surfaces of the insulating core and the support beam.

[0012] The present invention provides a space saving, load-bearing and fire resistant insulated wall element with high load-bearing capacity as the intermediate, insulating foam insulation material help to reduce the risk of buckling of the support beams. Thus, the vertical load capacity of the support beams is increased, and hence the vertical load capacity of the wall element is increased as the intermediate rigid foam insulation material arranged in the space(s) between the support beams border the support beams.

[0013] The substantially vertical support beams are preferably attached to the insulating core's surface.

[0014] The attachment of the support beams to the insulating core such as by an adhesive, may further help to prevent buckling of the support beams and may also help to provide a stronger and rigid prefabricated wall element that is also easy to handle during transport and installation.

[0015] When the substantially vertical support beams are so to say enclosed in/between the insulating core (preferably

attached to the insulating core's surface), the intermediate insulation (and/or an abutting support beam of another wall element arranged at an end surface of the wall element) and a cover layer such as a cover plate, e.g. a gypsum plate, this structure together provides a solution where the load carrying capacity of the wall element is high.

[0016] Moreover, it has shown that the attachment of the support beams to the insulating core by an adhesive connection provides advantages in relation to the fire resistance properties of the wall element; When a fire occurs on a first side of the wall element, the fire may will eventually burn through the support beams which may be made from a wood material. However, as the support beams of the support arrangements on opposing sides of the wall element are attached by gluing to the core element on the opposing surfaces of the core element, the burning of one of the support elements does not completely remove the load bearing properties of the wall element as the support beams on the opposing side at the other support arrangement still adheres to the other side of the insulating core and thus still will hold together the wall element for an amount of time.

[0017] The wall element is also very suitable for being prefabricated and subsequently erected at a building location to support on a building foundation.

[0018] The intermediate foam insulation material moreover provides that the wall element according to the invention, with the insulating core, provides a wall element having a low heat transfer capacity and thus enhanced insulation properties while at the same time being space saving and having a high load bearing property.

[0019] The substantially vertical support beams are configured to transfer vertical loads from an upper building structure of the building to a building foundation of the building thereby providing a load bearing functionality of the wall element.

[0020] The wall element according to the invention is moreover advantageous as it reduces if not even completely omits "cold bridges" between opposite sides of the wall element. The wall element may comprise substantially none through-going heat-transferring element(s) that extend through the insulating core in order to e.g. provide a load bearing and/or assembling structure, which enhances the insulating properties of the wall element. This may e.g. be achieved by the attachment of the support beams to the insulating core by e.g. an adhesive connection.

[0021] The wall element is preferably of a sandwich type.

[0022] The support beams may in aspects of the invention extend from an upper and/or a lower substantially horizontal beam at the upper and/or lower edge(s) of said wall element, preferably so that the support beams extends between an upper and a lower horizontal beam.

[0023] The insulating core may in preferred aspects of the invention comprise or consist of a Polyisocyanurate (PIR) foam insulation material element.

[0024] The space saving feature are shown in that the wall element have a reduced thickness when taking the insulation properties, load carrying capacities and/or fire resistance of the wall element into consideration. This provides that, when arranging windows or other openings providing inflow of daylight, a larger inflow of daylight can be obtained when using the wall element for an outer wall of a building, compared to the size of the opening.

[0025] The present invention may also provide a simpler, less complex and/or a cost effective wall element as it may be made from a few types of different cost efficient materials that are easy and fast to shape and adapt.

[0026] Providing the support arrangements at opposing side surfaces has shown to provide a solution with advantageous insulating properties and moreover very good load bearing functionality, both during normal use and in case of fire. For example, as there are support arrangements each including support beams and intermediate rigid insulating material, the wall element may provide a double load bearing functionality as explained in the following:

> In case of e.g. fire inside the building or outside a building, the fire resistance of the wall has proved to provide an advantageous load bearing functionality. In most cases, fire only occurs on one of the sides of the wall in a building but will over time weaken the load bearing structure of a wall. However, by the above solution, when the load-bearing functionality of the support beams and the intermediate insulating material of e.g. the first support arrangement is weakened due to heat from fire, the insulating core and especially the second support arrangement at the other side of the insulating core takes over the load and thus the load bearing capacity of the wall element is improved during fire. This may be considered as especially relevant since the wall element may not need to be designed to withstand the weight from e.g. snow during fire, thus providing/freeing more load carrying capacity to the support arrangement facing away from the fire, during fire. The insulating core (preferably a rigid PIR foam core element) and the intermediate insulation layer (also preferably made from PIR foam plates) facing/being closest to the fire may thus help to provide heat protection of the support arrangement facing away from the side of the wall element where the fire has occurred.

[0027] The wall element according to the invention has shown to be able to obtain an advantageous REI value (resistance during fire). The REI value of the wall element may thus be a REI 30 or even REI 60

[0028] The REI test criteria are described in relation to the European standard EN13501-2, and may comprise that the wall element should not collapse or deflect beyond the permitted levels when subjected to an applied load, the integrity of the room of the building must be maintained, and no breakthrough of flames is permitted. Also, the temperature

on the non-exposed side of the structural element must not rise more than 140° C above ambient as an average measurement and no more than 180° C at any one location. Wall elements complying with REI 30 comply with the above criteria for 30 minutes, and the wall elements complying with REI 60 comply with the above criteria for 60 minutes.

[0029] In preferred aspects of the invention, said substantially vertical support beams of one or both of said first and second support arrangements are substantially parallel and extends between a top part and a bottom part of said wall element at said side, and wherein said intermediate insulating material is arranged in the space between said substantially parallel support beams.

[0030] In preferred aspects of the invention, said support arrangement comprises at least three such as at least four e.g. at least five parallel e.g. at least six such as seven support beams at the same side of said insulating core.

[0031] In preferred aspects of the invention, at least one, preferably both, of said opposing side surfaces of the insulating core are substantially plan.

[0032] Preferably, in aspects of the invention, said intermediate insulating material may comprises plate modules attached to said side surface(s) of said insulating core, preferably by means of an adhesive layer.

[0033] This provides a wall element that is, space saving and/or cost efficient to produce as the plate modules may be arranged between the support beams after or before these beams are e.g. attached to the e.g. plane surface of the insulating core. Also, if the plate modules are attached by e.g. adhesive to the surface of the insulating core, it may help to provide an even stronger and rigid prefabricated wall element.

[0034] It has also shown to provide a solution where vapour barriers in the form of plastic sheets between insulation and cover layer/cover plate may be omitted as the foam insulation and adhesive layer between intermediate insulating core and the insulating core provides a sufficient vapour barrier.

[0035] In advantageous aspects of the invention, said support beams may be attached to/connected to said rigid intermediate foam insulation material by means of an adhesive layer arranged between the surfaces of the support beams facing the surfaces of the intermediate foam insulation material, and the surfaces of the intermediate foam insulation material bordering the respective support beam.

[0036] The support beams of the support arrangements may in aspects of the invention be arranged opposite to each other on opposing sides of the insulating core. Hence, the vertical support beams of the first support arrangement may be arranged so one or more (preferably all) of the support beams of the first arrangement is arranged opposite to a, preferably substantially corresponding, vertical support beam of the second support arrangement.

[0037] The intermediate insulating material and the insulating core may in other aspects of the invention be made from one insulating piece of insulating foam material. This may be provided by arranging the support beams and cover plates in a press/form, and then provide expanding insulation foam PIR or PUR insulation material between the support beams and cover plates. Hereby, when the insulation material has expanded, it will abut the cover plates and the support beams and thus provide the insulating core and the intermediate insulating material between support beams. Thus, the attachment of the support beams to the surface of the insulating core may in this aspect preferably be provided by the inherent adhesive properties of e.g. expanding PIR or PUR insulation foam, so that after the expansion of the foam insulation, the intermediate insulating material and insulating core may be provided in a one piece material which adhere to the inner surfaces of the cover plates and surfaces of the support beams.

[0038] Advantageously, in aspects of the invention, one or both of said first and second support arrangements may comprise a cover layer, preferably comprising one or more cover plates such as plaster plates.

[0039] The cover plate(s) are preferably attached to the wall element at least at the vertical support beams of the support arrangement, but it is to be understood that the cover layer may also or alternatively be attached to the surface of the intermediate insulating layer. The cover plates may provide supportive and/or fire resistance properties.

[0040] The cover plates are preferably arranged to face the surface of the intermediate insulation material and the surfaces of the support beams arrangements facing away from the insulation core.

[0041] The cover layer(s) may in preferred aspects of the invention comprise one or more cover plates having an inner surface attached to said vertical beams, preferably at least by means of an adhesive layer.

[0042] In preferred aspects of the invention, the cover layer comprises one or more cover plates having an inner surface attached to said intermediate insulating material by means of an adhesive layer.

[0043] Generally, it is understood that the cover plates may be conventional Gypsum/plaster plates, it may be plates made from a wooden material, fibre plaster plates it may be masonite plates, metal plates and/or the like.

[0044] The aspects of the invention where the support beams and/or the intermediate insulation layer is attached to the inner surface of a cover plate facing the insulating core helps to provide further strength to the wall element.

[0045] The wall element may in a prefabricated state where it is ready to be shipped to the building location however in aspects of the invention not comprise one or both of the cover layers, these may be mounted at the site after the wall element(s) are erected.

[0046] In other preferred aspects of the invention, at least one of the cover layers, e.g. the cover plates arranged to face the interior of the building, or even more preferably both cover plates, may be mounted during the prefabrication before shipping

[0047] Aspects of the invention where an inner surface of the cover plates are attached to the surface of the intermediate insulating material by means of an adhesive layer may provide an advantageous support function and also improved resistance to fire of the wall element. During fire, the material of the cover plates, such as plaster material plates, may start to crack and then fall from the surface of the intermediate insulating layer. When providing an adhesive layer between the intermediate insulating layer and the cover plate, the adhesive provides that the cover plate adhere to the intermediate insulating layer between the support beams, this may be prevented for a longer time and the plate material then covers the insulation for a longer time, which may improve the fire resistance property of the wall element.

[0048] In preferred aspects of the invention, the intermediate insulation material and/or said insulating core is made from a Polyisocyanurate foam insulation material.

[0049] By this solution, it has shown to be possible to provide a wall element that can be REI 60 certified. Hereby, the wall element may e.g. be usable for providing outer walls of multi-floor buildings due to the heat resistance properties of PIR insulation foam. The PIR insulation may moreover be considered a cost efficient insulation.

[0050] A PIR (Polyisocyanurate) foam insulation provides good heat resistance, and the inventor has found that it helps to provide a space saving solution where the Polyisocyanurate foam insulation due to its rigid characteristic act so as to increase the load capacity of the support beams when arranged in the space(s) between the adjoining support beams by e.g. preventing buckling.

[0051] In other embodiments of the invention, another rigid foam material such as polyurethane (PUR) foam may be utilized for the intermediate insulation material and/or the insulating core which may provide a wall element having a REI 30 certification.

[0052] In advantageous aspects of the invention, one of said support arrangements is configured to face towards the exterior of the building, which support arrangements for facing towards the exterior of the building comprises a plurality of substantially horizontal connection beams arranged between said support beams which plurality of substantially horizontal connection beams preferably extend horizontally in rows of substantially aligned connection beams.

[0053] This may e.g. provide a solution where easy and sufficient attachment of a siding system facing the exterior of the building is made possible in a space saving manner, while e.g. more weak cover plates such as plaster plate can be used as a cover plate between the siding system and the intermediate insulation layer. In aspects where the connection beams are arranged aligned and arranged between the substantially vertical support beams, the wall element thickness may be reduced while providing a larger flexibility as to the type of cover layer to be connected to the wall element at the exterior.

[0054] In preferred aspects of the invention, said support beams have a thickness between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm.

[0055] In advantageous aspects of the invention, said support beams have a width between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm.

[0056] A cover layer such as a plaster plate (to e.g. provide enhanced fire-resistance properties), wooden plate and/or the like may thus be arranged at the outside of the substantially horizontal connection beams, and a further siding structure such as siding planks, plates and/or the like may be arranged on the outside surface of the cover layer by mechanical fasteners penetrating the cover layer into the connection beams.

[0057] The plurality of substantially horizontal connection beams may in advantageous aspects of the invention be arranged to border or abut the side surface of the insulating core, and a surface of a cover layer facing towards the insulating core so that the substantially horizontal connection beams are arranged between the cover layer, such as a plaster plate or wooden plate, and the side surface of the insulating core.

[0058] In preferred aspects of the invention, the thickness of said intermediate insulating layer substantially matches the thickness of said support beams.

[0059] For example, the thickness of the intermediate insulating layer may be between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm.

[0060] Preferably, the surface of the intermediate insulating material facing away from said insulating core is substantially aligned with the surface of the support beams facing away from the inner insulating core. This e.g. provides that a cover plate will substantially abut the intermediate insulating material, thereby providing a space saving and yet effective insulating structure.

[0061] The thickness of the insulating core may in preferred aspects of the invention be between 100mm and 300mm, e.g. between 150mm and 250mm, such as between 160mm and 200mm, preferably around 190mm such as 185mm.

[0062] The thickness of said wall element may in preferred aspects of the invention be no more than 500mm such as no more than 400 mm, preferably no more than 350mm such as around 300mm.

[0063] In preferred aspects of the invention, the overall thickness of said wall element substantially corresponds to the sum of the thickness of said insulating core, the thickness of the support arrangement(s) of the wall element and preferably the thickness (TH4) of at least one, such as two cover layers such as cover plates.

