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(54) **BLOCKS AND MODULAR BUILDING SYSTEM**

(57) Semi-block for modular construction comprising: two main faces, designated as inner main face and outer main face; two side faces, left and right, and two end faces, upper and bottom, referred to as contact faces; wherein, when the semi-block is fitted in with another identical semi-block by the respective contact faces, the main faces of the semi-blocks form a contiguous surface; wherein each of the contact faces comprises a fitting with a protrusion with a ramp and a fitting with a recess with a ramp, so that the protrusion ramp is in contact with the recess ramp of the other identical semi-block, when the semi-block is fitted in with another semi-block; and wherein, when the semi-block is fitted in with another semi-block by the respective inner main faces, it forms a block with the other identical semi-block. The fittings with a protrusion comprise an end surface perpendicular to the outer main surface of the block and the fitting with a recess comprises an end surface perpendicular to the outer main surface of the block. The semi-block also has semi-cylindrical.

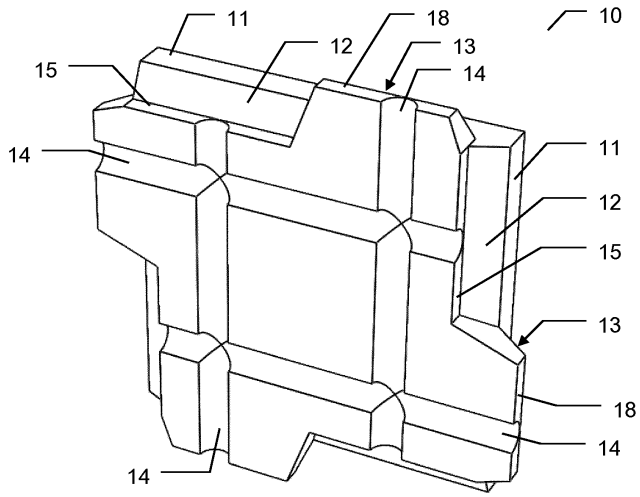

Fig. 2

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Description

Technical domain

[0001] The present description relates to a modular construction system based on multifunctional blocks, as well as to the fitting and attachment of said blocks.

Backgrou nd

[0002] Currently there are several modular or prefabricated construction systems, but the current systems are usually dedicated to a specific engineering field, that is, many of them are dedicated to civil construction and others are dedicated to furniture. The polyvalence of the presented solution is something that differs from all systems currently known and applied in product engineering.

Summary

[0003] This document presents a new modular construction system which uses blocks having a specific geometry so as to allow an easy connection and assembly of the elements forming a larger panel. This modular construction system can be used in several fields from civil construction to furniture or other engineering fields.

[0004] Currently there are several modular or prefabricated construction systems, but the current systems are usually dedicated to a specific engineering field, that is, many of them are dedicated to civil construction and others are dedicated to furniture. The proposed innovation allows solutions applicable in different contexts, since the geometry of the blocks (modular elements), as well as their connection and assembly system remain identical, wherein there is mainly, and only if need be, a change in the nature of the material or dimensions of the blocks. Thus, it should be noted that the system differs from the current solutions since it maintains its geometric characteristics and adjusts to dimensional and material nature characteristics depending on the use. Also, and unlike traditional models of construction, this modular system is constituted by pieces of reduced size which allows its easy transportation and also allows self-construction, wherein connection and assembly of parts of the system are carried out by the purchaser. The system can be assembled in panels and requires neither foundations for installation, nor additional work, in the case of its application in civil construction, for example. Inside dwellings its installation is easy and clean, it does not produce residues and can be installed by the own buyer of the system, wherein no specific construction knowhow is required, and it also allows the change and reorganization of the modules whenever so desired, as well as an extension provided that more parts of the system are purchased, these being perfectly compatible with the previous parts, given their specific geometry.

[0005] The production process of the blocks and all parts composing the system is economically feasible and accessible, since it does not require specific procedure or great technological complexity. Blocks can be obtained through conventional industrial processes or by using additive technologies for more specific cases. The remaining components of the system are standard parts and are usually available on the market or easily obtained upon order.

[0006] The constructive system is distributed by a set of individually produced prefabricated components, where each element is independent and thereafter joined to the final structure onsite. The separation into individual components allows the existence of parallel production systems, as well as the storage thereof. Each element is produced independently of the others, being only restricted to the need thereof, which allows them to be produced regardless of the final set. For example, wall panels are produced independently of the pillars or beams. In the assembly phase, the elements are selected for the work. There may be customized elements, which shall be produced for this purpose without however affecting the normal manufacturing chains.

[0007] The virtues of the system evidenced in civil construction are extended to other engineering fields, namely interior or urban furniture, without any restriction. With great potential for congregating synergies in both production and logistic processes and enhancing the modularity potential of the system, that is, with slight changes in materials and coatings thereof, it is possible to use the system in indoor and outdoor walls, floors or roofs. Also in the furniture field, it is possible to obtain tables, shelves or other indoor modules or shelters and outdoor exhibitors.

[0008] The polyvalence of the presented solution is something that differs from the systems currently known and applied in product engineering.

[0009] The system includes in a new proposal for connection and assembly of basic elements, designated as blocks, which, since having a specific geometry, allow the construction of panels or walls that can be used either in the construction of furniture, in the assembly of partitions or in the construction of dwellings.

