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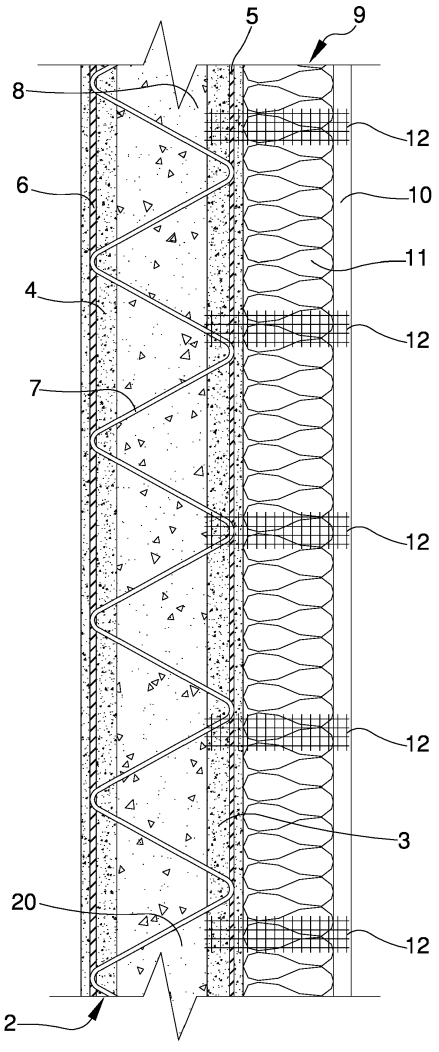
(54) PRECAST ELEMENT FOR BUILDINGS AND ITS REALIZATION PROCESS

(57) The precast element (1) for buildings comprises:
- a structural portion (2) having a first structural layer (3) and a second structural layer (4) substantially parallel to one another and comprises a first reinforcement (5) and a second reinforcement (6) respectively, connected to one another to make the first structural layer (3) integral to the second structural layer (4); and comprises a coating portion (9) coupled to said first structural layer (3) and comprising:
- a coating layer (10) adapted to be exposed in the environment;
- a heat insulating layer (11) interposed between the coating layer (10) and the first structural layer (3) and defining with the heat insulating layer (11) a coating portion (9) of the element (1); and
- at least one connecting element (12) which extends from the coating layer (10) to the first structural layer (3) and is partially inserted therein to retain the coating portion (9) coupled to the first structural layer (3).

Fig.1



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Description

[0001] The present invention relates to a precast element for buildings and its realization process.

[0002] In the construction sector precast reinforced concrete elements are known to be used both for the realization of structural support elements and for the realization of infrastructural elements, as well as for the realization of residential modules, industrial sheds and other buildings designed to create an environment accessible to people.

[0003] A well-known type of precast elements involves the realization of a "double-sheet" element having a first wall and a second wall, both in reinforced concrete, separated from each other to form an inter-space.

[0004] The double-sheet wall is provided with an iron trellis, welded to the reinforcements of both walls and adapted to make the walls themselves integral. The interspace can be empty or filled with various types of material.

[0005] This solution is used as a structural wall in the construction of buildings such as industrial sheds and homes, and can be realized by means of the disposable reinforced concrete formwork technique.

[0006] One drawback of this type of precast element is tied to the fact that in order to be used as a house wall, it requires subsequent treatments, e.g., the application of plasters and interior finishes, or heat-insulating coatings, or the application of external insulation, in order to realize a comfortable environment suitable for the needs of the residents.

[0007] Jobs done subsequently are unnatural, of low aesthetic value and easily susceptible to wear, with detachment of the material applied to the reinforced concrete walls.

[0008] Furthermore, subsequent jobs require time, additional material and manpower, resulting in increased installation costs.

[0009] Similar considerations can also be made for the other types of constructions, such as e.g. the industrial sheds.

[0010] For this type of building too, in fact, the need is known to create a climatically and aesthetically comfortable environment, in order to satisfy both the needs of the occupants and the parameters required by regulations, increasingly more restrictive in recent years.

[0011] In general, the need is known to realize buildings that save time and costs, but without sacrificing quality in terms of aesthetics, comfort, safety and energy saving.

[0012] The main aim of the present invention is to provide a precast element for buildings and its realization process which can be used in the construction of residential or industrial buildings.

[0013] One object of the present invention is to provide a precast element for buildings and its realization process which allows realizing ready-to-live residential and industrial buildings, which do not require subsequent interventions of coating or interior finishes.

[0014] A further object of the present invention is to provide a precast element for buildings and its realization process which allows realizing residential and industrial buildings having high quality and safety standards and which can meet the most stringent anti-seismic criteria required by law.

[0015] Another object of the present invention is to provide a precast element for buildings and its realization process which allows overcoming the aforementioned drawbacks of the prior art within the scope of a simple, rational, easy, efficient to use and cost-effective solution.

[0016] The aforementioned objects are achieved by the present precast element for buildings and its realization process having the characteristics of claim 1 and 9.

[0017] Other characteristics and advantages of the present invention will become more evident from the description of a preferred, but not exclusive embodiment of a precast element for buildings and its realization process, illustrated by way of an indicative, but non-limiting example, in the attached drawings in which:

Figure 1 is a side sectional view of a portion of the precast element according to the invention;

Figure 2 is an exploded view of the precast element according to the invention;

Figure 3 is a view of different types of the precast element according to the invention;

Figures 4 to 9 are schematic views of the different steps of a realization process of a precast element according to the invention.

[0018] With particular reference to these illustrations, reference numeral 1 globally indicates a precast element for buildings.