[0064] In advantageous aspects of the invention, said wall element has a heat transfer co-efficient (U-value) of no more than 0.2 such as no more than 0.1 preferably no more than 0.08 W/m2K.

[0065] Preferably, in aspects of the invention, said wall element is configured for carrying vertical loads up to 20kN such as up to 40kN such as up to 60kN before breaking. During fire, the wall element may be configured for carrying vertical loads up to 10kN such as up to 20kN e.g. as up to 30kN.

[0066] Preferably, said wall element may be pre-fabricated and configured for subsequent being transported to and erected at a building foundation.

[0067] The wall element is preferably suitable for constituting an outer, load-bearing wall of a building.

[0068] In preferred aspects of the invention, routing(s) configured for distributing building installations such as electrical installations and/or water piping is provided in said insulating core between the support beams of said support arrangements.

[0069] This has shown to provide an advantageous, prefabricated wall element wherein the load bearing capacity, reduced thickness, the insulating capacity and/or resistance to fire of the wall element is not compromised, while the installations such as electrical wires/cables, water pipes, gas pipes for e.g. cooking equipment etc. is not visible as it may be hidden inside the wall elements.

[0070] The routing is thus arranged between the support arrangements.

[0071] This may also help to provide a more gas-tight wall element and thus a more gas-tight building may be obtained as substantially no through going building installation routings are present in the wall element.

[0072] In preferred aspects of the invention, one or more of said adhesive layers are substantially continuous, comprises a plurality of adhesive lines/rows or comprises a plurality adhesive "dots" of an adhesive material extending/distributed between a top part and bottom part and/or between end surfaces of said wall element.

[0073] This may be advantageous in relation to fire protective properties of the wall element and/or in relation to providing a sufficient, "integrated" vapour barrier in the wall element.

[0074] The invention may moreover in a further aspect relate to use of a wall element according to any of the claims or other aspects as disclosed in this document for load-bearing outer walls of a building.

[0075] The invention moreover relates to a building, which building comprises outer walls made from wall elements according to any of the claims or other aspects as disclosed in this document, and wherein an upper building structure such as a roofing structure or a further wall element to provide further floors in a building is arranged to support on both support arrangements of the wall element.

[0076] Generally, if not considering the cover layer(s)/plates, the wall element according to preferred aspects of the invention may be considered as substantially comprising only two different main materials in the form of vertical and e.g. horizontal (e.g. wooden) beams, and foam insulation preferably in the form of PIR plates (or alternatively PUR plates) providing the intermediate insulation and the insulating core, these are in a simple manner connected/assembled by connection means such as adhesives. To this, the cover layer(s) such as one or more plaster plates may preferably be added and attached by adhesives, and/or mechanical fasteners such as nails, screws or the like driven into the support beams and/or horizontal beam(s) of the wall element.

[0077] In advantageous aspects of the invention, said intermediate insulating layer comprises one or preferably a plurality of recesses, in the surface facing said cover plate(s), and wherein said recesses are arranged to receive an adhesive material, such as excess adhesive, of an adhesive layer arranged between the cover plate and the respective, intermediate insulating layer. The ratio between the amount of surface area parts to be used for connection with a cover plate and the amount of the surface area that is recessed may preferably, in aspects, be between 2:1 and 100:1, such as between 3:1 and 30:1, e.g. between 4:1 and 20:1.

[0078] This may help to provide a sufficient/enhanced bonding by the adhesive as excess adhesive may be forced/moved into the recesses when placing a cover plate on the adhesive layer.

[0079] The invention may moreover in a still further aspect relate to a method of producing a wall element, e.g. according to any of the claims and/or other embodiments disclosed above or otherwise in this document, the method comprising the steps of

- arranging one or more first cover plates on a support surface
- providing a first adhesive layer to the surface of the cover plate,
- arranging intermediate insulation plate modules and support beams on said first adhesive layer, thereby providing a first support arrangement
- providing a second adhesive layer to the surface of the first support arrangement,
- providing one or more insulating core elements on the second adhesive layer,
- providing a third adhesive layer on the surface the one or more insulating core element's surface,
- arranging intermediate insulation plate modules and support beams on the third adhesive layer, thereby providing a second support arrangement,
- providing a fourth adhesive layer to the surface of said second support arrangement, and
- arranging one or more second cover plates on said fourth adhesive layer.

[0080] The insulating, wall element for load-bearing walls of buildings produced according to said method may in aspects of the invention be a wall element according to any of claims 1-13.

[0081] By the method, a cost efficient and simple way of producing an insulating wall element for load-bearing walls of buildings, e.g. providing one or more of the above mentioned properties and/or advantages in relation to e.g. fire resistance, load bearing properties and/or the like.

Figures

[0082] Aspects of the present disclosure will be described in the following with reference to the figures in which:

fig. 1 : illustrates a cross-sectional view of a wall element according to embodiments the invention

fig. 2 : illustrates routing for building installations are provided in an insulating core of a wall element according to embodiments of the invention,

figs. 3-4 : illustrates a wall element according to embodiments of the invention where the wall element have substantially vertical support beams

fig. 5a-5b : illustrates a wall element according to embodiments of the invention seen in perspective,

fig. 6 : illustrates examples of widths and thicknesses of the wall element and its components according to embodiments of the invention,

fig. 7 : illustrates a wall element according to embodiments of the invention, where a support arrangement comprises horizontal connection beams,

fig. 8 : illustrates a wall element according to further embodiments of the invention,

fig. 9 : illustrates a wall element according to embodiments of the invention where a one-piece insulation solution is provided,

fig. 10 : illustrates a wall element according to further embodiments of the invention having adhesive layers,

Fig. 11 : illustrates a cross sectional view of an advantageous embodiment of the invention seen from above

Fig. 12a : illustrates examples of an insulation material plate 4 seen in perspective, and

Fig. 12b : illustrates a further example of an insulation material plate 4 seen in perspective

Detailed description

[0083] Fig. 1 illustrates a cross sectional view seen from above of an insulating wall element 1 according to embodiments of the invention. The insulating wall element 1 is prefabricated and configured to be load-bearing so as to provide e.g. outer load-bearing walls of a building.

[0084] The insulating wall element 1 comprises an inner, rigid foam insulation core 2. The insulating core 2 is preferably substantially solid and comprises or consists of polyisocyanurate (PIR) foam material, and has plane side surfaces 11, 12 which a support arrangement 10a can border or abut. In other embodiments of the invention, the insulating core 2 may comprise or consist of polyurethane (PUR) foam insulation.

[0085] The understanding of the surfaces 11, 12 being plane may in embodiments of the invention be that both the support beams 3 and the intermediate insulating material 4 (in embodiments where these are attached by adhesive to the core 2 surfaces 11, 12) are arranged at substantially the same level at the surface 11, 12. Hence, if the surfaces 11, 12 e.g. comprises recesses for receiving excess adhesive as described in relation to figs 11-12b may also, these may still be considered as substantially plane. Such recesses may however in embodiments of the invention be omitted

[0086] Preferably, the insulating core 2 is made from large, pre-foamed, prefabricated insulation plates/elements onto which support arrangements 10a, 10b are arranged at the plane opposing side surface(s) 11, 12.

[0087] The insulating wall element 1, comprises a first support arrangement 10a arranged at the substantially plane side surface 11, and a second support arrangement 10b arranged at the substantially plane opposite side surface 12 of the inner, insulating core 2, so that the insulating core 2 is arranged between the support arrangements 10a, 10b.

[0088] The support arrangements 10a, 10b are in embodiments of the invention substantially identical to the extent that they each comprises substantially vertical support beams 3 and intermediate insulation 4 as e.g. described below. At least one of the support arrangements 10a, 10b may moreover in embodiments of the invention comprise e.g. connection beams as described later on.

[0089] The support arrangements 10a, 10b each comprises a plurality of substantially vertical support beams 3 arranged with a mutual distance D1, thereby providing one or more spaces 7 (see e.g. fig. 3 indicating the spaces 7) between the plurality of support beams 3 on the side 11 of the insulating core 2.

[0090] The support arrangements 10a, 10b moreover each comprises a rigid intermediate insulation material 4 arranged in each space 7 between two adjoining support beams 3 of the respective support arrangement 10a, 10b. The intermediate foam insulation material 4 borders the support beams 3 providing the respective space 7. Thereby, the intermediate foam insulation material 4 between the support beams 3 provides a supportive function along the beams and thus helps to prevent buckling of the adjacent beams 3. The intermediate foam insulation material 4 preferably borders the support beams 3 substantially along the entire height of the respective space 7.

[0091] The intermediate insulation material 4 is in preferred embodiments of the invention made from a rigid polyisocyanurate (PIR) foam insulation material. The intermediate insulation material 4 may in other embodiments of the invention made from a rigid polyurethane (PUR) foam insulation material.

[0092] In preferred embodiments of the invention, the insulating core 2 between the support arrangements 10a, 10b and the intermediate foam insulation material 4 between the support beams may both be made from rigid polyisocyanurate (PIR) foam insulation material.

[0093] In other embodiments of the invention, the insulating core 2 may be made from PIR foam insulation material while the intermediate foam insulation material 4 is made from PUR foam insulation.

[0094] In further embodiments of the invention, the insulating core 2 may be made from PUR foam insulation while the intermediate foam insulation material 4 is made from PIR foam insulation.

[0095] In still further embodiments of the invention, both the insulating core 2 and the intermediate foam insulation material 4 may be made from PUR foam insulation material.

[0096] In preferred embodiments of the invention, the intermediate insulating material 4 are made from pre-foamed insulation plates that are arranged between adjoining beams 3 and preferably attached to a plane side surface 11, 12 of the insulating core 2, preferably by means of an adhesive applied between a plane surface 15 of the insulation plate 4 facing the insulating core 2 and a substantially plane side surface 11 of the insulating core 2.

[0097] In further embodiments (not illustrated) of the invention, the intermediate insulating material 4 may be an integrated part of the insulating core 2, and the support beams 3 may be arranged in longitudinal cut-outs for the support beams in the insulating material.

[0098] In preferred embodiments of the invention, the support beams 3 may be attached to a side surface 11 of the said insulating core 2, preferably by means of an adhesive applied between a support beam surface 14 facing a side surface 11 of the insulating core 2, and a side surface 11 of the insulating core 2.

[0099] It is generally to be understood that different types of vapour barriers (not illustrated) such as one or more plastic sheets or vapour barriers applied in a liquid state and subsequently cured in embodiments of the invention may be applied/provided between a cover plate 5 and a support arrangement 10a and/or between support arrangement 10a and insulating core 2. However such vapour barriers of plastic sheets may in preferred embodiments of the invention be omitted as the constitution and material choice of the wall element 1 and an adhesive between surfaces 11, 15 may provide a sufficiently vapour tight insulating, load-bearing wall element 1 that complies with the related building regulations.

[0100] The wall element in fig. 1 comprises cover layers 5, 6 in the form of cover plates 5, 6. One cover plate 5 is arranged at a side surface of the support arrangement 10a facing away from the insulating core 2, and the other opposing cover plate 6 is arranged at a side surface of the support arrangement 10b facing away from the insulating core 2

[0101] Generally, it is to be understood that cover plates 5, 6 may be arranged at opposing sides of the wall element 1 and may be made from different materials or the same material. For example, cover plates 5, 6 on opposite sides may both be gypsum/plaster plates, it may be gypsum/plaster pates at the part of the wall element 1 to face the interior of the building while the cover plates facing the exterior of the building (e.g. in embodiments of the invention where the wall element is an outer wall for a building), may be wooden plate(s), masonite plates, metal plates, wooden or Non-wood (polymer) planks/profiles and/or other types pf siding systems or siding means for siding wall structures.

[0102] The cover layers 5, 6 have an outer surface 16, 17 facing away from the insulating core 2. This/these outer surfaces 16, 17 may be the surfaces to be applied with painting, wallpaper, a siding system and/or the like, or, if the cover layer such as cover plates or longitudinal profiles has/have the desired, visible appearance, the surface(s) 16, 17 may constitute the wall surface(s) of the wall element visible to people. The insulating core 2 and one or more support arrangements 10a, 10b are thus positioned between the cover layers 5, 6.

[0103] The cover plates 5, 6 may in embodiments of the invention be attached to the support beams 3 by means of mechanical fastening means such as a plurality of screws, nails and/or the like penetrating the cover plate and the support beams 3, but it is understood that in preferred embodiments of the invention, the cover plate(s) 5, 6 may be

attached to the support beams 3 by means of at least an adhesive or a combination of adhesive and screws/nails and/or the like.

[0104] In preferred embodiments of the invention, the wall element 1 is configured to provide a wall element for an outer building wall, and the wall element may comprise both cover plates 5, 6 when leaving the factory. The cover plate, such as a gypsum/plaster plate of the side of the wall element to face the interior of a building may thus constitute the inner wall for facing the interior of the building of an outer wall of the building to be painted, provided with wall paper, a felt sheet and/or the like. The cover plate of the side of the wall element to face the exterior of a building, such as a gypsum/plaster plate, may provide support/underlay for a further siding system for establishing the façade of a building when multiple wall elements 1 have been erected next to each other at the building location to provide the outer wall.