[0010] The blocks have the following characteristics:

- Lightweight, compact and very easy to produce.
- Easy to carry and pack.
- Allow easy and error-free assembly.
- Allow perfect alignment between the various elements creating a larger flat surface.
- Allow assembly in different orientations, taking the symmetry of the joining fittings into account.
- The joining between the elements is guided, self-adjustable, stable and disassemblable.
- Allow different types of finishing on external surfaces and customization by the customer.
- Can be produced in different types of materials.
- Can be produced in a single material or using several materials.

[0011] Blocks can be obtained from materials of diverse nature, in particular from natural recyclable materials and can be customized according to aesthetic or functional aspects. They have a specific geometry that facilitates their production and assembly. The assembly of several aligned blocks allows the construction of a panel or wall of higher dimensions. This assembly can be improved by the use of internal metal elements, locked at the ends by a metal sheet. This system locks the set of blocks making them behave as a single larger and rigid element, as a result of the assembly and coupling system between blocks that is reinforced by the internal metal structure.

[0012] The panel assembly system can be used in the furniture industry for obtaining table tops and tables, or in civil construction industry, for the manufacture of modular houses, where the assembly system can be used to obtain internal or external walls or even the roof.

[0013] A prefabricated modular system for construction is described, characterized by using multifunctional blocks with specific geometry, which are joined in a continuous manner and in two directions.

[0014] An embodiment is characterized in that the multifunctional blocks are self-adjustable.

[0015] An embodiment is characterized in that the multifunctional blocks are constructed with a plurality of single or multi-material materials, namely natural or recyclable materials, by the creation and filling of a core in the manufacturing phase.

[0016] An embodiment is characterized in that the multifunctional construction blocks have two main faces, an inner and an outer, and an upper face, a lower face, and two side faces, for the construction by connection of a panel, a wall or a partition by incorporating blocks, one after the other and one on top of the other so that their upper and lower faces are in mutual contact, as well as their side faces, these faces designated as "contact" faces, and so that both main faces of each block can form a continuous surface constituted by the inner and outer wall faces.

[0017] An embodiment is characterized in that the multifunctional construction blocks are obtained by connection and closing of two equal semi-blocks.

[0018] An embodiment is characterized in that the multifunctional construction blocks have a symmetrical geometry longitudinally on each of the four fitting and uniaxial extraction faces.

[0019] An embodiment is characterized in that the multifunctional construction blocks have symmetrical geometry of the fittings, according to two planes orthogonal between them and which intersect on a central axis perpendicular to the main face.

[0020] An embodiment is characterized in that the side fittings of the multifunctional blocks are bi-angular, symmetrical, inverted and self-locking.

[0021] An embodiment is characterized in that each multifunctional construction block has at least one vertical hole that crosses the entire block, for passage of a structure reinforcing element or block attachment, the axis of which is coplanar with the outer face of the block and perpendicular to the closing faces, the holes being equidistant between them, forming with the blocks arranged, at least, one aligned rail of constant section.

[0022] An embodiment is characterized in that the semi-blocks have semi-cylindrical channels, preferably three or four, arranged perpendicular among them two by two or 2 by 1 and which, after being closed and the block being obtained, the semi-cylinders form through-holes through a tunnel-like space, for passage of other elements,

[0023] An embodiment is characterized in that the connection system of the parts can be reinforced with a tubular structure assembled in the longitudinal direction thereof, taking advantage of the existing internal holes and which form a tunnel;

[0024] An embodiment is characterized in that in the tubular structure the positioning and attachment are ensured by a profiled sheet.

[0025] An embodiment is characterized in that the tubular support structure works as a cage and the coating thereof through blocks creates a separation and insulation surface.

[0026] An embodiment is characterized in that the joining between the parts whose use of a more rigid internal structure, e.g. said tubular support structure, allows improving the behaviour of the set.

[0027] An embodiment is characterized in that it is customizable by the application of face coating foils which may be developed, namely for solar energy retention, incorporation of light sensors, structural analysis of the system, or the like.

[0028] A semi-block for modular construction is described comprising:

two main faces, designated as inner main face and outer main face;

two side faces, left and right, and two end faces, upper and bottom, referred to as contact faces;

characterised in that, when the semi-block is fitted in with another equal (or identical) semi-block by the respective contact faces, the main faces of the semi-blocks form a contiguous surface;

and in that the contact faces, particularly each of the contact faces comprises a fitting with a protrusion with a ramp and a fitting with a recess with a ramp, so that the protrusion ramp stays in contact with the recess ramp of the other semi-block, in particular in contact with the recess ramp of the other equal (or identical) semi-block, when the semi-block is fitted in with the other semi-block, particularly when fitted in with the other equal (or identical) semi-block;

and in that, the inner face comprises one or more fittings for fitting in with yet another semi-block, particularly the other semi-block being equal (or identical) by the respective inner main faces, so as to form a block with the yet another semi-block, particularly

the other semi-block being equal (or identical).

[0029] In an embodiment, the fittings of the contact faces have 90° rotational symmetry on a central axis perpendicular to the main face.

[0030] In an embodiment, the fitting with a protrusion comprises an end surface perpendicular to the outer main surface of the block and the fitting with a recess comprises an end surface perpendicular to the outer main surface of the block, so that the end surface of the protrusion stays in contact with the end surface of the recess of another semi-block, when the semi-block is fitted in with another semi-block.