[0019] The element 1 is particularly suitable as a supporting wall for buildings (Figure 3) with or without openings for door and window frames, but different uses cannot be ruled out in the construction and building sector, such as e.g. as an infill element.

[0020] Figure 3 shows equivalent solutions wherein the element la has an opening 18 for windows, the element 1b has an opening 19 for large doors, and the element 1c has no openings.

[0021] The element 1 comprises a structural portion 2 having a first structural layer 3 and a second structural layer 4 substantially parallel to one another.

[0022] The structural layers 3, 4 comprise a respective first reinforcement 5 and a second reinforcement 6 connected to one another, so as make the first structural layer 3 integral to the second structural layer 4.

[0023] In the present embodiment, the reinforcements 5, 6 are made of steel, and are electro-welded to one another.

[0024] In particular, in the present embodiment, the first reinforcement 5 comprises a trestle connecting portion 7 coming out of the first structural layer 3.

[0025] The trestle connecting portion 7 is adapted to

make the two structural layers 3, 4 integral to one another and create the inter-space 8 in which the connecting portion 7 is placed.

[0026] At the time of final on-site installation, the inter-space 8 can be filled with different types of material depending on the use that can be made of the element 1.

[0027] If used as a load-bearing wall, the inter-space 8 can be filled in-situ with filling material 20 such as concrete, mortar or other types of mixtures.

[0028] Usefully, the structural portion 2, can comprise foundation rods (not shown in the illustrations), i.e. steel elements coming out of the structural layers 3, 4 and adapted to be secured onto specific foundation slabs.

[0029] Advantageously, the first structural layer 3 comprises a structural binding material, hereinafter referred to as the "second binding material".

[0030] In particular, the second binding material comprises cement and has the properties of a hydraulic binder.

[0031] By way of example, the second binding material is of the type of a mixture of concrete, comprising cement and aggregates.

[0032] Technically equivalent solutions cannot be ruled out wherein the second binding material comprises a mixture of cement, aggregates and other substances such as additives or retardants.

[0033] In the present embodiment, the first structural layer 3 is of the type of a reinforced concrete slab.

[0034] The second structural layer 4 also comprises a structural binding material, hereinafter referred to as the "third binding material".

[0035] In particular, the third binding material comprises cement and has the properties of a hydraulic binder.

[0036] By way of example, the third binding material is of the type of a mixture of concrete, comprising cement and aggregates.

[0037] Technically equivalent solutions cannot be ruled out wherein the third binding material comprises a mixture of cement, aggregates and other substances, for example additives or retardants.

[0038] In the present embodiment, the second structural layer 4 is also of the type of a reinforced concrete slab.

[0039] For the second and third binding materials, the use cannot be ruled out of different cement-based binding materials, e.g. cement mixtures such as "cement and leca", or "polystyrene and cement", or materials known at the state of the art as "pumice" or "lapillus".

[0040] Cement with additives or solutions cannot be ruled out wherein the first structural layer 3 is made of a material different to the second structural layer 4. According to the invention, the element 1 comprises a coating portion 9 coupled to the first structural layer 3.

[0041] In particular, the coating portion 9 comprises a coating layer 10 adapted to be exposed in the environment.

[0042] The coating layer 10 comprises a coating binding material, hereinafter referred to as the "first binding material".

[0043] Advantageously, the first binding material comprises gypsum.

[0044] This way, the coating layer 10 is made of gypsum and involves advantages tied to the properties of gypsum.

[0045] Gypsum, in fact, besides having excellent thermal and hygrometric properties, allows creating a pleasant appearance adapted to increase the comfort of the environment in which the coating layer is exposed, e.g., the interior of a house.

[0046] In the present embodiment, the first binding material is of the fibrous gypsum type, so that it is more resistant to deformation forces.

[0047] Different solutions cannot be ruled out wherein the first binding material is of the type of another aerial binder, such as mixtures of gypsum, mortar, plaster, or of the type of a hydraulic binder, such as a cement mixture.

[0048] Furthermore, solutions cannot be ruled out which provide mixtures comprising gypsum and other aggregates as a first binding material.

[0049] Advantageously, the coating portion 9 comprises a heat insulating layer 11 interposed between the coating layer 10 and the first structural layer 3.

[0050] The heat insulating layer 11 has the function of giving both thermal and acoustic insulating properties to the coating portion 9.

[0051] The heat insulating layer 11, in particular, comprises foamed polymer material. In the present embodiment, the heat insulating layer 11 is made of a single heat insulating material 16.

[0052] In particular, the heat insulating layer 11 is made of polyurethane foamed panels, but different solutions involving the use of polystyrene foam or other heat insulating material of natural origin cannot be ruled out.

[0053] Solutions cannot furthermore be ruled out wherein the heat insulating layer 11 is made of several layers of heat insulating materials coupled together, e.g., a heat insulating material 16 coupled with a second, different heat insulating material.

[0054] According to the invention, the element 1 comprises at least one connecting element 12 which extends from the coating layer 10 to the first structural layer 3.

[0055] The connecting element 12 is partially inserted both in the coating layer 10 and in the first structural layer 3, by passing through the whole heat insulating layer 11, so as to retain the coating portion 9 coupled to the first structural layer 3. Advantageously, the connecting element 12 is of the type of a fiberglass net.

[0056] In the present embodiment, the element 1 comprises a plurality of connecting elements 12 evenly distributed with respect to the coating portion 9, as shown in Figure 2.

[0057] The connecting elements 12 are of the type of fiberglass net, in particular high alkali resistant fiberglass net with 5 mm by 5 mm mesh size.