[0105] In other embodiments of the invention one or both of the cover plates 5, 6 may be mounted at the building location before or after erecting the wall elements. Also, in certain embodiments of the invention, at least the cover layer of the side of the wall element 1 to face the exterior of a building may be a siding system, preferably having fire resistant abilities, which may be mounted after erecting the wall element.

[0106] In preferred embodiments of the invention, the cover plates 5, 6 may be attached to the surface of the intermediate insulation material 4 by means of an adhesive at the inner surface of the cover plates 5, 6 facing the insulating core 2., In preferred embodiments of the invention, the adhesive layer may extend substantially over the entire surface of the intermediate insulation material 4 surface facing the cover plate, and preferably also over support beam surfaces facing the cover plate.

[0107] The wall element 1 comprises end surfaces 20, 21 configured to border end surfaces of further wall elements 1 (not illustrated) of substantially the same type, so that load-bearing building walls can be erected to support a roof of a building and/or a horizontal division of a multi-floor building having two or more rooms arranged above each other with intermediate ceiling/floor division(s).

[0108] The wall element 1 may naturally in embodiments of the invention (not illustrated) be provided with one or more openings in the form of one or more windows, doors or other openings for providing inflow of daylight into the building and/or access to the building room(s). Such openings may e.g. be arranged in the space 7 between the support beams 3.

[0109] As can be seen from e.g. fig. 1 and one or more of the subsequent figures, the support beams 3 of the support arrangements 10a, 10b may be arranged opposite to each other on opposing sides of the insulating core 2. Hence, the vertical support beams 3 of the first support arrangement 10a may be arranged so one or more (preferably all) of the support beams 3 of arrangement 10a is arranged opposite to a, preferably substantially corresponding, vertical support beam 3 of the second support arrangement 10b.

[0110] In other embodiments of the invention, the support beams 3 of the support arrangements 10a, 10b may not be arranged opposite to each other on opposing sides of the insulating core 2.

[0111] The vertical support beams 3 of the first support arrangement 10a is preferably substantially parallel to the vertical support beams 3 of the second support arrangement 10b, see e.g. also fig. 5a and fig. 10.

[0112] Fig. 2 illustrates an embodiment of the invention seen in perspective, wherein a routing 70, 73 for building installations such as electricity installations, water piping, gas piping, ventilation piping and/or the like are provided and distributed in the wall element in the insulating core 2. For simplicity of the drawing of fig. 2, the support arrangements 10a, 10b and cover layers 5, 6 are not shown.

[0113] In preferred embodiments of the invention, the routing for the building installations are provided mainly internally in the insulating core 2 between the surfaces 11, 12. In other embodiments of the invention, the electric wires, water piping and/or the like may be configured to be arranged in grooves (not illustrated) in the surface 11 and/or 12 of the insulating core 2, and thus subsequently covered by the support arrangements. Also combinations of the above may be provided in embodiments of the invention

[0114] In the present example, the insulating core comprises routing for electrical installations 70 including electric wiring 74 (such as one-phase 220-230 Volt AC or 110-120 Volt AC for light, electrical sockets, kitchen equipment and or the like, and/or three phase 400 Volt AC for other electrical appliances), where the electrical wiring 74 for different electrical switches, wire connection points and/or the like 71 are distributed in the insulating core 2 in/at the routing 70.

[0115] The electrical wires/cables 74 to be interconnected with an electrical installation in another wall element abutting the respective wall element may be preinstalled in the routings 70 in one wall element at the factory for producing the wall element and then pulled/guided into a preformed building installation routing in/at the insulating core of the next wall element at the building site to a power point/outlet for interconnection of the electrical wiring.

[0116] Also, a routing 73 for water installation may be pre-formed in the insulating core. Hence, when the wall element is transported to the building location to be erected, water pipes may thus be guided into the preformed water installation routing 73 from e.g. the foundation of the building, and out of an opening in the wall element surface 16 or 17.

[0117] Fig. 3 illustrates schematically an embodiment of a wall element 1 according to the invention, seen from a side of the wall element 1, where the wall element 1 is not provided with a cover layer yet, in order to illustrate embodiments of the support arrangement 10a.

[0118] The support beams 3 extend vertically between a top part 8 and a bottom part 9 of the wall element 1.

[0119] The support beams 3 may in embodiments of the invention be part of a frame structure, where the support beams 3 extend from an upper 22 and/or a lower 23 substantially horizontal beam at the upper and/or lower parts of the wall element 1. Preferably, the support beams 3 extend between an upper 22 and a lower horizontal beam 23. In other embodiments of the invention, the upper 22 and/or lower 23 horizontal beam may be omitted and the support beams 3 may thus e.g. support substantially directly at the building foundation 30 and extend from an upper horizontal beam 22.

[0120] In the embodiment of fig. 3, the support beams 3 support on the lower, horizontal beam 23, which extend substantially the entire length L of the wall element 1 and may thus e.g. help to distribute vertical forces F provided by the upper building structure 31 such as a roof structure or a horizontal division of the building to the building foundation 30 of the building.

[0121] The upper horizontal beam 22 may thus act as a support for the upper building structure such as a further wall element 1 and/or a roof structure and distribute forces F to the support beams 3 towards the building foundation 30.

[0122] In the present example, a support arrangement of the wall element 1 comprises five support beams 3 with a mutual distance D1, thereby providing the four spaces 7 between adjoining support beams 3 of the support arrangement 10a. The intermediate insulating material 4 is placed in these spaces 7.

[0123] The distance D1 between two support beams 3 is in embodiments of the invention between 450mm and 600 mm, such as between about 490mm and 560mm.

[0124] Preferably, the outer surface 40 of the intermediate insulating material 4 facing away from the insulating core 2 (the core 2 is not visible in fig. 3) is substantially aligned with the surface 41 of the support beams 3 facing away from the inner insulating core 2.

[0125] Preferably, the substantially vertical support beams 3 are, in embodiments of the invention, substantially parallel as illustrated, thereby providing a rectangular space 7 between the adjoining support beams 3. This may be provided by the vertical support beams 3 being arranged to extend vertically with an angle about 90° to the foundation 30 when the wall element 1 is erected at a building.

[0126] In other embodiments, as e.g. illustrated in fig. 4, the substantially vertical support beams 3 may be arranged in an angle α between 50°- 90° in relation to horizontal, e.g. between 60° and 80°, and e.g. be parallel or be arranged in a kind of zig-zag pattern (e.g. as illustrated) along the length L of the wall element 1 and/or the like.

[0127] Turning back to fig. 3, fig. 3 moreover illustrates by dotted lines that further wall elements 1 may be arranged next to each other so that the end surfaces 20, 21 of the wall element borders end surfaces 20, 21 of further wall elements 1, thereby providing a load bearing wall build from a plurality of wall elements 1 according to embodiments of the invention.

[0128] It is generally understood that the height H of the wall element 1 in preferred embodiments of the invention is between 2000 mm and 3500mm, preferably between 2300 mm and 3000 mm, such as about 2500-2700mm, e.g. about 2600mm.

[0129] It is generally understood that the length L of the wall element 1 in preferred embodiments of the invention is between 1000 mm and 4000mm, preferably between 2000 mm and 3200 mm, such as about 2500-3000mm, e.g. about 2900mm -3000mm.

[0130] In the present example, the wall element comprises five parallel support beams 3 (providing four spaces 7) but it is understood that this may be varied. In preferred embodiments of the invention, a support arrangement 10a, 10b may comprises at least three such as at least four e.g. at least five parallel e.g. at least six support beams, e.g. no more than 10 support beams 3 at the same side 11, 12 of the insulating core 2.

[0131] As a non-limiting example, the support arrangement of the wall element 1 may in advantageous embodiments comprise six parallel support beams 3 distributed over a distance L of about 3000 mm (e.g. about 2935 mm), with the width D1 of the resulting five spaces 7 (and thus the width of the intermediate insulation 4) varying between about 500 and 555mm, and where the width of each support beam is about 45mm. The height of the support beams 3 may in this embodiment be about 2000mm - 2600mm (e.g. about 2500mm), and the support beams 3 may extend between two horizontal beams 22, 23 thereby providing a wall element with a height about 2600 mm.

[0132] Fig. 5a illustrates an embodiment of the wall element 1 seen in perspective, where the wall element 1 is divided into different parts which when connected provides the pre-fabricated wall element 1 seen in fig. 5b. The wall element 1 hence provides that the support arrangements 10a, 10b can be build up/provided at the opposite, plane side surfaces 11, 12 of the insulating core 2, thereby providing a "sandwich" wall element structure where substantially no heat transferring parts of the wall element penetrates the insulating core. The vertical parallel support beams 3 of the respective support arrangements 10a, 10b are thus arranged between the horizontal beams 22, 23, to abut the side surfaces 11, 12 (e.g. attached by an adhesive), and rigid, pre-shaped insulation plates 4 are arranged in the spaces 7 between vertical adjoining support beams 3 to border the support beams 3 providing the respective spaces 7. Then the cover layers such as cover plates 5, 6 are arranged to enclose the support beams 3 and intermediate insulation between the cover plates and the insulating core 2, e.g. by attaching the plates to the vertical 3 and/or horizontal 22, 23 beams by an adhesive and/or mechanical fastening means such as screws or nails.

[0133] This results in the prefabricated wall element 1 illustrated in perspective in fig. 5b, which can be moved to a building site to be erected. The wall element 1 of figs. 5a and 5b comprises two support arrangements 2 according to

preferred embodiments of the invention, e.g. as seen and described in relation to fig. 2, but in other aspects of the invention, the wall element 1 may comprise just one support arrangement as illustrated in fig. 1.

[0134] The support beams 3, and upper and lower beams 22, 23 may together constitute a support frame of a support arrangement to be arranged on a plane side surface 12, 11 of the insulating core 2, and the height and length of the support arrangement (including possible lower/upper beams 22, 23) preferably substantially matches the height and length of the insulating core 2 and preferably substantially the height H and length L of the wall element 1.

[0135] In embodiments of the invention, the cover layers such as cover plates 5, 6 may be attached during pre-fabrication of the wall element 1 seen in fig. 5b. However, in other embodiments of the invention, the cover plates 5 and/or 6 may first be mounted on the wall element 1 after the wall element 1 is erected at the building foundation, e.g. to allow mounting if siding systems extending over a length that is larger than the length L of one wall element 1, in order to allow installation of electrical wires, switches, water pipes and/or the like "inside" the wall element 1 before the cover layers (s) 5, 6 are attached to the wall element 1 and/or the like.

[0136] In embodiments of the invention, the end surfaces of the inner core 2 forms a part of the end surfaces 20, 21 of the wall element, thereby e.g. providing that an end surfaces of an insulation core of a further wall element can be arranged to abut the surface of the insulating core 2 in order to provide a good insulation and thereby better insulation properties when arranging a plurality of wall elements end to end in order to provide a building. The ends 20, 21 of the wall elements 1 may thus e.g. be arranged to abut each other, they may be connected by attachment means such as an adhesive, by mechanical fastening means, e.g. by (by bolts, screws and/or the like) fixing two vertical support beams 3 arranged closest to the end surfaces 20, 21 of the wall elements together, see e.g. fig. 3, and/or the like.

[0137] Fig. 6 illustrates an example of a cross sectional view of a wall element 1 according to embodiments of the invention, seen from above.

[0138] The insulating wall element 1 comprises two of the support arrangements 10a, 10b arranged at opposite side surfaces 11, 12 of the insulating core 2.

[0139] The overall thickness TH1 of the insulating wall element 1 is preferably no more than 500mm such as no more than 400 mm, preferably no more than 450mm such as around 300mm. The thickness TH1 may thus be between 200mm and 350mm such as between 280 and 320mm including end values.

[0140] The thickness TH2 of the insulating core 2, preferably a PIR foam core, is preferably between 100mm and 300mm, e.g. between 150mm and 250mm, such as between 160mm and 200mm, preferably around 190mm such as 185mm.

[0141] The length of and height of the insulating core may substantially correspond to the length L and height H of the wall element 1, see e.g. fig. 3 and 5b.

[0142] The thickness TH3 of the support beams 3 may be between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm.

[0143] The thickness TH5 of the intermediate insulating layer 4 substantially matches the thickness TH3 of said support beams 3, so that the surface of the intermediate insulating material 4 facing away from the insulating core 2 is substantially aligned with the surface of the support beams 3 facing away from the core 2.

[0144] Preferably, the thickness TH 4 of a cover layer 5, 6 such as a cover plate may be between 1mm and 30mm such as between 10mm and 20mm, e.g. about 12-14mm such as 13mm, e.g. corresponding to the thickness of a conventional plaster plate.

[0145] Preferably, the overall thickness TH1 of the wall element 1 may be given by the thickness of the insulating core 2, the thickness T3, T5 of the support beams 3 / intermediate insulation 4 of the support arrangement(s) 10a, 10b, and preferably also the thickness of the cover layer(s) 5, 6.

[0146] In one example, the thickness TH2 may be about 185 mm, the thickness TH3 may be about 45 mm and the thickness TH4 may be about 13 mm, resulting in a prefabricated wall element 1 with an overall thickness TH1 of

$$TH1 = TH2 + (2 \times TH3) + (2 \times TH4) \rightarrow$$

$$TH1 = 185mm + (2 \times 45mm) + (2 \times 13mm) \rightarrow$$

$$TH1 = 301mm$$

for e.g. a wall element 1 according to preferred embodiments of the invention where the wall element 1 comprises two support arrangements 10a, 10b on opposing side surfaces 11, 12 of the insulating core 2 so that the insulating core 2 is arranged between the support arrangements 10a, 10b.