[0031] In an embodiment, the fittings of the contact faces have symmetry according to two planes orthogonal among them and which intersect on a central axis perpendicular to the main face.

[0032] In an embodiment, the semi-block has a symmetrical geometry longitudinally on each of four fitting and uniaxial extraction faces.

[0033] In an embodiment, the inner main face comprises one or more channels opened for receiving a longitudinal support element.

[0034] In an embodiment, the channels are semi-cylindrical.

[0035] An embodiment comprises two horizontal channels and two vertical channels, or comprises two vertical channels and one horizontal channel.

[0036] In an embodiment, the inner main face comprises one or more coupling elements for joining the semi-block to another semi-block, in particular the other semi-block being equal (or identical) when the semi-block is fitted in with another semi-block, in particular the other semi-block being equal (or identical).

[0037] In an embodiment, the inner main face comprises two complementary coupling elements, symmetrically placed with respect to the geometric centre of the semi-block.

[0038] An embodiment of the semi-block has a substantially quadrangular shape.

[0039] An embodiment of the semi-block has 90° or 180° rotation symmetry on an axis perpendicular to the outer main face.

[0040] An embodiment of the semi-block has a substantially rectangular shape.

[0041] An embodiment of the semi-block has 180° rotation symmetry on an axis perpendicular to the outer main face.

[0042] In an embodiment, the inner main face comprises two complementary coupling elements, symmetrically placed with respect to the geometric centre of the semi-block.

[0043] An embodiment comprises a hollow, recess or alveolus on its inner face.

[0044] An embodiment comprises a coating on its outer main face.

[0045] In an embodiment, the semi-block is a semi-block obtained by pressure-forming, in particular by pressure-forming of aggregate or laminate composite materials.

[0046] In an embodiment, the semi-block is a semi-block obtained by injection moulding, in particular by injection moulding of ceramic, composite or polymeric materials.

[0047] A block for modular construction is further described comprising two semi-blocks for modular construction of any of the described embodiments, fitted in to each other by their inner main faces.

[0048] A modular construction wall is further described comprising a plurality of semi-blocks according to any of the described embodiments, fitted into each other by their side and/or end faces.

[0049] A modular construction wall is further described comprising a plurality of described blocks, fitted into each other by their side and/or end faces.

[0050] A piece of furniture is described comprising a modular construction wall according to any of the described embodiments.

[0051] A support structure is described for a modular construction of semi-blocks according to any of the described embodiments or of blocks according to any of the described embodiments, comprising a lower beam, an upper beam and a plurality of bars joining the lower beam to the upper beam, in particular wherein the bars are parallel to one another.

[0052] In an embodiment, the bars are tubes, in particular cylindrical tubes.

[0053] In an embodiment, the lower and upper beams have a sheet profile.

[0054] The embodiments described are combinable.

Brief Description of the Drawings

[0055] For an easier understanding, drawings are herein attached, which represent preferred embodiments which are not intended to limit the scope of the present disclosure.

Figure 1: Representation of an embodiment of the proposed modular system, with the construction of a building.

Figure 2: Representation of an embodiment of a module, of substantially quadrangular shape, of the proposed modular system.

Figure 3: Representation of an embodiment of a module of the proposed modular system obtained by connection and closing of two equal semi-blocks.

Figure 4: Representation of an embodiment of a module, of substantially rectangular shape, of the proposed modular system.

Figure 5: Representation of an embodiment of the proposed modular system, with the construction of

a wall.

Figure 6: Representation of an embodiment of the proposed modular system with the inclusion of a structure with support tubes, the positioning and attachment of which is ensured by two profiled sheets, an upper and a lower sheet.

Detailed Description

[0056] The proposed system is based on an assembly of self-adjustable blocks, which can be obtained from materials of different nature, and are also compatible with the use of natural and recyclable materials. The developed system uses blocks that can be locked through two metal tubes that pass longitudinally and are fixed at the extremities through two profiled sheets. The assembly of the tubes and the locking sheets form a cage-like structure and the blocks work as a coating of the metal structure, forming a larger panel that can be used as a partition or wall. The metal structure is rigid and self-supporting and the blocks undertake the insulation and surface finishing.

[0057] **Figure 1** shows an embodiment of the proposed modular system with the construction of a building, wherein the block with a specific geometry, allowing its inter-relational assembly forming a larger surface or wall **1,** a foundation base of the building **2,** locking tubes of the assembly **3,** lower sheet profile **4,** upper sheet profile **5,** and column **6** are shown.

[0058] In the system, there is a block **1** with a specific geometry that allows its inter-relational assembly forming a larger surface or wall. In construction, there is a foundation base **2** where the set will be assembled. In the base **2** a sheet profile **4** is applied where the locking tubes **3** of the assembly are attached. At the side ends there is a column **6,** the blocks are placed into the tubes through through-holes therein. The end geometry of the blocks will allow their alignment and assembly, increasing the size of the wall in both height and length. Subsequently to the last upper block being assembled and once the wall assembly is completed, it is fixed by assembling the upper sheet profile **5.** In the proposed system, elements **3, 4, 5, 6** form a rigid wall support cage-like structure, where the blocks **1** enclose the structure thus promoting its insulation and creating a single separation surface.