[0058] This way, the connecting elements 12 do not

transmit heat, thus favoring the heat insulation of the element 1.

[0059] The nets are equally spaced along the coating portion 9 so as to distribute the cutting forces as evenly as possible and thus ensure maximum non-deformability of the element.

[0060] Alternative solutions to the one shown above cannot be ruled out wherein the connecting elements 12 are made differently, e.g., with stainless steel or iron or fiberglass elements, or are of the type of pultruded bars made of carbon fiber and its derivatives.

[0061] In the present embodiment, the element 1 is advantageously equipped with systems 15 which are of the type of electrical, hydraulic, technological systems, and other accessories now to be found in every home.

[0062] This way, the element 1 can be installed and fitted to other similar elements for the construction of a ready-to-live housing unit, without the need for any further interventions.

[0063] A process for the realization of a precast element for buildings is schematically shown in the figures from 4 to 9.

[0064] According to the invention the process comprises a first step A of realization of a coating layer 10 adapted to be exposed in the environment, e.g. in a home environment.

[0065] The first step A comprises casting in a mold 13 a first binding material to form a coating layer 10.

[0066] The first binding material passes from an initial state in which it is substantially liquid, and therefore moldable, to a final state in which it is substantially solid.

[0067] Usefully, the step A comprises the preliminary arrangement of systems 15 which may be of the type of electrical, hydraulic systems or accessories, as required by technical standards and the common housing practice.

[0068] Still according to the invention, the process comprises a second step B of realization of a heat insulating layer 11 associated with the coating layer 10 to form a coating portion of the element 1.

[0069] Preferably, the second step B comprises inserting the heat insulating material 16 into the mold on top of the coating layer 10 when the first binding material is in the initial state, so as to form the heat insulating layer 11.

[0070] Solutions cannot be ruled out wherein other materials having insulating properties are inserted in addition to the heat insulating material 16, so as to form a heat insulating layer 11 provided with several overlapping materials.

[0071] The second step B also provides inserting at least one connecting element 12 in the coating layer 10 when the first binding material is in said initial state.

[0072] Usefully, the connecting element 12 is partially left to protrude from the coating portion 9, as shown in Figure 5.

[0073] In the present embodiment, the second step B provides to arrange heat insulating material 16, usefully foam polyurethane panels, on the coating layer 10 when the first binding material is still in a substantially liquid state.

[0074] This way, the heat insulating material 16 is made to adhere to the coating layer 10.

[0075] At the same time, the second step B provides inserting a plurality of connecting elements 12, preferably fiberglass nets, in the coating layer 10.

[0076] The nets are distributed in a substantially even manner on the surface of the coating layer 10 and are positioned so as to protrude from the heat insulating layer 11.

[0077] Still according to the invention, the process comprises a third step C of realization of a first structural layer 3 coupled to the coating portion 9 so as to form a precast portion 17.

[0078] The first structural layer 3, therefore, is realized already coupled to the coating portion 9 so as to obtain a single precast portion 17 which can be maneuvered for the realization of successive steps.

[0079] In particular, the third step C comprises pouring a second binding material into the mold 13, on top of the heat insulating layer 11 and so as to come in contact with the connecting elements 12, submerging them, to form a first structural layer 3 coupled to the coating portion 9.

[0080] The second binding material passes from an initial state in which it is substantially liquid to a final state in which it is substantially solid.

[0081] The third step C also provides placing a first reinforcement 5 in the first structural layer when the second binding material is in the initial state.

[0082] In the present embodiment is arranged the first reinforcement 5 which, as shown, comprises a connecting portion 7 intended to protrude from the first structural layer 3.

[0083] Subsequently, the second binding material is poured so as to form a layer which submerges the first reinforcement 5, but not the connecting portion 7.

[0084] At the end of these first three steps A, B, C, with the binding materials consolidated in the final state, a precast portion 17 is obtained which can be lifted from the mold 13, and possibly overturned.

[0085] The process in fact comprises a fourth step D of realization of a second structural layer 4 associated with the first structural layer 3 and substantially parallel thereto.

[0086] In particular, the fourth step D comprises fixing a second reinforcement 6 to the connecting portion 7, in a substantially parallel position to the first reinforcement 5.

[0087] Subsequently, the fourth step D provides transferring by tilting the precast portion 17 into a second mold 14 into which a third binding material is poured.

[0088] The connecting elements 12 allow absorbing part of the deformation forces which generate during the lifting and overturning of the precast portion 17.

[0089] This way, the coating layer 10 is protected from cracks which would damage the coating portion 9.

[0090] The third binding material is adapted to submerge the second reinforcement 6 to create the second structural layer 4.

[0091] In the same way as described for the other binding materials, the third binding material also changes from an initial state in which it is substantially liquid to a final state in which it is substantially solid.

[0092] In the present embodiment, the precast portion 17 is lifted and overturned, by placing the connecting portion 7 inside the second mold 14 where the third binding material is cast.

[0093] Usefully, the third binding material and the second binding material are of the same type, but solutions cannot be ruled out which provide for the use of different materials for the first structural layer 3 and for the second structural layer 4.

[0094] The precast element 1 and the realization process described in the present patent document comprise a coating portion 9 and a structural portion 2.

[0095] Similar solutions cannot be ruled out which provide for further stratifications, both during the process step and during the assembly step of the precast element.

[0096] It has in practice been ascertained how the described invention achieves the intended objects and, in particular, the fact is underlined that the provided precast element for constructions can be used in the construction of residential or industrial buildings.