[0147] In advantageous embodiments of the invention, the support beams 3 my each have a width W1 between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm.

[0148] Fig. 7 illustrates a wall element 1 according to embodiments of the invention where the wall element 1 is configured to be used for e.g. load-bearing outer, insulating walls of a building.

[0149] The support arrangement 10a comprises vertical support beams 3 and insulating material, preferably in the form of PIR insulation blocks/plates that can be arranged to border the surface of the insulating core 2 (not illustrated in fig. 7) and the respective support beams 3 providing the spaces 7.

[0150] The wall element 10 comprises horizontal connection beams 50 arranged between the upper and lower part of the wall element 1, in this case between horizontal beams 22,23.

[0151] The horizontal connection beams 50 comprises in the present embodiment a plurality of connection beams 50 each arranged between adjoining, substantially vertical support beams 3, which help to assure that the overall thickness of the wall element 1 can be reduced as the surfaces of the connection beams may e.g. substantially align with the outer surface(s) 41 of the support beams 3 facing away from the inner insulating core 2.

[0152] However, in other embodiments of the invention, the horizontal connection beams 50 may be arranged on and attached to the outer surface 41 of the vertical support beams 3, and e.g. extend over more than two support beams, e.g. the entire length L of the wall element.

[0153] The connection beams 50 may in embodiments of the invention have cross sectional dimensions corresponding substantially to the cross sectional dimensions TH3, W1 of the substantially vertical support beams 3 as e.g. described in relation to fig. 6.

[0154] The horizontal connection beams 50 are configured to be used for connecting a siding system (not illustrated) or the like which is e.g. arranged to be a cover layer 5, 6 that will provide the outmost layer of the wall element 1 facing the exterior of the building. the cover layer is thus connected to the wall element by means of the connection beams, e.g. by means of mechanical fastening means such as screws, nails, clips, longitudinal profiles attached to the connection beams 50 and/or the like.

[0155] The connection beams 50 may moreover provide a supportive function to the support arrangement 10a and thereby to the wall element 1.

[0156] The intermediate insulating material 4 such as the PIR plates may thus in embodiments of the invention be arranged in rectangular spaces 7 to border the vertical support beams 3 and the horizontal connection beams 50.

[0157] The connection beams 50 arranged between the different adjoining support beams 3 are preferably arranged in horizontal rows as illustrated (the connection beams 50 of in adjacent spaces 7 are arranged substantially at the same height), and may comprise e.g. two rows, such as three rows (as illustrated) or even more rows of aligned connection beams 50.

[0158] The connection beams 50 may be arranged in parallel rows with a substantially similar vertical distance D2 between the rows of connection beams 50. The distance D2 may e.g. be between 300mm and 1000mm, such as between 600 mm and 800mm, for example between 740mm and 780mm. This distance D2 may naturally be adapted based on the number of connection beam rows and /or the height H of the wall element 1.

[0159] Generally it is to be understood that the wall element 1 in embodiments of the invention may comprise different configurations of support arrangements 10a, 10b on opposing side surfaces 11, 12 of the insulating core 2. This is illustrated in fig. 8 which illustrates a cross sectional view of an embodiment a wall element 1 according to embodiments of the invention, seen from the side.

[0160] In fig. 8, a first support arrangement 10a is arranged on the side surface 11 of the insulating core 2, and is arranged/configured to face the interior INT of the building. The first support arrangement 10a may substantially correspond to the support arrangements illustrated in e.g. figs. 5a and 5b where the intermediate insulation material 4, such as PIR plates, extend substantially from the bottom part/end to the top part/end of the wall element 1 with no horizontal connection beams 50 between the bottom part 9 and top part 8 of the wall element 1 (beyond the optional upper 22 and/or a lower 23 substantially horizontal beams).

[0161] Moreover, in fig. 8, the side surface part of the wall element 1 configured to face the exterior EX of the building comprises a second support arrangement 10b comprising horizontal connection beams 50 arranged to extend between the substantially vertical support beams 3 (not illustrated in fig. 8). The intermediate insulation material 4 (such as PIR plates) borders the support beams 3 and the connection beams 50 as illustrated in fig. 7. The support arrangement 10b is arranged on the substantially plane side surface 12 of the insulating core 2. The connection beams 50 are arranged between the intermediate insulating plates 4, and may moreover in preferred embodiments of the invention adhere to the surface 12 of the insulating core 2 by means of an adhesive.

[0162] The wall element 1 comprises cover layers in the form of cover plates 5, 6, e.g. plaster/gypsum plates configured to e.g. face the interior INT of the building, and this may in embodiments of the invention be provided already during prefabrication of the wall element 1 before the wall element is transported to the location of the building site.

[0163] A further siding structure/system for siding a building structure (not illustrated) such as siding planks/profiles, plates and/or the like may be arranged on the outside surface of the cover layer 6 by mechanical fasteners penetrating the cover layer into the connection beams 50. This may be done after erecting the building by arranging a plurality of wall elements 1 according to the present invention in order to establish an outer wall of a building.

[0164] In further embodiments of the invention, as illustrated in fig. 7 and 8, the support arrangements 10a, 10b are preferably both configured to be arranged to support on the building foundation 30, and both transfer vertical loads from

an upper building structure 31 such as a roof structure or a horizontal division of the building, to the building foundation 30. Ref 60 indicates the foundation support such as sand, soil and/or the like.

[0165] The upper building structure 31 such as a further wall element 1 (to provide a multi-floor building) (e.g. arranged on a an intermediate horizontal division), a roofing structure and or the like are in preferred embodiments of the invention configured to extend in over the wall element to support on both support arrangements 10a, 10b. Thus, during fire at one side INT or EXT of the wall element 1, if the load bearing capability of one of the support arrangements 10a, 10b fail over time due to the fire, the other support arrangement at the other side than where the fire is located takes over the load from the upper building structure 31.

[0166] Generally, it is to be understood that the support beams 3, horizontal upper/lower beams 22,23 and/or connection beams 50 in preferred embodiments of the invention may be made from longitudinal (preferably solid) wood elements/bars, preferably softer wood materials such as e.g. connifer wood, for example fir/pine wood cut into suitable pieces. In other embodiments of the invention, the wood material may be of a harder wood sort. In other embodiments of the invention, the support beams 3, horizontal upper/lower beams 22, 23 and/or connection beams 50 may be made from metal profiles such as longitudinal aluminium profiles.

[0167] The support beams may in advantageous embodiments of the invention 45x45mm (cross sectional) wood elements/bars, but it may also be 90x90mm (cross sectional) wood bars or the like e.g. dependent on the desired load carrying capability. The thickness of the insulating core and/or the intermediate insulation 4 may be adapted based on the cross sectional size of the support beams 3.

[0168] The support beams 3, horizontal upper/lower beams 22,23 and/or connection beams 50 preferably have/has a cross sectional, rectangular profile, such as e.g. a substantially quadratic, cross sectional profile, preferably having substantially the same thickness TH3 (see e.g. fig. 6).

[0169] Fig. 9 illustrates a cross-sectional view of a wall element 1 according to an embodiment of the invention, seen from above, where a one-piece insulation solution is provided.

[0170] In this embodiment, the intermediate insulating material 4 and the insulating core 2 is made from one piece of insulating foam material. This may be provided by arranging the support beams 3 and cover plates 5, 6 for each support arrangement in a press/form or the like, and then provide expanding PIR or PUR insulation foam between the support beams 3 and cover plates 5, 6 so it expands in a cavity provided between these beams 3 and plates 5. After the expansion of the foam, the intermediate insulating material 4 and insulating core 2 is provided in a one piece material.

[0171] Hereby, when the insulation material has expanded, it will abut the cover plates 5, 6 and the support beams 3 and thus provide the insulating core 2 and the intermediate insulating material 4 between support beams 3.

[0172] Alternatively, in other embodiments of the invention, it may be achieved by providing a pre-shaped insulating material element that has a thickness corresponding substantially to 2xTH5+1xTH2 (see fig. 6). The support beams 3 may hereby be arranged in longitudinal, substantially vertical cut-outs or channels in the insulating material at both side surfaces of the material, thereby providing that the insulating material between adjoining cut-outs constitutes/provides the intermediate insulation 4.

[0173] The opposing side surfaces 11, 12 of the insulating core 2 in fig. 10 has substantially vertical recesses in the side surfaces 11, 12, for the plurality of substantially vertical support beams 3.

[0174] Adhesive layers 100a, 100d (not illustrated in fig. 9, see fig. 10) may be provided between cover plates 5, 6 and intermediate insulation 4 and/or support beams 3.

[0175] Fig. 10 illustrates a cross-sectional view of a wall element 1 according to an embodiment of the invention, seen from above, where adhesive layers 100a-100c, as previously mentioned, may be provided.

[0176] The insulating wall element 1 of fig. 10 may substantially correspond to a wall element 1 as e.g. described in relation to fig. 1 and/or fig. 3 and/or fig. 5a and/or fig. 7-8. The wall element's insulating core 2 have opposing, substantially plane side surfaces 11, 12, and the intermediate insulating material 4 is provided by pre-shaped plate foam insulation modules (such as PIR or PUR) attached to the substantially plane side surfaces (11, 12) of the insulating core (2) by means of adhesive layers 100a-100c.

[0177] During production, a first cover plate/plates 6 such as a plaster plate or the like as e.g. described above may be arranged lying on a support (not illustrated in fig. 10), and a first adhesive layer 100a may then be added to the cover plate 6. The intermediate insulation plate modules 4 and support beams 3 are then placed on the first adhesive layer 100a to provide a first support arrangement 10b. Then a further, second adhesive layer 100b may be provided and the core element/layer 2 can then be added on this second adhesive layer 100b. Then, a third adhesive layer 100c may be provided on the surface 11 and the other, second support arrangement 10a with intermediate insulation module plates 4 and support beams 3 can be added on this third adhesive layer 100c. Finally, a fourth adhesive layer 100d is provided on the second support arrangement 10a, and a cover plate 5, such as a plaster plate or the like as e.g. described above, may be provided.

[0178] The adhesive layers 100a-100d preferably extends substantially between top part 8 and bottom part 9 and between end surfaces 20, 21 (see previous figures and description) of the wall element 1. The adhesive layers 100a-100d may in embodiments of the invention be substantially continuous or comprise lines/rows or "dots" of adhesive

material extending between/arranged between top part 8 and bottom part 9 and/or between end surfaces 21, 20.

[0179] A test example of a wall element 1 according to embodiments of the present invention e.g. as substantially illustrated and described in relation to figs. 1-3 and 5-8, having

- 45x45mm (cross-sectional) wooden support beams 3 at both sides attached to surfaces 11, 12 by adhesives,
- Upper and lower 45x45mm (cross-sectional) horizontal beams 22, 23
- intermediate insulation layers 4 and insulating core 2 being PIR foam,
- the cover layers 5, 6 being conventional 13mm plaster/gypsum plates,
- intermediate insulation layers 4 attached to insulating core 2 surfaces 11,1 2 by adhesive
- The wall element 1 having an overall thickness TH1 of about 300mm, has shown to:

    - comply with the REI certification REI 60
    - Provide a load caring capability of about at least 20kN, and
    - Provide a heat transfer co-efficient (U value) between 0,07 and 0,09 (about 0,08) W/m2K

[0180] The adhesive/glue layer(s) (100a-100d) may in embodiments of the invention be two component polyurethane adhesive. For example, an available SikaForce ® adhesive such as the SikaForce Component A SikaForce®-7710 L100 and Component B SikaForce®-7010 has been utilized and have been found advantageous, usable and acceptable as an adhesive for providing an insulating wall element that has been approved by fire-testing authorities and building authorities. The Component A - SikaForce®-7710 L100 is the basis part in the two-component polyurethane adhesive and may be used with the Component B - SikaForce®-7010 hardener.

[0181] The Component A may have a base comprising or consisting of polyols and one or more fillers, and Component B may comprise or consist of isocyanate(s).

[0182] Preferably the adhesive to be utilized is configured to allow hardening at a room temperature such as between 5°C to 50°C such as between 15°C to 30°C.

[0183] Generally, it the adhesive may have a "press time" (i.e. where a suitable press force is applied to assure adequate contact between the parts of the wall element to be connected). The "press time" may be between 3 minutes and 600 minutes, e.g. between 30 minutes and 400 minutes, e.g. between 150 minutes and 300 minutes. This may however vary with the temperature during hardening/curing and "open time" (working time to make a bond, where the surface still retains sufficient/adequate tack) of the glue/adhesive used for the layers 100a-100d.

[0184] It is to be understood that any suitable type of adhesive may be utilized in embodiments of the invention for one or more of the adhesive layers (100a-100d) in other embodiments of the invention. These may not necessarily be two-component adhesives, and they may e.g. be selected based on their adhesive properties, fire-resistant properties, their relation between the open time and press time and/or the like.

[0185] Generally, it is to be understood that the amount of adhesive applied to the surfaces of the wall element as for example described above, in embodiments of the invention may be between 20 g/m^2 to 750g/m^2 Such as between 50 to 500 g/m^2, e.g. between 100 to 250 g/m^2,

[0186] In embodiments of the invention, one or more of the applied adhesive layers (100a-100d) may comprise a fire resistant component embedded/mixed into the adhesive, for example an aluminium hydroxide such as an aluminium trihydroxide and/or other components providing enhanced fire-resistance properties. In other embodiments of the invention, such fire resistant component may however be omitted as the intermediate insulating layers 4 and/or the insulating core 2, may provide sufficient fire resistance together with the cover layers such as plaster plates or the like, e.g. as described previously in this document.