[0059] **Figure 2** shows an embodiment of a module, of substantially quadrangular shape, of the proposed modular system. The multifunctional construction semi-block **10** has two main faces, an inner and an outer face, and an upper face, a lower face, and two side faces. The upper and bottom faces of blocks contiguously placed are in mutual contact, as well as their side faces, these faces being designated as "contact" faces **11,** and so that at least one of the main faces of each block can form at least a continuous surface constituted by the main faces, either the inner, outer, or inner and outer faces of a set of blocks.

[0060] The multifunction construction blocks **10** preferably have symmetrical and biaxial geometry in the fittings. An embodiment is characterized in that the side fittings of the multifunctional blocks are bi-angular, symmetrical, inverted and self-locking. The fittings comprise for each contact face **11,** preferably adjacent to contact face **11,** two fitting parts. One part has a protrusion which includes a ramp surface **13,** preferably with an end surface **18** perpendicular to the outer main face of the block **10.** The other part has a recess including a ramp surface **12,** preferably with an end surface **15** perpendicular to the outer main face of the block **10.** The protrusion ramp **13** stays in contact with the recess ramp **12** of the subsequent block, when the blocks are placed contiguously. Preferably, the end surface of the protrusion **18** stays in contact with the end surface of the recess **15** of the subsequent block, when the blocks are placed contiguously.

[0061] Each block may have at least one vertical hole that passes through the entire block, for passage of a structure reinforcing element or block attachment, the axis of which is coplanar with the outer face of the block and perpendicular to the closing faces. Preferably, with the blocks placed contiguously, the holes are equidistant from each other, forming at least one aligned rail of constant section along vertically aligned blocks. A possible embodiment for this hole includes the semi-blocks having semi-cylindrical channels **14,** preferably three or four, arranged perpendicular between them two by two or 2 by 1 and which, after being closed and the block being obtained, the semi-cylinders form through-holes through a tunnel-like space, for passage of a structure reinforcing element or block attachment, or of other elements.

[0062] **Figure 3** shows an embodiment of a module of the proposed modular system obtained by joining and closing two equal semi-blocks. The inner closure faces of the block may contain hollows or alveoli, in particular a hollow in the form of a quadrangular recess **17,** preferably placed centrally on the inner face of the semi-block, and which, among other advantages, lighten the structure and create a insulating airgap from heat and/or noise.

[0063] An embodiment is characterized in that the multifunctional construction blocks are obtained by connection and closing of two equal semi-blocks through coupling elements **16a/16b.**

[0064] **Figure 4** shows an embodiment of a module **20,** of substantially rectangular shape, of the proposed modular system. This module **20** may be seen to be half of the substantially quadrangular block **10.** The multifunctional construction blocks **20** preferably have biaxial symmetrical geometry in the fittings on the vertical ends, as was the case in the substantially quadrangular module **10.** An embodiment is characterized in that the fittings on the side faces of the multifunctional blocks comprise for each contact face **21,** preferably adjacent to the contact face **21,** a fitting part. On one of the side faces, the fitting part has a protrusion including a ramp surface **23,** preferably with an end surface **28** perpendicular to the

outer main face of the block **20.** On the other side face, the fitting part has a recess including a ramp surface **22,** preferably with an end surface **25** perpendicular to the outer main face of the block **20.** The protrusion ramp **23** stays in contact with the recess ramp **22** of the subsequent block, when the blocks are placed contiguously. Preferably, the end surface of the protrusion **28** stays in contact with the end surface of the recess **25** of the subsequent block, when the blocks are placed contiguously.

[0065] **Figure 5** shows an embodiment of the proposed modular system, with the construction of a wall with a plurality of blocks **10** fitted in as described above.

[0066] **Figure 6** shows an embodiment of the proposed modular system with the inclusion of a structure with support tubes, the positioning and attachment of which is ensured by two profiled sheets, an upper and a lower sheet.

[0067] **Figure 6a** shows a plurality of blocks **10** fitted in as described above and joined through a tubular structure **30** which passes through the blocks through the aforementioned semi-cylindrical channels, contributing to an even more solid and robust structure.

[0068] **Figure 6b** shows the construction of the tubular support structure **30** comprising a plurality of bars **32,** e. g. cylindrical elements or tubes, which are sustained on a lower beam **33** and an upper beam **31.** Preferably, the beams are designed in sheet profiles.

[0069] This concept can be used to create exterior walls or interior partitions, and even be used for floors or roofing instead of tile.

[0070] In relation to the current construction systems, the system proposed in this innovation is perfectly compatible with the conventional methods in specialised civil construction, namely in water and energy arrangements. It also allows to combine constructive solutions adopted in this system with other more conventional ones, for example the use of a conventional tile roof on walls built in this system.

[0071] The proposed solution allows adopting more conventional work planning and logistic methods such as on-site wall surveys, since the blocks can be used as substitutes for blocks in cement or clay, or assembling the panels in factory and then transporting them to the site, thus lowering costs and construction time.

[0072] The modular construction system based on this multifunctional block concept also has the following advantages:

When applied in civil construction, it can be used for the construction of exterior or interior walls.

It is very easy to produce, transport and assemble which makes its application in prefabricated or modular construction excellent.

The walls built using this concept do not crack, do not need maintenance and the interior and exterior finish thereof can be completely customized.