[0097] The coating portion, in fact, is particularly adapted to be used in the construction of residential buildings, both for the thermal and acoustic insulation properties of the heat insulating layer, and for the properties of the coating layer.

[0098] The latter, in particular, being made of gypsum or similar mixtures, is particularly pleasant for the person living in the building.

[0099] Furthermore, the provided precast element can also be used for the construction of ready-to-use residential and industrial buildings, which do not require subsequent coating or interior finishing.

[0100] The precast element, in fact, during the realization phase, can be equipped with all the electrical systems and accessories normally used in buildings, so as to obtain an element ready to be put in place and installed.

[0101] Furthermore, there is no need to carry out further realization steps of further coating layers, as the gypsum coating layer is already ready.

[0102] The provided precast element therefore permits realizing residential and industrial buildings to high quality and safety standards.

[0103] Such buildings, in fact, being realized with precast elements of this type, can comply with the most stringent anti-seismic criteria provided for by law, ensuring high resistance to seismic stresses.

Claims

1. Precast element (1) for buildings comprising a structural portion (2) having a first structural layer (3) and a second structural layer (4) substantially parallel to one another and comprising a first reinforcement (5) and a second reinforcement (6) respectively, connected to one another to make said first structural layer (3) integral to said second structural layer (4); **characterized by** the fact that it comprises a coating portion (9) coupled to said first structural layer (3) and comprising:

- a coating layer (10) adapted to be exposed in the environment;
- a heat insulating layer (11) interposed between said coating layer (10) and said first structural layer (3) and defining with said heat insulating layer (11) a coating portion (9) of said element (1); and
- at least one connecting element (12) which extends from said coating layer (10) to said first structural layer (3) and is partially inserted therein to retain said coating portion (9) coupled to said first structural layer (3).

2. Element (1) according to claim 1, **characterized by** the fact that said connecting element (12) is of the type of a fiberglass net.

3. Element (1) according to one or more of the preceding claims, **characterized by** the fact that it comprises a plurality of said connecting elements (12) evenly distributed with respect to said coating portion (9).

4. Element (1) according to one or more of the preceding claims, **characterized by** the fact that said coating layer (10) comprises a first binding material.

5. Element (1) according to one or more of the preceding claims, **characterized by** the fact that said first binding material comprises gypsum.

6. Element (1) according to one or more of the preceding claims, **characterized by** the fact that said first structural layer (3) comprises a second binding material.

7. Element (1) according to one or more of the preceding claims, **characterized by** the fact that said second binding material comprises cement.

8. Element (1) according to one or more of the preceding claims, **characterized by** the fact that said heat insulating layer (11) comprises foamed polymer material.

9. Process for the realization of a precast element for buildings, **characterized by** the fact that it comprises:

- a first step (A) of realization of a coating layer (10) adapted to be exposed in the environment;
- a second step (B) of realization of a heat insulating layer (11) associated with said coating layer (10) to form a coating portion (9) of said element;
- a third step (C) of realization of a first structural layer (3) coupled to said coating portion (9) to form a precast portion (17);
- a fourth step (D) of realization of a second structural layer (4) associated with said first structural layer (3) and substantially parallel thereto, to form a precast element (1).

10. Process (1) according to claim 9, **characterized by** the fact that said first step (A) comprises casting in a mold (13) a first binding material to form a coating layer (10), said first binding material passing from an initial state in which it is substantially liquid to a final state in which it is substantially solid.

11. Process (1) according to claim 9 or 10, **characterized by** the fact that said second step (B) comprises:

- inserting the heat insulating material (16) into said mold (13) on top of said coating layer (10) when said first binding material is in said initial state, to form said heat insulating layer (11);
- inserting at least one connecting element (12) in said coating layer (10) when said first binding material is in said initial state, said connecting element (12) partially protruding from said coating portion (9).

12. Process (1) according to one or more of claims 9 to 11, **characterized by** the fact that said third step (C) comprises:

- pouring a second binding material into said mold (13) on top of said heat insulating layer (11) and in contact with said connecting element (12) to form a first structural layer (3) coupled to said coating portion (9), said second binding material passing from an initial state in which it is substantially liquid to a final state in which it is substantially solid;
- placing a first reinforcement (5) in said first structural layer (3) when said second binding material is in said initial state, said first reinforcement (5) comprising a connecting portion (7) partially protruding from said first structural layer (3).

13. Process according to one or more of claims 9 to 12, **characterized by** the fact that said fourth step (D) comprises:

- fixing a second reinforcement (6) to said connecting portion (7) and in a substantially parallel position to said first reinforcement (5);
- transferring by tilting said precast portion (17) into a second mold into which a third binding material is poured adapted to submerge said second reinforcement (6) to create said second structural layer (4), said third binding material passing from an initial state in which it is substantially liquid to a final state in which it is substantially solid.