[0187] Figs. 11, 12a and 12b illustrate embodiments of the invention wherein the surface of the intermediate insulation material comprises recesses 18.

[0188] Fig. 11 illustrates a cross sectional view of an advantageous embodiment of the invention seen from above, wherein the intermediate insulation layer 4 comprises a plurality of recesses 18 arranged in the surface 19 of the intermediate insulation material 4. The recesses 18 are arranged so as to receive adhesives from the adhesive layer 100a between a cover plate 5, 6 and the surface 19 of the respective intermediate insulation material 4. The recesses 18 may as illustrated be in the form of channels in the surface of the intermediate insulation material 4.

[0189] Accordingly, when an adhesive layer 10a is applied and the cover plate 5, 6 is positioned and pressed on top of the adhesive layer 100a, a pressure force may be applied on the element 1 in order to provide a sufficient bonding by the adhesive layer(s). This forces "surplus" adhesive 100a (which has not yet hardened/cured) into the recesses 18 in the surface 19 of the intermediate insulation layer 4 facing the cover plate 5, 6.

[0190] Fig. 12a illustrates examples of an insulation material plate 4 seen in perspective, to be used between the support beams 3 as described above. The surface 19 comprises continuous recessed channels 18 extending between opposite, (e.g. substantially parallel) side surfaces 24, 25 as illustrated in fig. 12a.

[0191] The ratio between the amount of the surface 19 used for upper surface parts 28 to be used for connection with

the board 5, 6 and the amount of the surface that is recessed 18 may be determined by the following ratio:

$$m^2{}_{entire\ surface} : \sum m^2{}_{recessed\ surface}$$

between the surface area of the upper surface parts 28 to face and connect to the board 5, 6 by the adhesive layer, and the recessed parts 18 of the surface 19 may preferably be between 2:1 and 100:1, such as between 2:1 and 30:1, e.g. between 4:1 and 20:1 such as between 5:1 and 10:1. Preferably, the amount of surface 28 not recessed is larger than the amount of surface that is recessed.

[0192] For example (it is understood that the following size example and ratios is a non-limiting example for explanatory purposes): the ratio for an insulating plate 4 having:

- a width D1 of e.g. 50 cm
- a height H of e.g. 40 cm,
- six similar recessed channels 18 between the side surfaces 24, 25,
- width W2 of the recessed channels is about 1 cm

may result in the ration surface ratio:

$$m^2{}_{entire\ surface} : \sum m^2{}_{recessed\ surface}$$

$$(H\ x\ D1) : \sum 6\ x\ (H\ x\ W2)$$

$$= (40\ x\ 50) : \sum 6\ x\ (40\ x1) =$$

$$= 2000cm^2 : 240cm^2$$

$$\simeq 8.3 : 1$$

[0193] So in this example, the surface area of the upper surfaces 28 between the recessed channels 18 is about 8.3 times larger than the surface area used for the recesses 18, i.e. a ratio of 8.3:1.

[0194] Fig. 12b illustrates a further example of an insulation material plate 4 seen in perspective to be used between the support beams 3 as described above. The surface 19 comprises continuous recessed channels 18 extending between opposite, (e.g. substantially parallel) side surfaces 24, 25, and moreover further recessed channels 18 extending between opposite, (e.g. substantially parallel) side surfaces 26, 27. The recessed channels may thus cross each other.

[0195] Generally, it is to be understood that the recesses 18 in the surface 19 may have any suitable form and/or direction of extension in the surface 19, as well as the surface may comprise one or more of the recesses 18 in the surface 19. The recesses may also in embodiments be provided by holes (not illustrated) such as round, oval or rectangular holes in the surface 19.

[0196] It is understood that the surface 15 (see fig. 11) opposite to the surface 19 having the recesses 18 (the downwardly facing surface in figs. 12a and 12b) in embodiments of the invention also may comprise recesses 18 (not illustrated) as described above. However, in other embodiments, this surface may also be substantially plane. Moreover, figs. 12a and 12b illustrates that the intermediate insulating layer may be provided by pre-shaped, rectangular plates 4 of a rigid intermediate foam insulation material such as PIR or PUR.

[0197] For example figs. 5a, 5b and 10 illustrates that a wall element according to embodiments of the invention may be produced by the following method:

- arranging one or more first cover plates 6 on a support surface, e.g. substantially horizontally.
- providing a first adhesive layer 100a to the surface of said one or more first cover plates 6,
- arranging intermediate insulation plate modules 4 and support beams 3 on said first adhesive layer 100d, 100a, thereby providing a first support arrangement 10b,
- providing a second adhesive layer 100b to the surface 15, 14 of the first support arrangement 10b,
- providing one or more insulating core elements 2 on said second adhesive layer 100b,
- providing a third adhesive layer 100c on the surface 11 of said one or more insulating core elements,

- arranging intermediate insulation plate modules 4 and support beams 3 on said third adhesive layer 100c, thereby providing a second support arrangement 10a,
- providing a fourth adhesive layer 100d to the surface of said second support arrangement 10a, and
- arranging one or more second cover plates 6 on said fourth adhesive layer 100d.

[0198] After the adhesive layers has cured/hardened, e.g. under pressure applied on both cover layers/plates, the wall element may be transported to and erected at a building foundation.

[0199] In general, it is to be understood that the present invention is not limited to the particular examples described above but may be adapted in a multitude of varieties within the scope of the invention as specified in e.g. the claims. Accordingly, for example, one or more of the described and/or illustrated embodiments above may be combined to provide further embodiments of the invention. For example, it is generally to be understood that the different examples of thicknesses, lengths, heights, widths, placement, material choice of the wall element 1 and/or its component as e.g. described in relation to e.g. fig. 6 and/or any of the other figures may be utilized in any of figs. 1-5 and 7-10 and e.g. figs 11-12b.

[0200] Also, according to the above mentioned embodiments of the wall element 1 as disclosed in figs. 1-10 and/or fig. 11, it is generally understood that it is preferred that the intermediate insulation material 4 and the insulating core 2 between the support arrangements 10a, 10b are kept fixed relative to each other, e.g. by a one piece insulation as disclosed in relation to e.g. fig. 9 or by adhesive layers 100b and/or 100c. This provides an advantageous supporting effect and may help to provide a strong load bearing and space saving wall element 1 according to embodiments of the invention that has advantageous fire resistance properties.

List

[0201]

1	: Prefabricated wall element
2	: Insulating core
3	: substantially vertical support beams
4	: intermediate insulation material
5, 6	: Cover layers
7	: Space between adjoining support beams
8	: top part of wall element
9	: bottom part of wall element
10a, 10b	: support arrangements,
11, 12	: plane side surface(s) if insulating core
14	: Support beam surface facing side surface of the insulating core
15	: Surface of the insulation plate facing insulating core
16, 17	: Outer surfaces of cover layers/plates
18	: Recess in intermediate insulation material surface for receiving adhesive
20, 21	: End surfaces of wall element
22	: Upper substantially horizontal beam of support arrangement
23	: Lower substantially horizontal beam of support arrangement
24, 25, 26, 27	: End/side surfaces of intermediate insulation material plate
28	: upper surfaces between recesses 18
30	: Building foundation
31	: upper building structure of building to be supported by wall element
40	: Outer surface 40 of intermediate insulating material
41	: Surface of support beams facing away from the inner insulating core
50	: Connection beams
60	: Building foundation support
70, 73	: Routing for building installations
74	: Electrical wires
100a-100d	: Adhesive layers.

Claims

1. An insulating wall element (1) for load-bearing walls of buildings, wherein said insulated wall element (1) comprises:

an inner, rigid insulating core (2) of a foam insulation material which rigid insulating core (2) has opposing side surfaces (11, 12), and
a first support arrangement (10a) and a second support arrangement (10b) arranged at each their opposite side surfaces (11, 12) of said insulating core (2),
wherein each of said support arrangements (10a, 10b) comprises:

a plurality of substantially vertical support beams (3) arranged with a mutual distance, thereby providing one or more spaces (7) between said plurality of support beams (3), and
a rigid intermediate foam insulation material (4) arranged in each space (7) between two adjoining support beams (3) of said support arrangement (10a, 10b), which intermediate foam insulation material (4) borders the support beams (3) providing said one or more spaces (7), and

wherein said support beams (3) are attached to said insulating core (2).

2. Insulating wall element (1) according to claim 1, wherein said support beams (3) are attached to said insulating core (2), by means of an adhesive layer (100c, 100b).

3. Insulating wall element (1) according to any of the preceding claims, wherein said intermediate insulating material (4) comprises plate modules attached to said side surface(s) (11, 12) of said insulating core (2), preferably by means of an adhesive layer (100b, 100c), and wherein said at least one, preferably both, of said opposing side surfaces (11, 12) of said insulating core (2) preferably are substantially plane.

4. Insulating wall element (1) according to any of the preceding claims, wherein one or both of said first and second support arrangements (10a, 10b) comprises a cover layer (5, 6), preferably comprising one or more cover plates (5, 6) such as plaster plates, plates made from a wooden material, fibre plaster plates or masonite plates.

5. Insulating wall element (1) according to claim 4, wherein said cover layer (5, 6) comprises one or more cover plates (5,6) having an inner surface attached to said intermediate insulating material(4), preferably by means of an adhesive layer (100a, 100d).

6. Insulating wall element (1) according to claim 4 or 5, wherein said cover layer (5, 6) comprises one or more cover plates (5,6) having an inner surface attached to said vertical beams (3) by means of an adhesive layer (100a, 100d).

7. Insulating wall element (1) according to any of the preceding claims wherein one or more of said adhesive layers (100a-100d) are substantially continuous, or comprises a plurality of adhesive lines/rows or comprises a plurality adhesive "dots" of an adhesive material (100a-100d) extending/distributed between a top part (8) and bottom part (9) and/or between end surfaces (21, 20) of said wall element (1).

8. Insulating wall element (1) according to any of the preceding claims, wherein the intermediate insulation material (4) and/or said insulating core (2) is made from a Polyisocyanurate (PIR) foam insulation material (4).

9. Insulating wall element (1) according to any of the preceding claims, wherein the thickness (TH5) of said intermediate insulating layer (4) substantially matches the thickness (TH3) of said support beams (3), and wherein said intermediate insulating layer (4) preferably is provided by pre-shaped foam insulation modules having a thickness (TH5) substantially matching the thickness (TH3) of said support beams (3).

10. Insulating wall element (1) according to any of the preceding claims, wherein routing(s) (70, 73) for distributing building installations such as electrical installations (74) and/or water piping is provided in said insulating core (2) between the support beams (3) of said support arrangements (10a, 10b).

11. Insulating wall element (1) according to any of the preceding claims, wherein said intermediate insulating layer (4) comprises one or preferably a plurality of recesses (18), in the surface (19) facing said cover plate(s) (5, 6), and wherein said recesses (18) are arranged to receive an adhesive material, such as excess adhesive, of an adhesive layer (100a-100d) arranged between the cover plate (5) and the respective, intermediate insulating layer (4),
wherein the ratio between the amount of surface area parts (28) to be used for connection with a cover plate (5, 6) and the amount of the surface area that is recessed (18) preferably is between 2:1 and 100:1, such as between 3:1 and 30:1, e.g. between 4:1 and 20:1.

12. Insulating wall element (1) according to any of the preceding claims, wherein said support beams (3) are made from a wood material, preferably softer wood materials such as e.g. conifer wood, for example fir/pine wood, and wherein said support beams (3) have:

- a thickness (TH3) between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm, and
- a width (W1) between 20mm and 100mm such as between 30mm and 60mm, preferably between 40mm and 50mm, such as around 45mm.

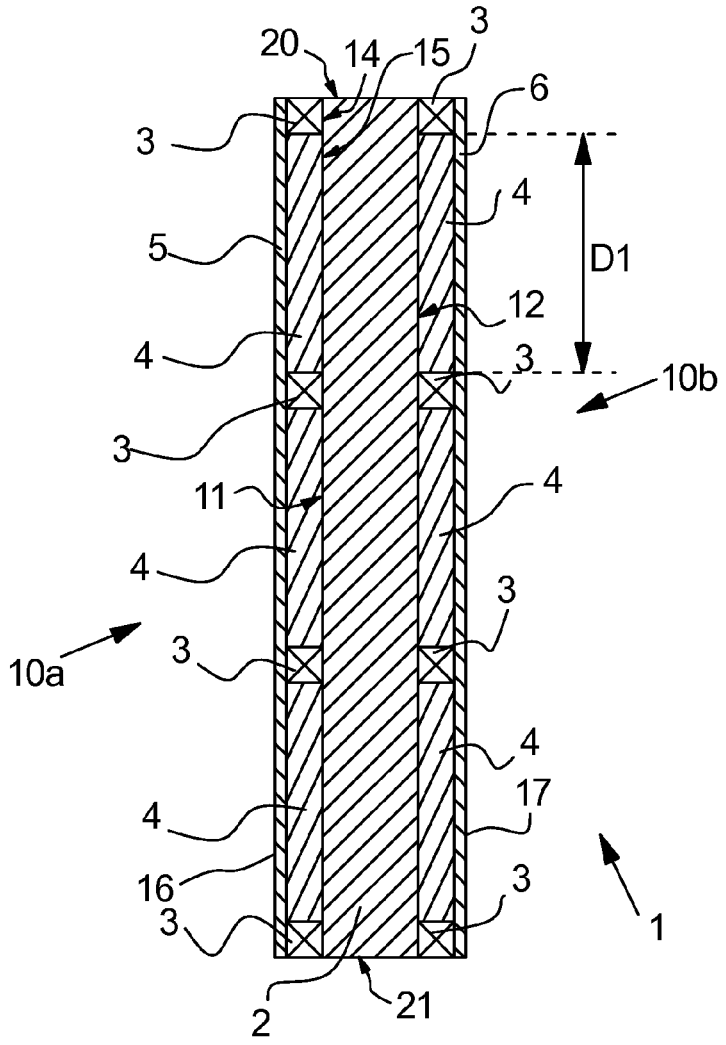
13. Insulating wall element (1) according to any of the preceding claims, wherein the overall thickness (TH1) of the insulating wall element (1) is no more than 500mm such as no more than 400 mm, preferably no more than 450mm such as around 300mm, for example so that the thickness (TH1) may be between 200mm and 350mm such as between 280 and 320mm including end values.