The use of these modular elements in civil construction is perfectly compatible with the conventional methods used in civil construction.

The assembly, disassembly or alteration of interior walls is absolutely clean and free of dust.

[0073] It allows easy and error-free assembly.

[0074] It allows perfect alignment between the various elements creating a larger flat surface.

[0075] It allows assembly in different orientations, taking the symmetry of the connection fittings into account.

[0076] The connection between the elements is guided, self-adjustable, stable and disassemblable.

[0077] It allows different types of finishing on external surfaces and customization by the customer.

Application Examples

[0078] In civil construction it can be used for the construction of housing modules - by pre-fabricated construction or modular construction - as well as walls and partitions.

[0079] The system can also be used in the manufacture of furniture, tables, desks, shelves, among others.

[0080] It is obvious that the virtues of the system evidenced in civil construction can be extended to other engineering fields, namely indoor or urban furniture, without any restriction. With great potential for congregating synergies in both production and logistic processes and enhancing the modularity potential of the system, i.e. with slight changes in material and coating thereof, it is possible to use the system in interior walls, exterior walls, floors or roofs. Also in the furniture field, it is possible to obtain tables, shelves or other indoor modules or shelters and external exhibitors.

[0081] The embodiments described are combinable. The following claims set out particular embodiments of the disclosure.

[0082] Blocks may be manufactured by pressure-forming processes using aggregate or laminate composite materials.

[0083] Blocks can be manufactured by injection moulding processes when ceramic, composite or polymer materials are used.

Claims

1. Semi-block for modular construction comprising:

two main faces, designated as inner main face and outer main face;

two side faces, left and right, and two end faces, upper and bottom, referred to as contact faces;

characterised in that, when the semi-block is fitted in with another identical semi-block by the respective contact faces, the main faces of the semi-blocks form a contiguous surface;

and **in that** each of the contact faces comprises a fitting with a protrusion with a ramp and a fitting

with a recess with a ramp, so that the protrusion ramp is in contact with the recess ramp of the other identical semi-block, when the semi-block is fitted in with the other identical semi-block;
and **in that**, the inner face comprises one or more fittings for fitting in with yet another identical semi-block by the respective inner main faces, so as to form a block with the yet another identical semi-block.

2. Semi-block for modular construction according to the previous claim wherein the fittings of the contact faces have a 90° rotational symmetry on a central axis perpendicular to the main face.

3. Semi-block for modular construction according to any previous claim, wherein the fitting with a protrusion comprises an end surface perpendicular to the outer main surface of the block and the fitting with a recess comprises an end surface perpendicular to the outer main surface of the block, so that the end surface of the protrusion is in contact with the end surface of the recess of another semi-block, when the semi-block is fitted in with another semi-block.

4. Semi-block for modular construction according to any previous claim, wherein the semi-block has a symmetrical geometry longitudinally on each of four fitting and uniaxial extraction faces.

5. Semi-block for modular construction according to any previous claim, wherein the inner main face comprises one or more channels opened for receiving a longitudinal support element.

6. Semi-block for modular construction according to the previous claim, wherein the channels are semi-cylindrical.

7. Semi-block for modular construction according to the previous claim, comprising two horizontal channels and two vertical channels, or comprising two vertical channels and one horizontal channel.

8. Semi-block for modular construction according to any previous claim, wherein the inner main face comprises one or more coupling elements for joining the semi-block to another identical semi-block when the semi-block is fitted in with another identical semi-block.

9. Semi-block for modular construction according to the previous claim, wherein the inner main face comprises two complementary coupling elements, symmetrically placed with respect to the geometric centre of the semi-block.

10. Semi-block for modular construction according to any previous claim, having a substantially quadrangular shape.

11. Semi-block for modular construction according to the previous claim, with 90° or 180° rotation symmetry on an axis perpendicular to the outer main face.

12. Semi-block for modular construction according to any claim 1-9, having a substantially rectangular shape.

13. Semi-block for modular construction according to the previous claim, with 180° rotation symmetry at an axis perpendicular to the outer main face.

14. Semi-block for modular construction according to any previous claim, wherein the inner main face comprises two complementary coupling elements, symmetrically placed with respect to the geometric centre of the semi-block.

15. Semi-block for modular construction according to any previous claim comprising a hollow, recess or alveolus on the inner face thereof.

16. Semi-block for modular construction according to any previous claim comprising a coating on the outer main face thereof.

17. Semi-block for modular construction according to any previous claim obtained by pressure-forming, in particular by pressure-forming of aggregate or laminate composite materials.

18. Semi-block for modular construction according to any claim 1-16 obtained by injection moulding, in particular by injection moulding of ceramic, composite or polymeric materials.

19. Block for modular construction comprising two semi-blocks for modular construction according to any claim 1-18, fitted into each other by their inner main faces.

20. Modular construction wall comprising a plurality of semi-blocks according to any claim 1-18, fitted into each other by their side faces and their end faces.

21. Modular construction wall comprising a plurality of blocks according to claim 19, fitted into each other by their side faces and their end faces.

22. Piece of furniture comprising a modular construction wall according to claim 20 or 21.

23. Support structure for a modular construction of semi-blocks according to any claim 1-18 or of blocks according to claim 19, comprising a lower beam, an

upper beam and a plurality of bars joining the lower beam to the upper beam, in particular wherein the bars are parallel to one another.