Fig.1

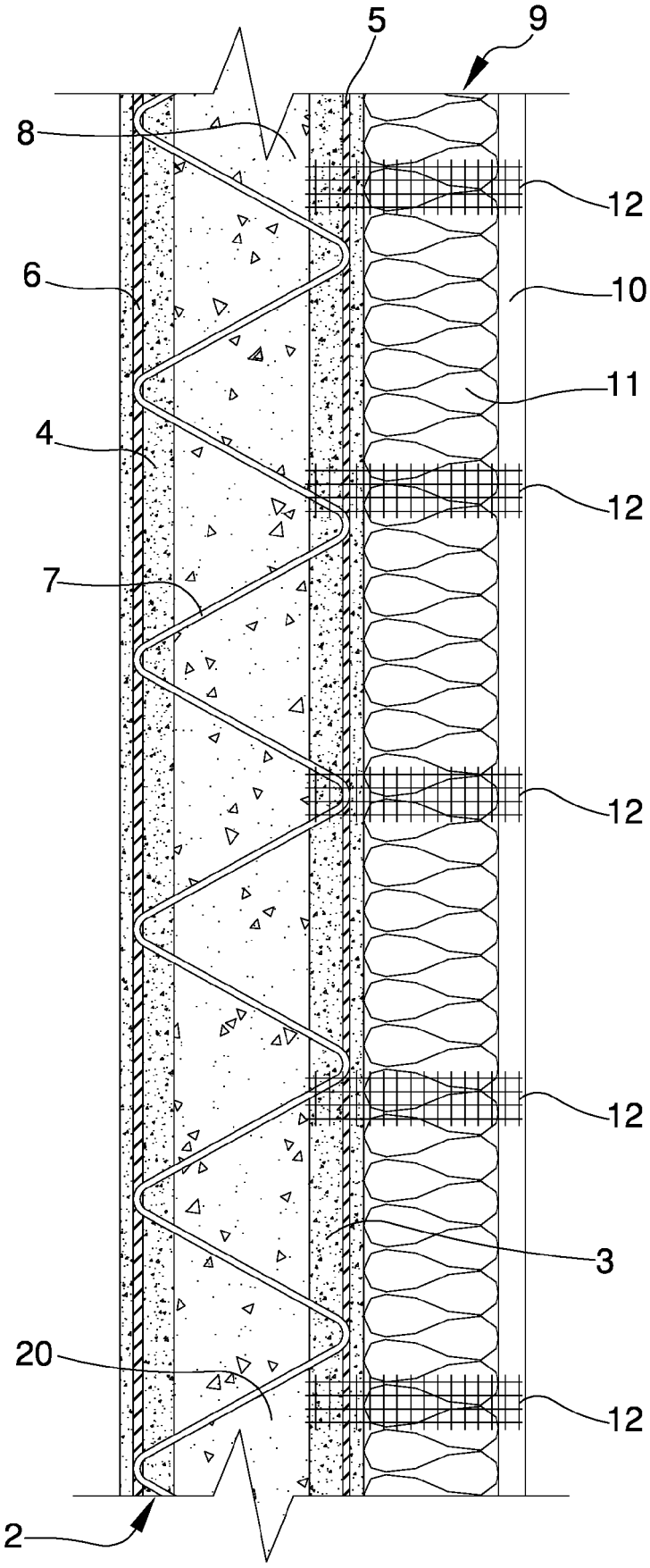
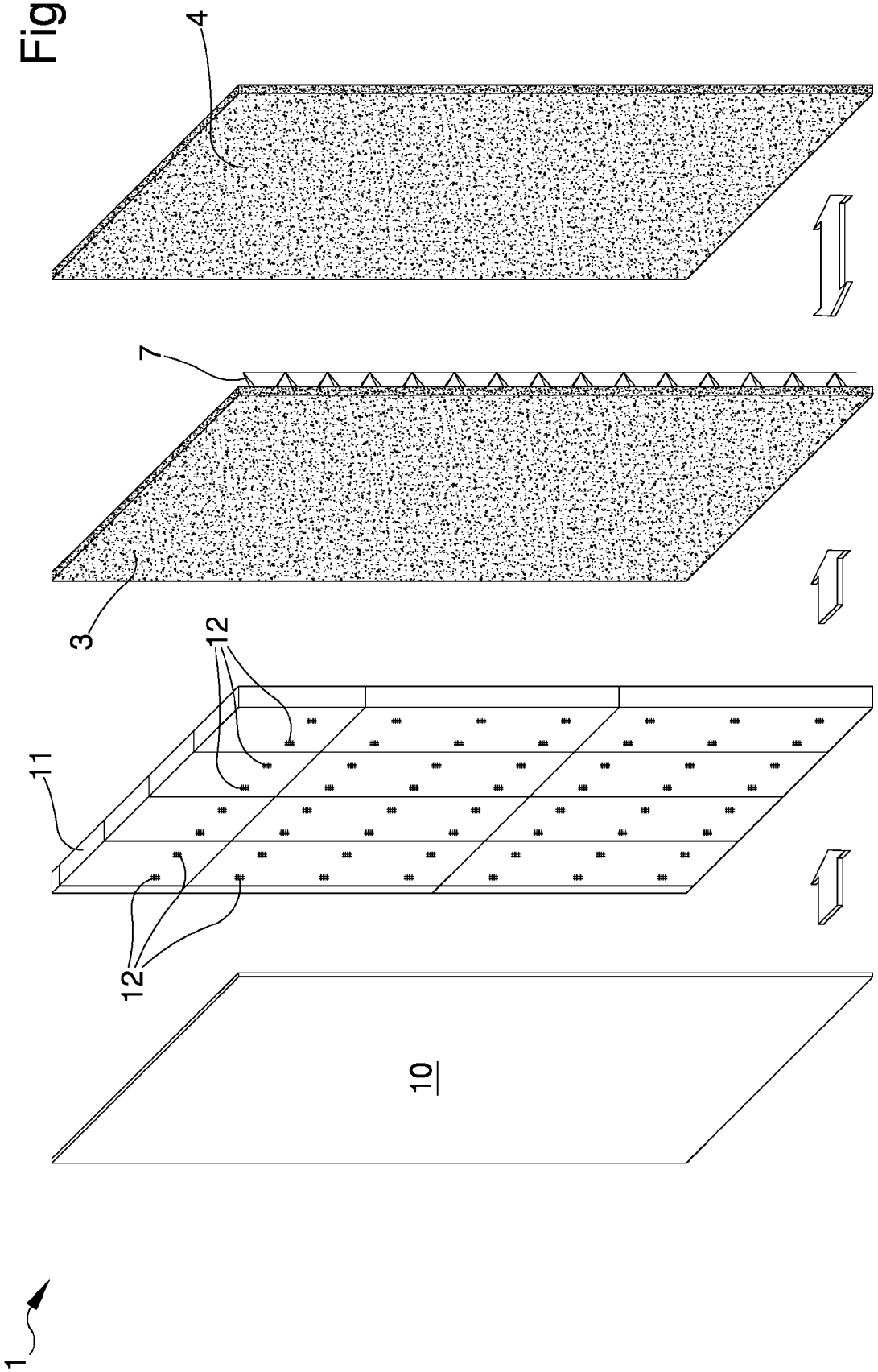