14. A building, which building comprises outer walls made from wall elements (1) according to any of the preceding claims, wherein said building comprises an upper building structure (31), such as a roofing structure or a further wall element to provide further floors in the building, which upper building structure (31) is arranged to support on both support arrangements of the wall element (1).

15. A method of producing an insulating wall element (1) for load-bearing walls of buildings, the method comprising the steps of

- arranging one or more first cover plates (6) on a support surface
- providing a first adhesive layer (100a) to the surface of said one or more first cover plates (6),
- arranging intermediate insulation plate modules (4) and support beams (3) on said first adhesive layer (100d, 100a), thereby providing a first support arrangement (10b),
- providing a second adhesive layer (100b) to the surface (15, 14) of the first support arrangement (10b),
- providing one or more insulating core elements (2) on said second adhesive layer (100b),
- providing a third adhesive layer (100c) on the surface (11) of said one or more insulating core elements,
- arranging intermediate insulation plate modules (4) and support beams (3) on said third adhesive layer (100c), thereby providing a second support arrangement (10a),
- providing a fourth adhesive layer (100d) to the surface of said second support arrangement (10a), and
- arranging one or more second cover plates (6) on said fourth adhesive layer (100d),

wherein the insulating, wall element (1) for load-bearing walls of buildings produced according to said method preferably is a wall element according to any of claims 1-13.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3
6
3
4
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D1
12
4
3
10b
3
11
4
4
3
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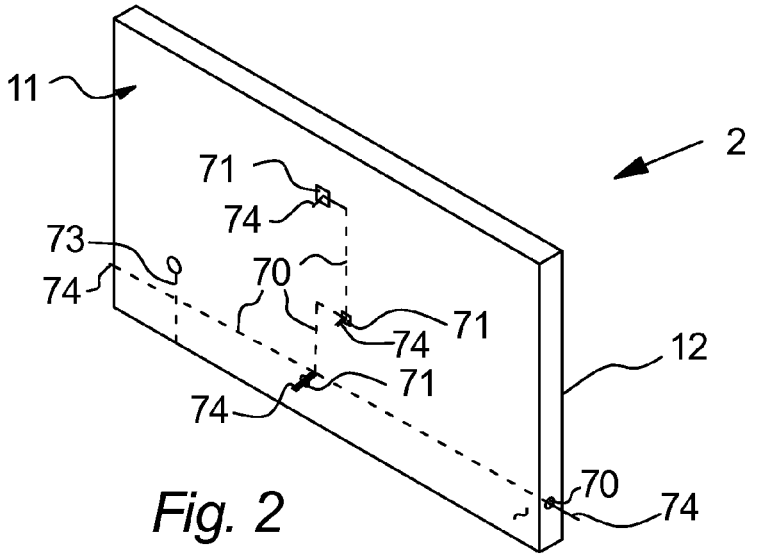
4
17
4
16
3
3
1
2
21

Fig. 1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2
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74
73
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12
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70
74

Fig. 2

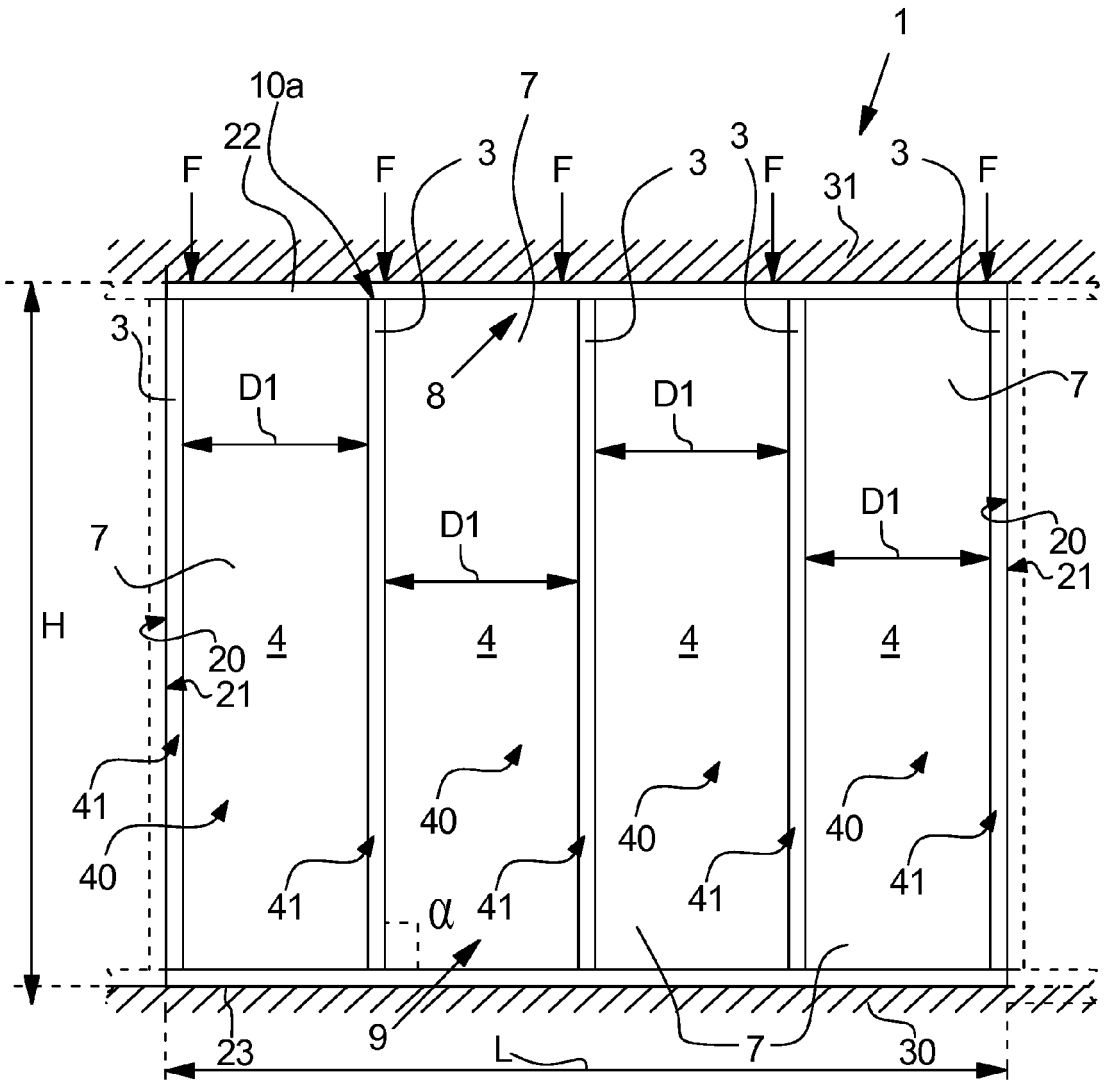


Fig. 3

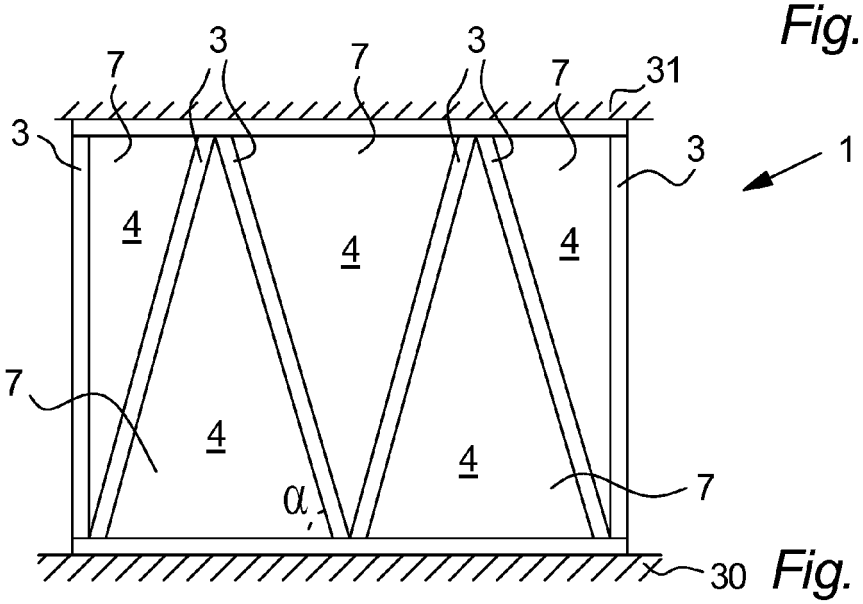
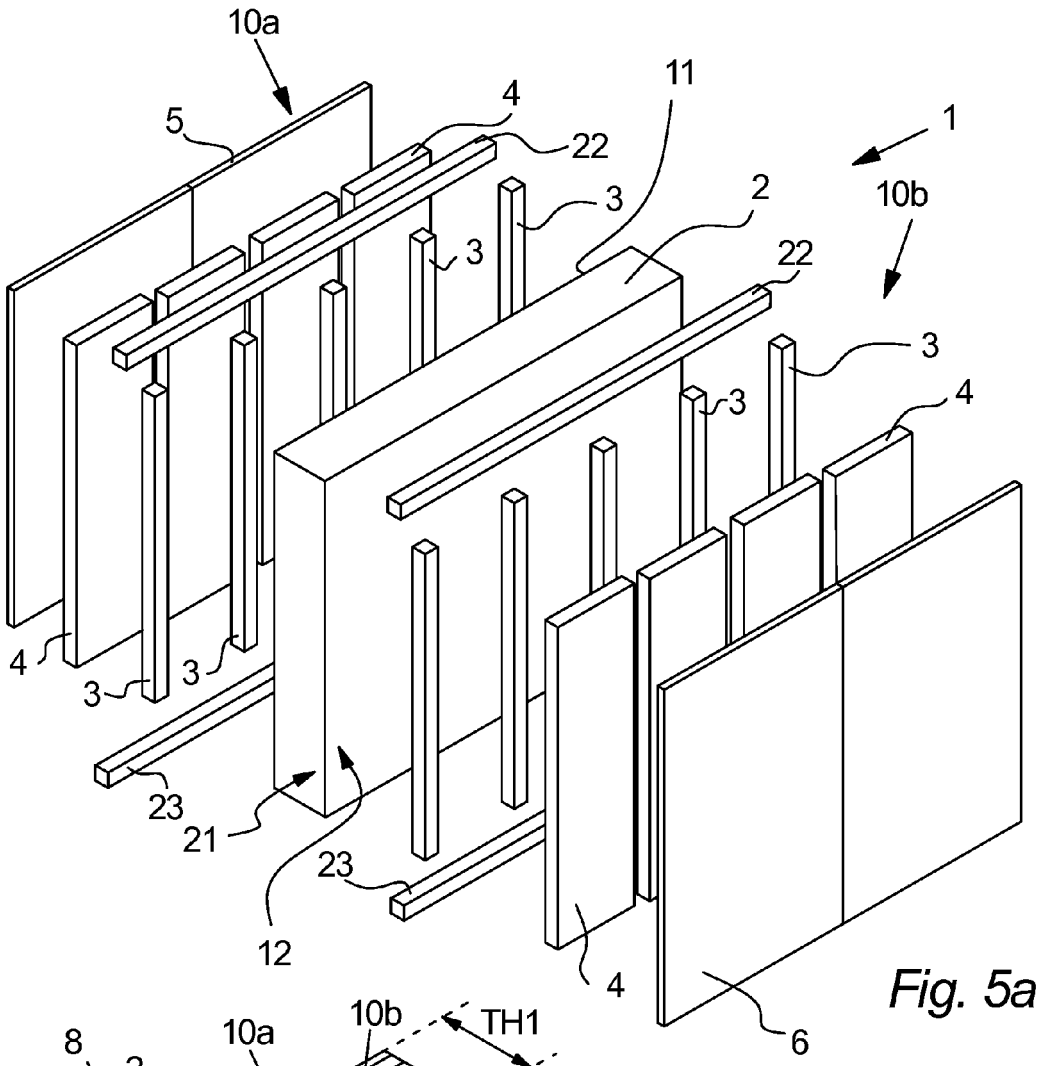