24. Support structure according to the previous claim wherein the bars are tubes, in particular cylindrical tubes.

25. Support structure according to claim 23 or 24 wherein the lower and upper beams are in sheet profile.

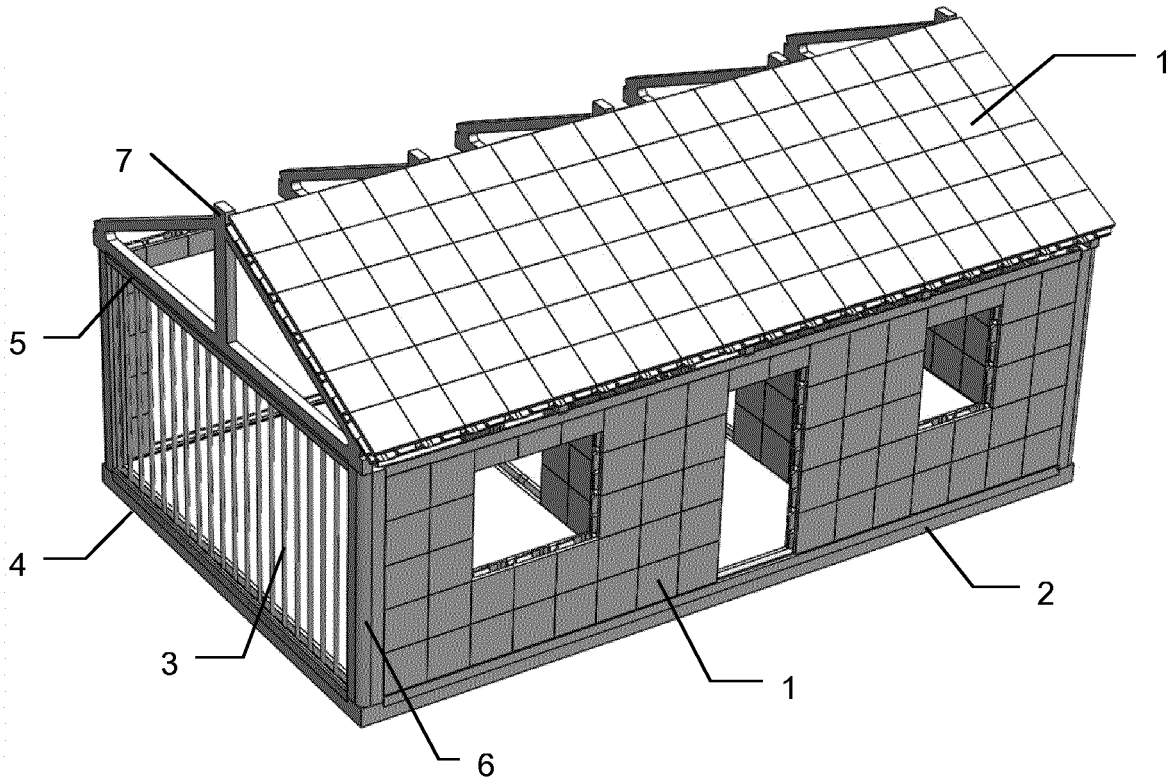

Fig. 1

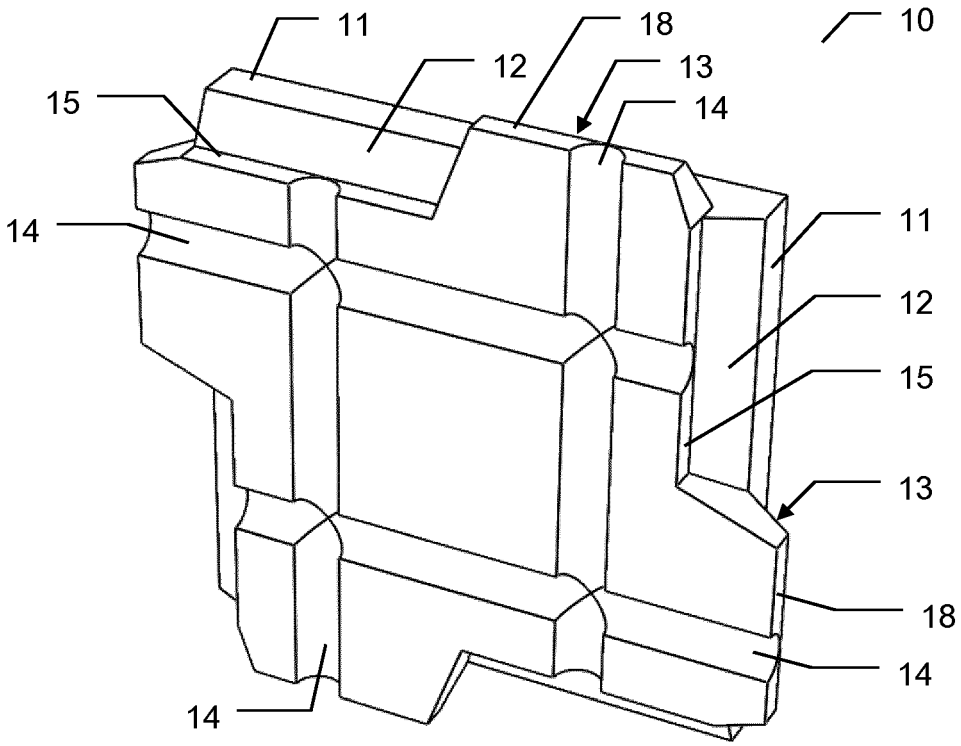

Fig. 2

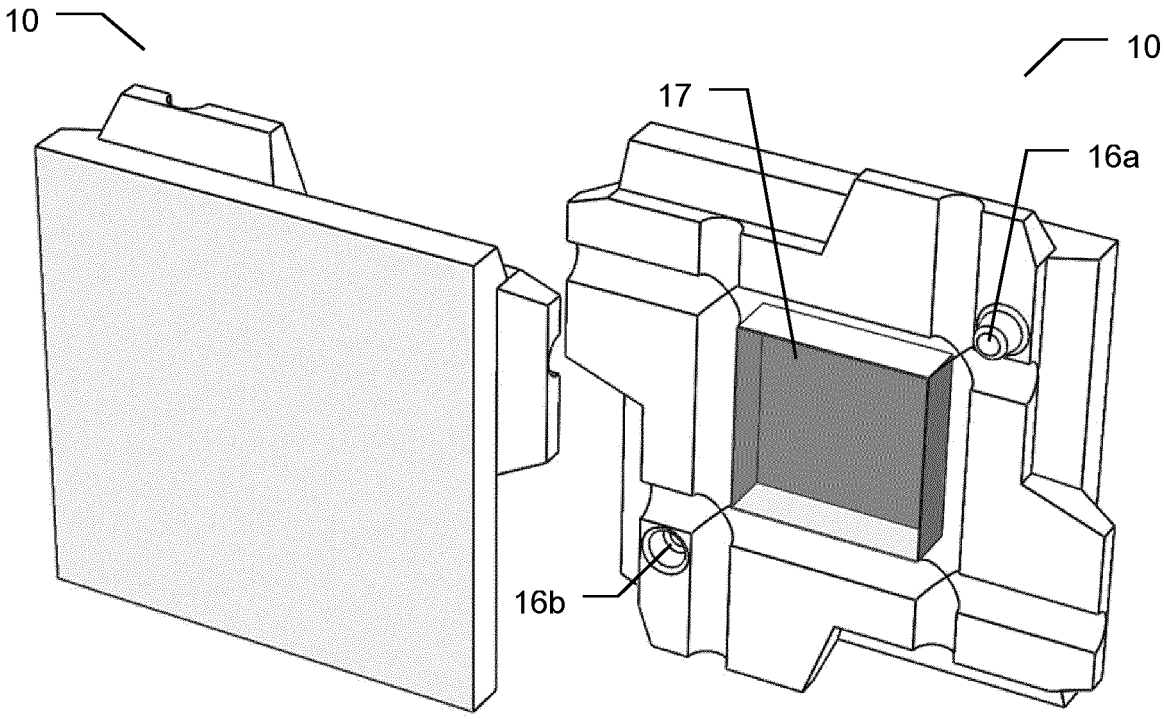

Fig. 3

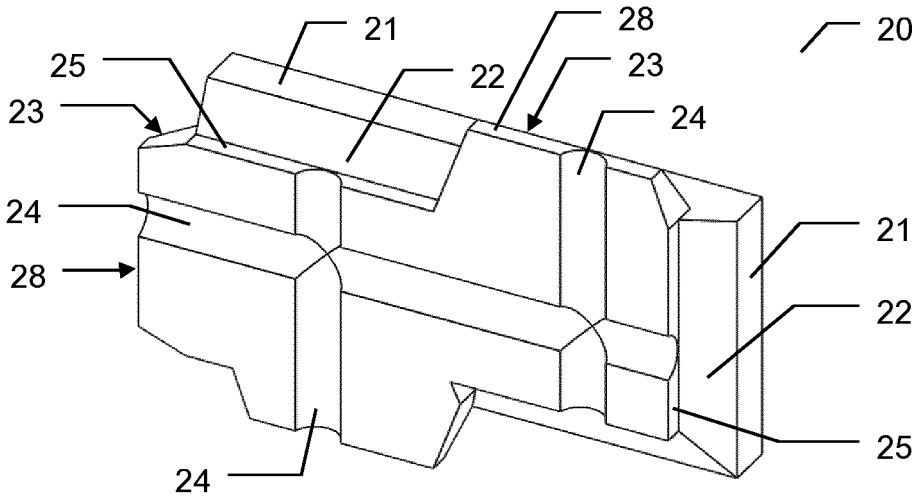

Fig. 4

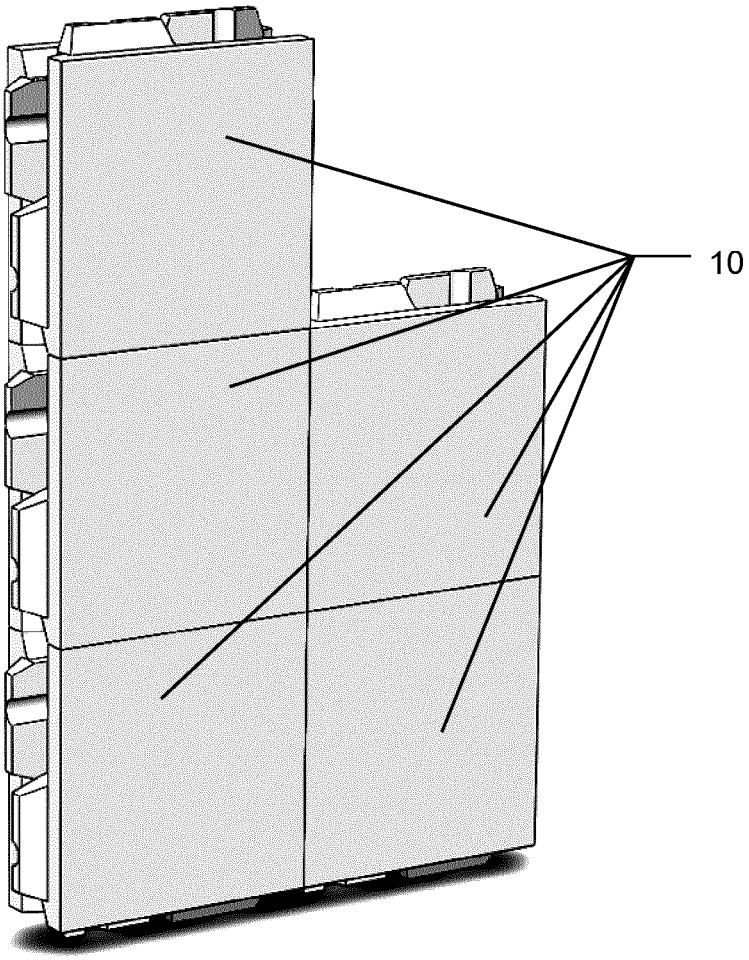

Fig. 5

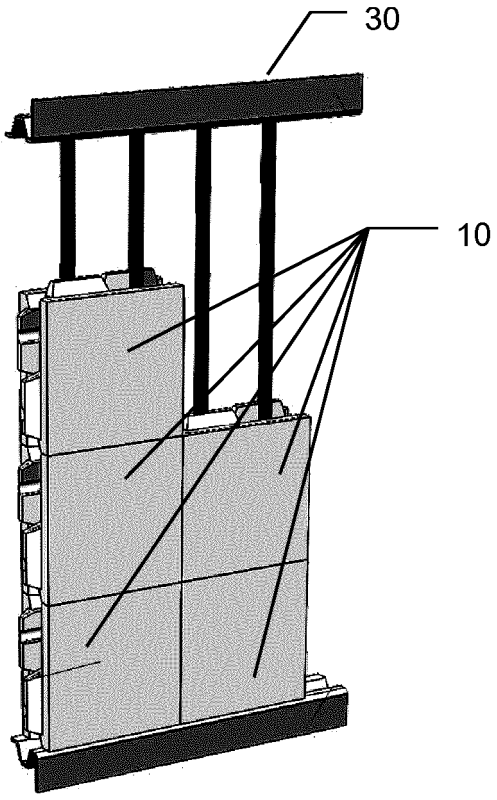

Fig. 6a

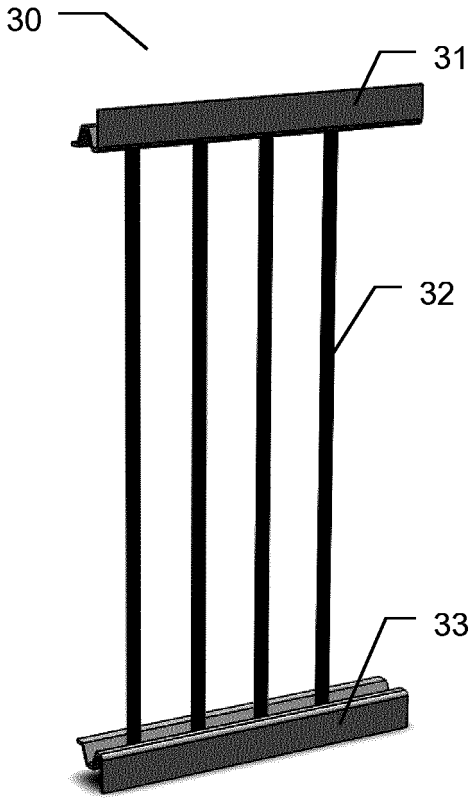

Fig. 6b

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/052338

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B2/46 E04B2/48 E04B2/58 E04B2/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 322 988 A1 (LEROY VICTOR [FR]) 1 April 1977 (1977-04-01) page 3, line 35 - page 4, line 28; figures 3,4 -----	3,4, 8-10,12, 14,16-22
X	GB 2 458 317 A (FUNKE HERMAN [GB]) 16 September 2009 (2009-09-16) page 9, line 19 - page 10, line 2; figures 4,5 -----	1,3-5, 8-22
X	GB 1 381 791 A (RATHKE W) 29 January 1975 (1975-01-29) page 4, line 122 - page 5, line 51 page 6, line 23 - line 48 figures 1-4,7,13 ----- -/--	1-22

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2017	31/07/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Delzor, François

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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 2 549 027 A2 (UNIV DO MINHO [PT]; SOFALCA SOC CENTRAL DE PRODUTOS DE CORTICA LDA [PT]) 23 January 2013 (2013-01-23) paragraph [0038] - paragraph [0039]; figures 1-5	1-22

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