Fig.2



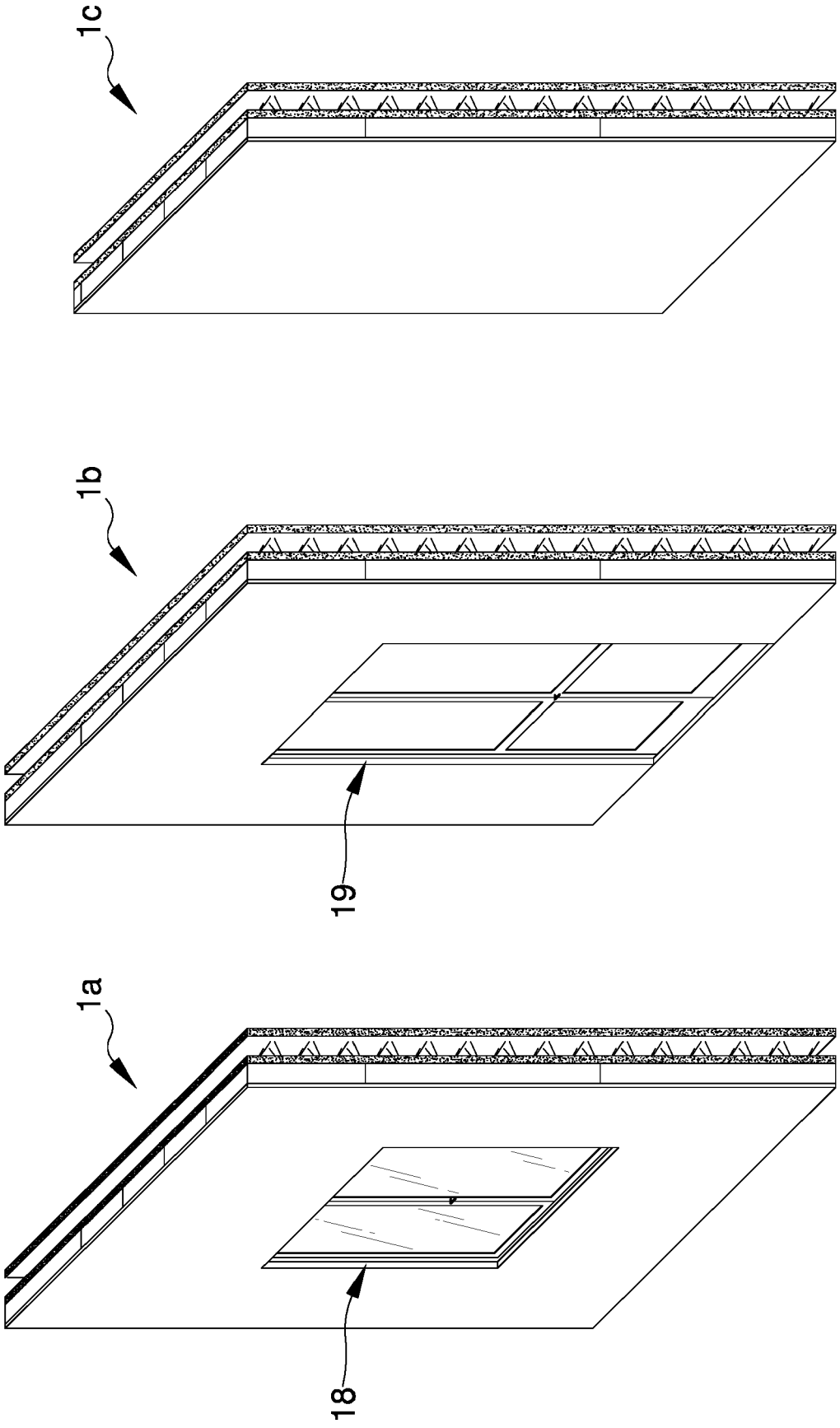


Fig.3

Fig.4

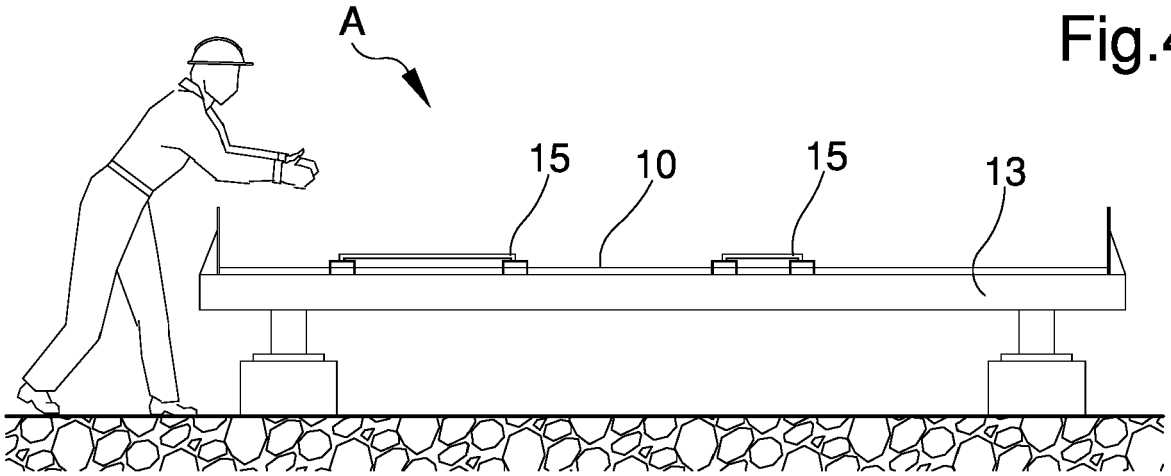


Fig.5

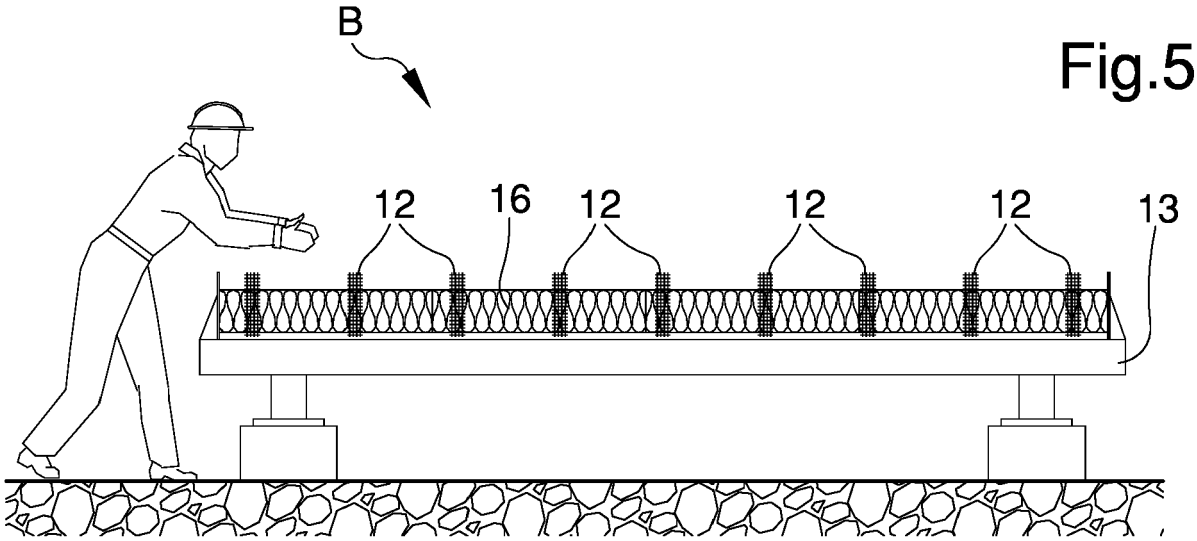


Fig.6

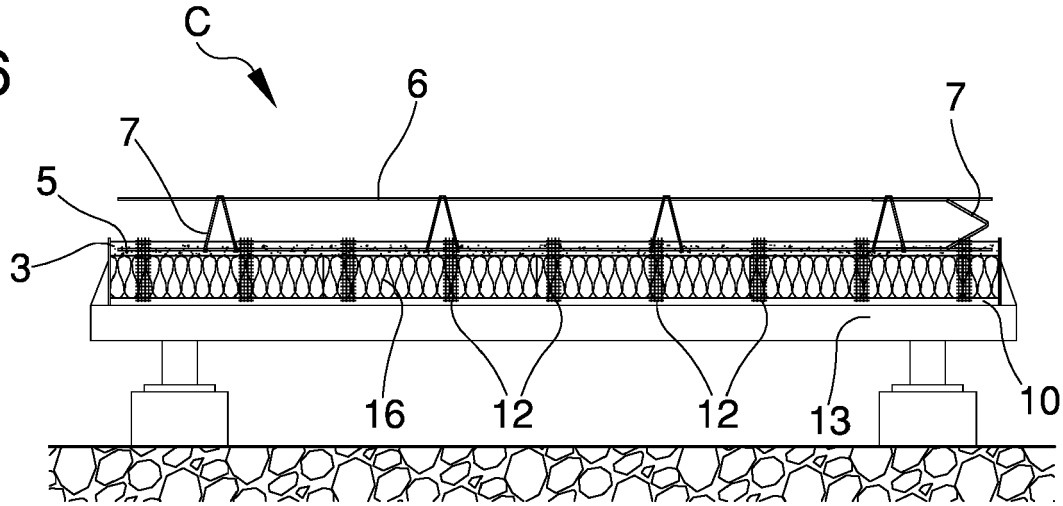


Fig.7

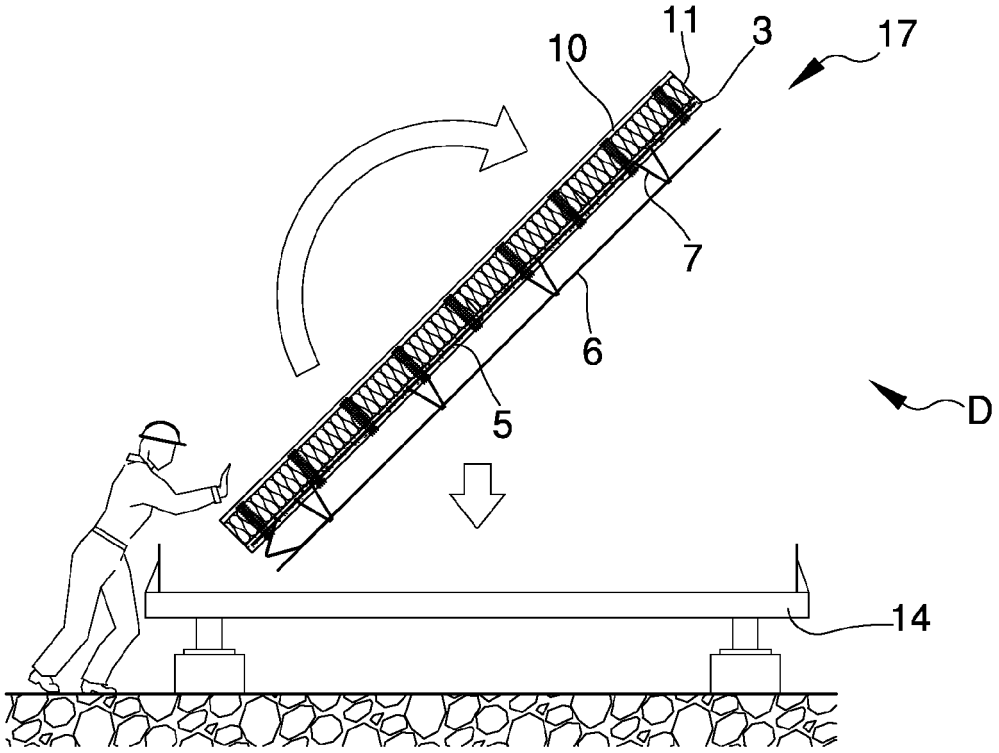


Fig.8

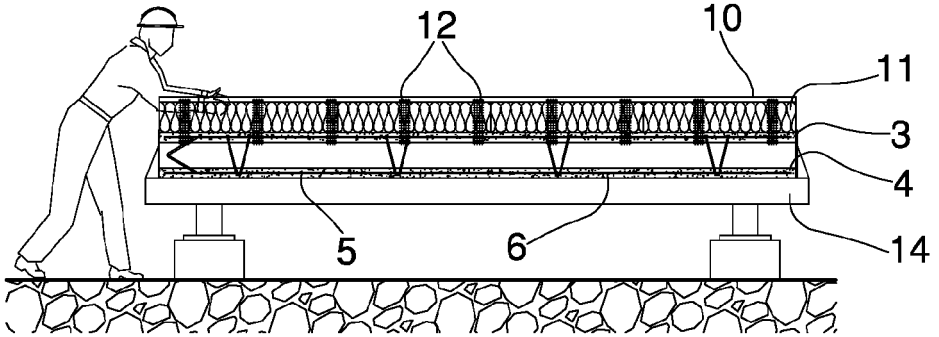
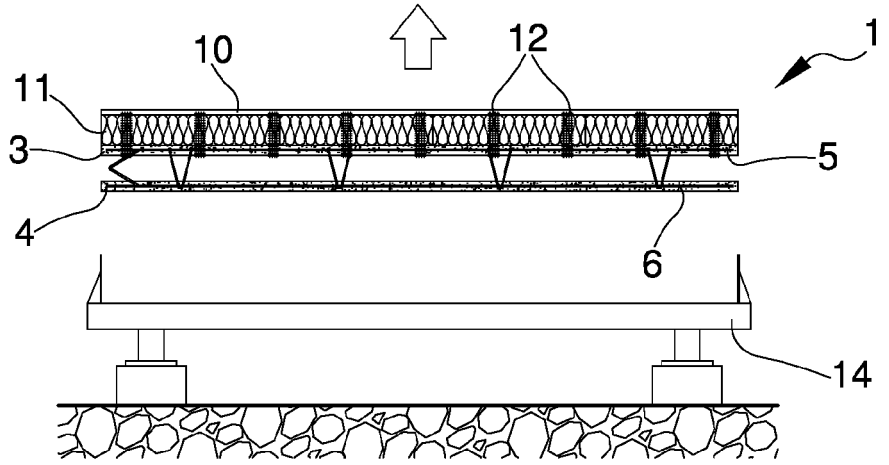


Fig.9



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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 9536

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	DE 21 34 533 A1 (EGGERSMANN CLEMENS) 8 February 1973 (1973-02-08) * page 3, last paragraph - page 10, paragraph 1 * * figure 3 *	1-13	INV. E04B1/76 E04B2/86 E04C2/04 E04C2/288 E04F13/04
X	EP 0 693 597 A1 (PLASTEDIL SA [CH]) 24 January 1996 (1996-01-24) * column 8, line 15 - column 14, line 43 * * figure 20 *	1	E04B1/16
A	FR 2 789 417 A3 (PREFABRICADOS DE CATALUNA S A [ES]) 11 August 2000 (2000-08-11) * page 3, line 9 - page 4, line 24 * * figures *	13	

TECHNICAL FIELDS SEARCHED (IPC)

E04B
E04C
E04F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 June 2018	López-García, G

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 15 9536

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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20-06-2018

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