Fig. 4


10a
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4
22
11
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3
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10b
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22
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3
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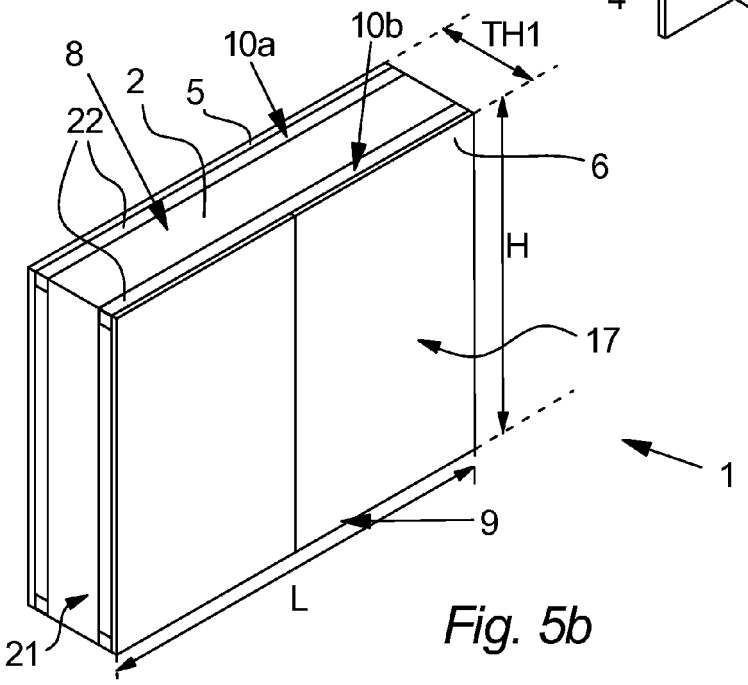
3
23
21
23
12
4
6

Fig. 5a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10a
10b
TH1
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6
H
17
1
9
L
21

Fig. 5b

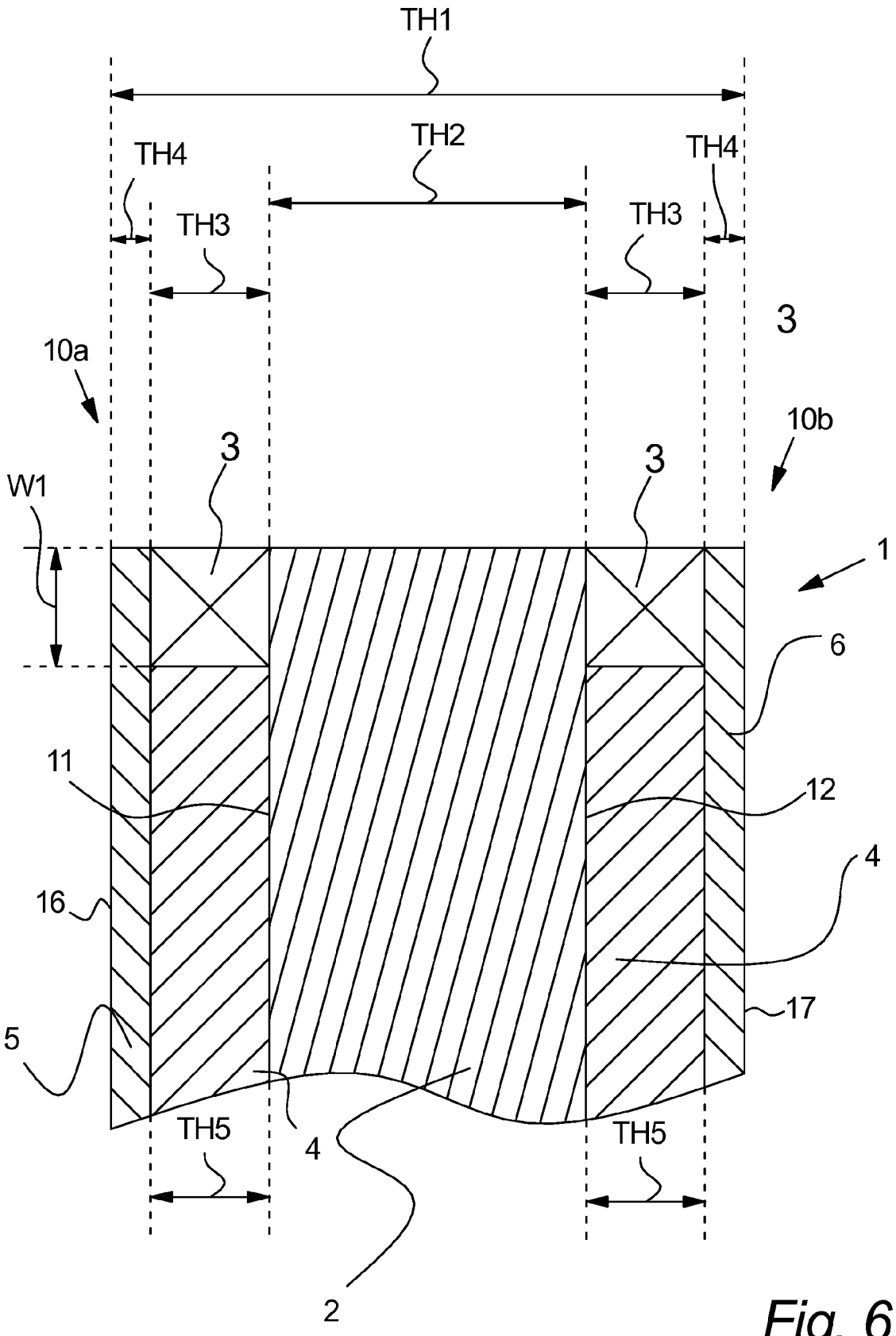
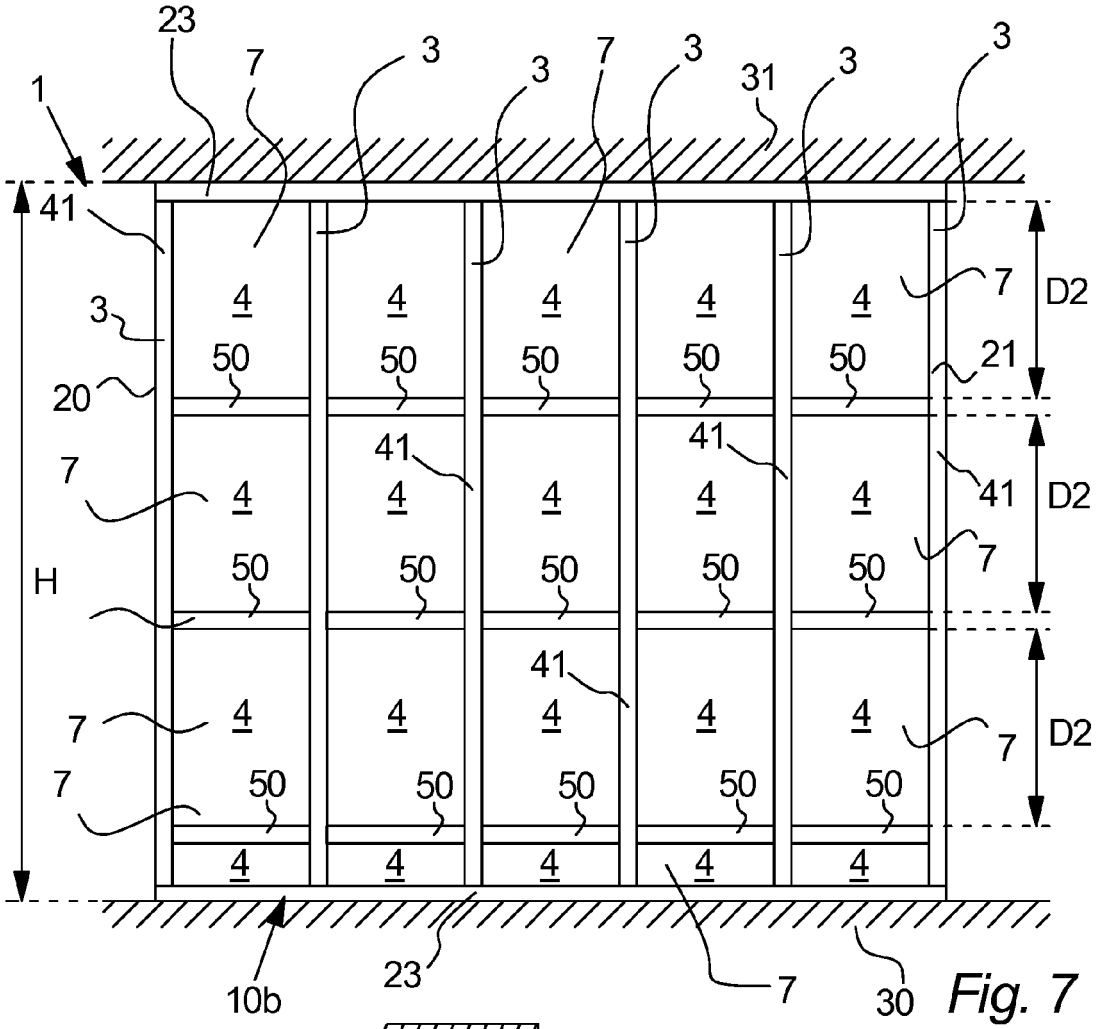


Fig. 6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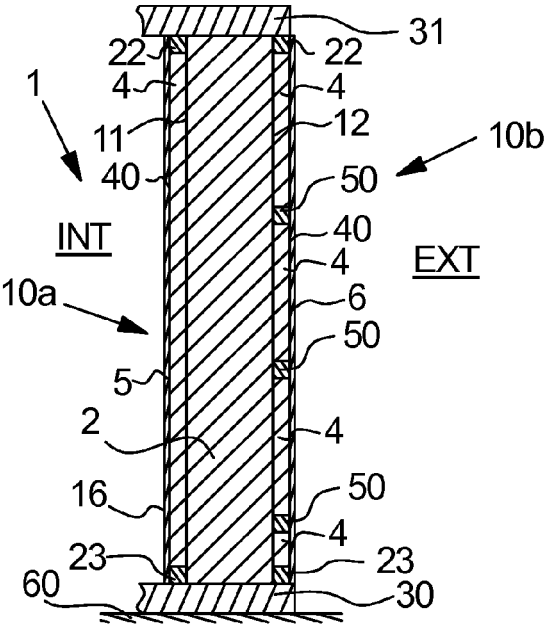
30

Fig. 7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4
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60
30

Fig. 8

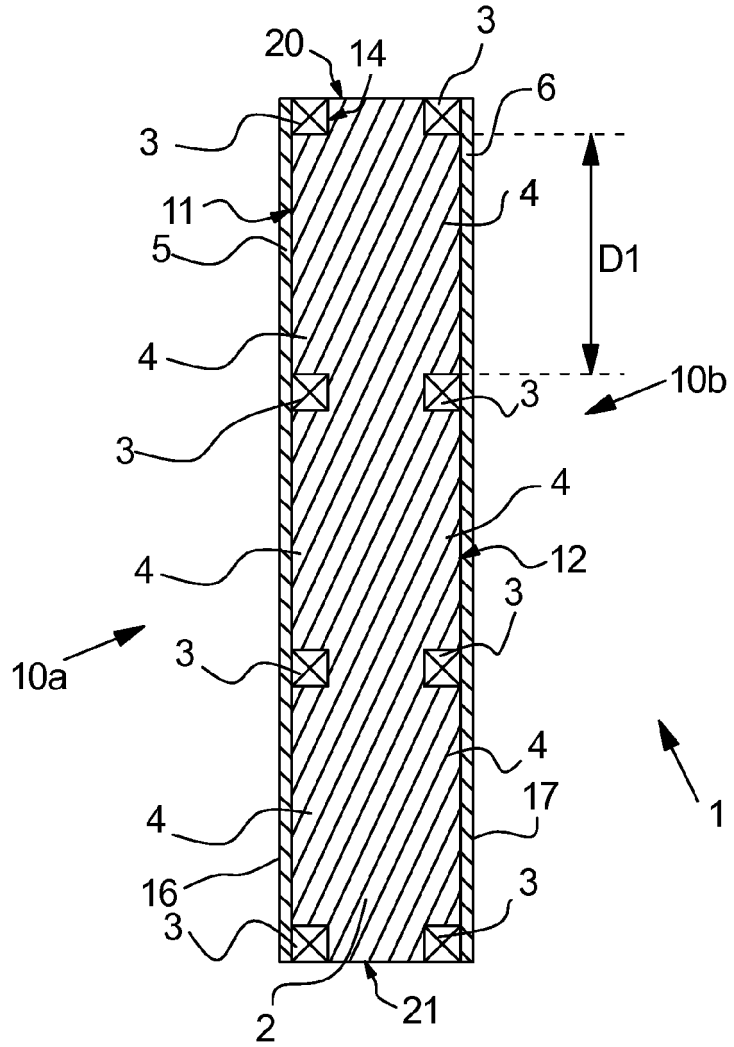
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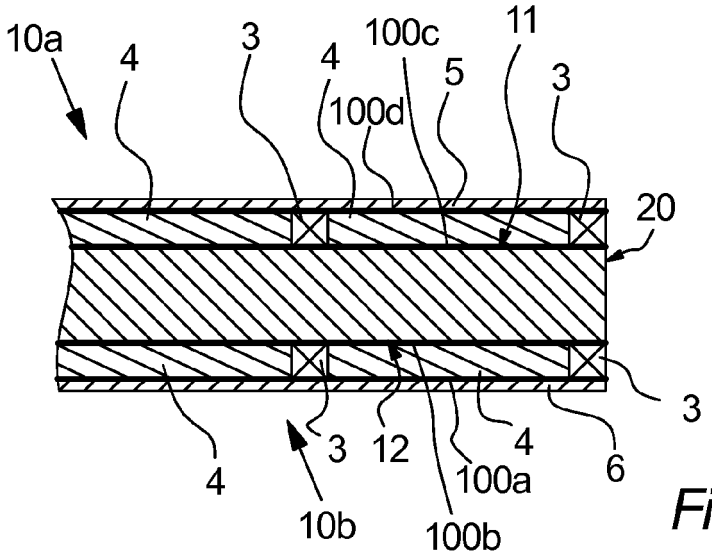
Fig. 9


10a
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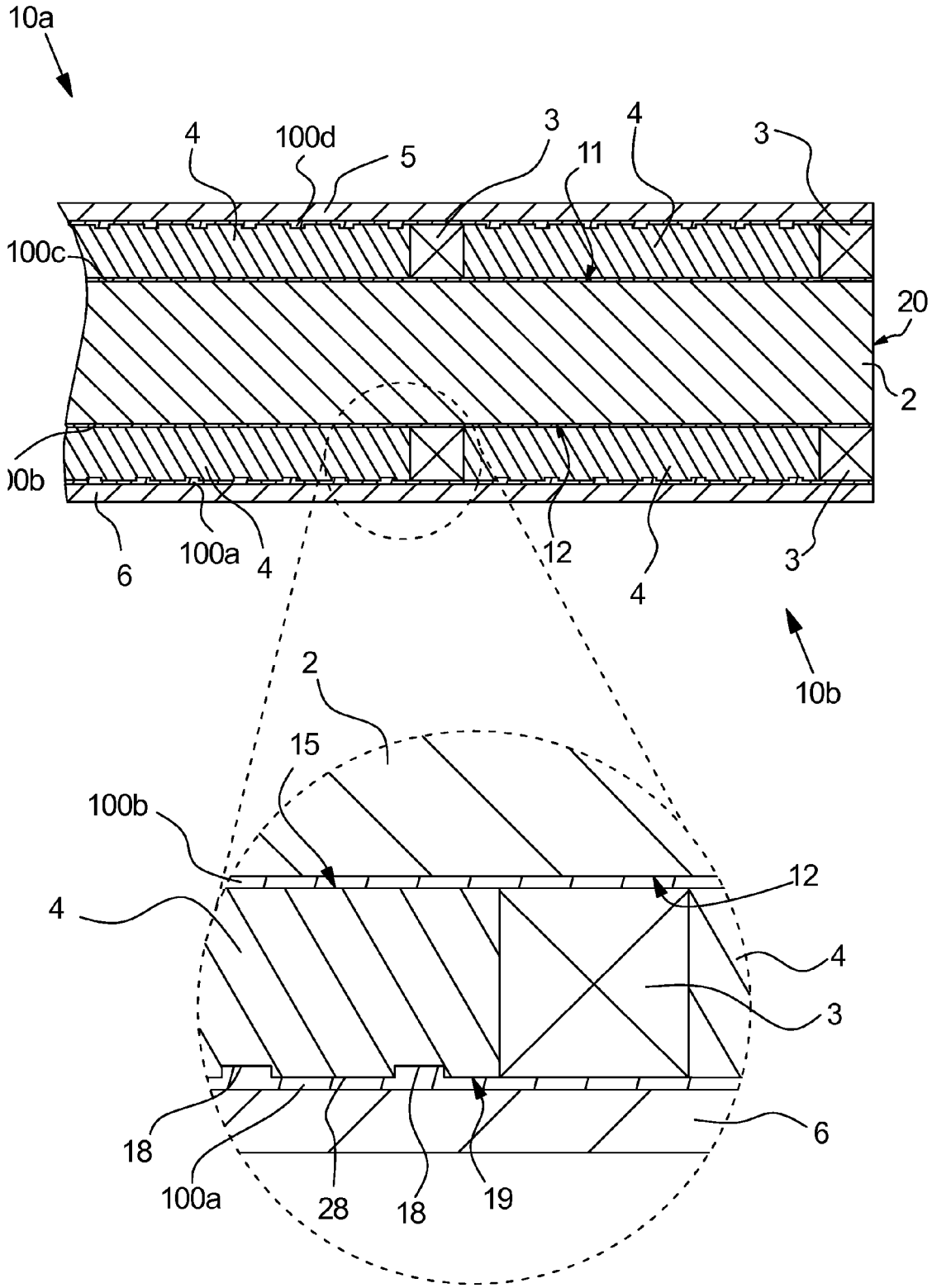
3
4
100c
11
5
3
100d
20
3
4
3
12
4
6
100a
10b
100b

Fig. 10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2
)0b
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100a
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3
18
100a
28
18
19
6

Fig. 11

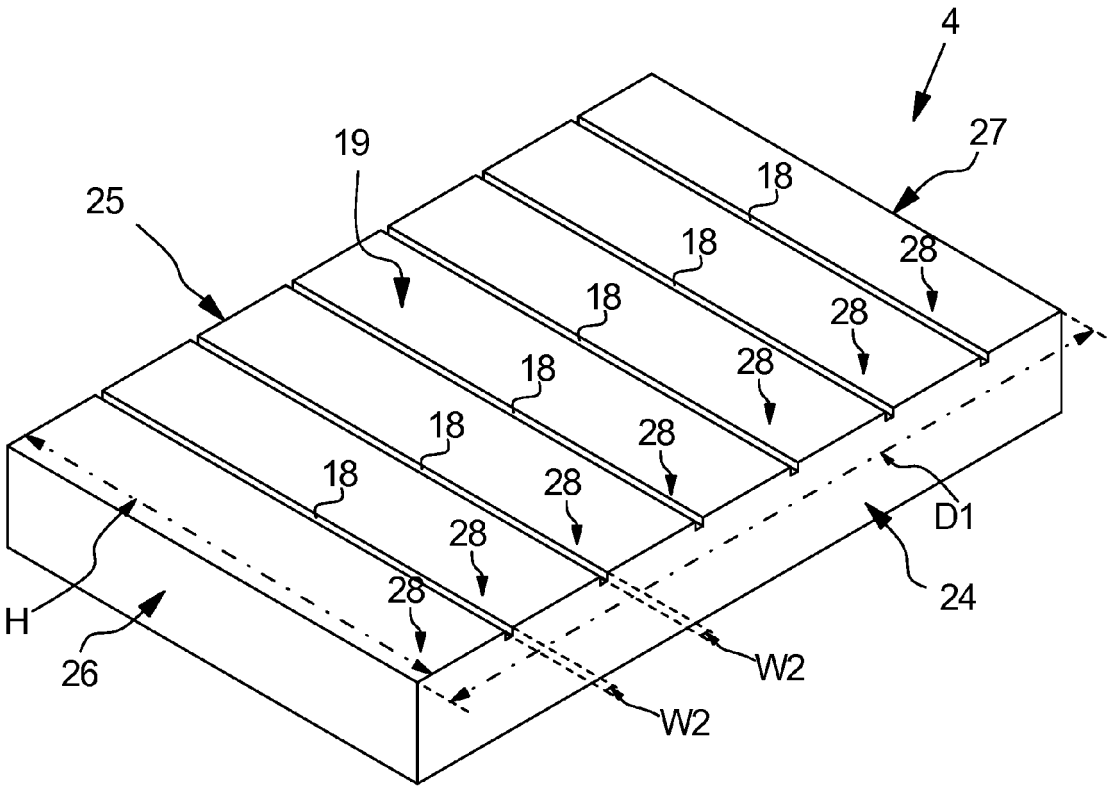

Fig. 12a

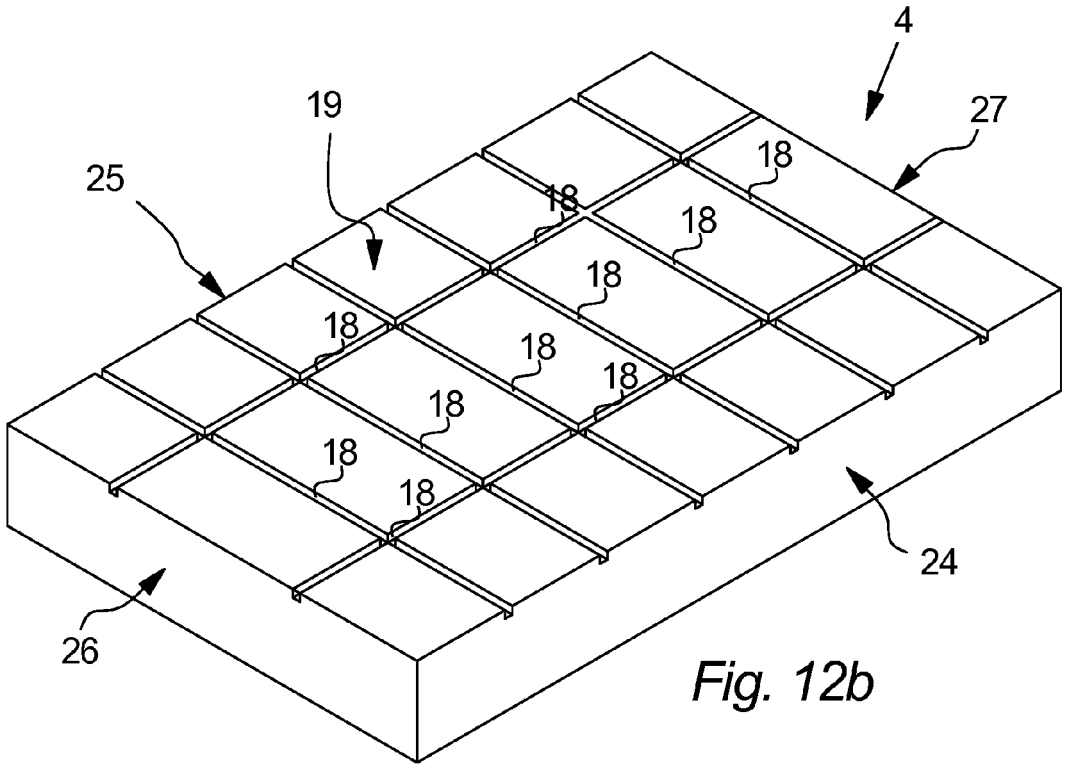

Fig. 12b

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EUROPEAN SEARCH REPORT

Application Number
EP 16 16 7425

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 141 299 A2 (UNIDEK B V [NL]) 6 January 2010 (2010-01-06) * paragraph [0001] - paragraph [0006] * * paragraph [0023] - paragraph [0024] * * paragraph [0028] - paragraph [0039]; figures 1,2 *	1-6,9, 11-13	INV. E04C2/20 E04B1/10 E04C2/296 E04C2/38
X	WO 95/34721 A1 (NESTE OY [FI]; KARIMAEKI SEPPO [FI]) 21 December 1995 (1995-12-21) * page 1, line 5 - line 32 * * page 4, line 14 - page 5, line 6 * * page 5, line 26 - page 7, line 9; figures 1-7 *	1,2,4-8, 10,14	
X	US 8 925 269 B1 (BEAUDIN CALEB J [US]) 6 January 2015 (2015-01-06) * column 2, line 34 - line 48 * * column 3, line 17 - column 8, line 12; figures 1-10 *	1,2,4, 6-8,10, 14	
A	DE 102 50 665 A1 (WEINMANN HOLZBAUSYSTEMTECHNIK [DE]) 25 March 2004 (2004-03-25) * the whole document *	1-15	TECHNICAL FIELDS SEARCHED (IPC) E04C E04B
A	US 4 163 349 A (SMITH GLENN W [US]) 7 August 1979 (1979-08-07) * column 3, line 6 - column 4, line 61; figure 3 *	1-15	
A	US 5 953 883 A (OJALA LEO V [US]) 21 September 1999 (1999-09-21) * column 1, line 4 - line 6 * * column 6, line 45 - column 8, line 58; figures 1-4 *	1-15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 November 2016	Giannakou, Evangelia

CATEGORY OF CITED DOCUMENTS

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10-11-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2141299 A2	06-01-2010	EP 2141299 A2	06-01-2010
		NL 2001759 C2	05-01-2010
WO 9534721 A1	21-12-1995	AU 2738795 A	05-01-1996
		EE 9600173 A	16-06-1997
		EP 0766766 A1	09-04-1997
		FI 942732 A	11-12-1995
		HU 215516 B	28-01-1999
		NO 965263 A	07-02-1997
		PL 317648 A1	28-04-1997
		RU 2153047 C2	20-07-2000
		WO 9534721 A1	21-12-1995
US 8925269 B1	06-01-2015	NONE	
DE 10250665 A1	25-03-2004	AT 343693 T	15-11-2006
		AU 2003282010 A1	30-04-2004
		CA 2498561 A1	25-03-2004
		DE 10250665 A1	25-03-2004
		EP 1537279 A1	08-06-2005
		RU 2333324 C2	10-09-2008
		US 2006096214 A1	11-05-2006
		WO 2004025046 A1	25-03-2004
US 4163349 A	07-08-1979	NONE	
US 5953883 A	21-09-1999	NONE	

EPO FORM P0459

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Patent documents cited in the description

- EP 2369084 A2 **[0002]**
- WO 9534721 A **[0006]**
- NO 151251 B **[0007]**