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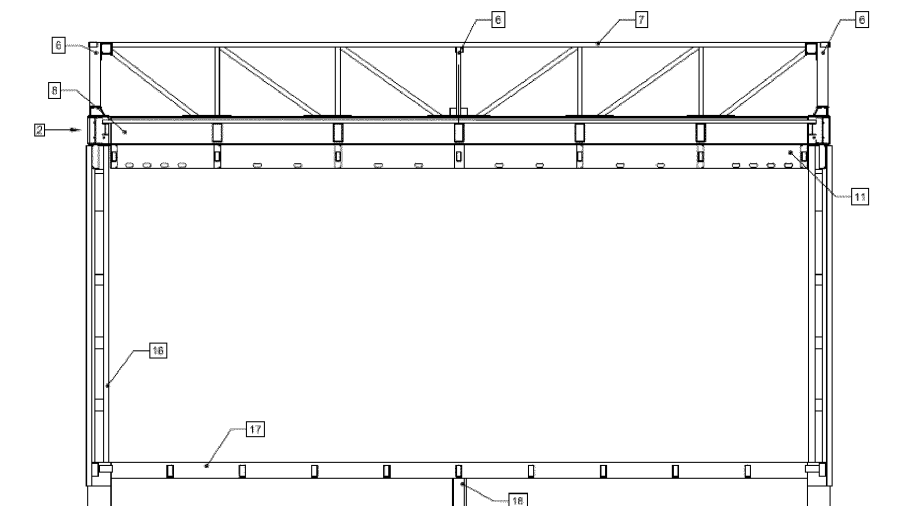
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(54) **INDUSTRIALISED MODULE FOR PREFABRICATED HOUSING SOLUTIONS**

(57) Industrialised module for prefabricated housing solutions comprising:

- A roof made with three levels: a first level (1), followed by a second level (2) and finished with a third level (3)
  - A series of pillars (16) joined at their upper ends to the third level (3) and at the lower end to the ground and to
  - A lower slab (17) joined to the pillars and further supported by a series of central supports (18)
- where the First Level (1) of the roof comprises a first

ribbed sheet (5); the second level (2) comprises a first perimeter frame (8), tubular crossbeams (9) and a ribbed sheet (10), to support a load for the upper reinforcement; and the third level (3) comprises a second perimeter frame (11) and tubular crossbeams (12). An inhabitable module is achieved, which ensures safety, with reinforced facades, as well as under-roof reinforcement, which is quick to assemble and disassemble.



**FIG. 1**

## Description

### OBJECT OF THE INVENTION

[0001] The object of the present invention, as established in the title of the invention, is to provide an industrialised module for prefabricated housing solutions that serves as a construction unit for creating any type of building by means of the juxtaposition of the units.

[0002] The present invention is characterised by the special construction characteristics of each and every one of the elements forming part of the module, and their relative arrangement and inter-relation, achieving a module that enables a series of requirements related to habitability and safety reinforcement to be resolved, given that the use for which it is intended requires certain highly demanding technical responses.

[0003] The present invention therefore pertains to modular assemblies. More specifically, it pertains to modular assemblies made from metal structures that seek to resolve housing problems.

### BACKGROUND TO THE INVENTION

[0004] In the prior state of the art, different modular construction solutions are known; however, none simultaneously offers features such as reinforcement, resistance to load requirements, a high level of thermal and acoustic comfort and simplicity of transport and assembly, enabling the solution to be disassembled and reassembled easily for transport.

[0005] The object of the present invention is therefore to develop

1.- A module all of whose facades are reinforced with sheet steel

2.- A module capable of accommodating a thickness of 60 cm throughout the entire surface of its roof through the positioning of superimposed sand bags that will serve to damp against strong shocks, provided with a monolithic structure resistant to strong load demands.

3.- A module that offers a high level of thermal and acoustic comfort to enable all forms of activity to be performed, ranging from those a simple warehouse to homes of a high aesthetic and functional level.

4.- A module capable of being transported to its site over long distances and assembled rapidly, capable of creating residential complexes by joining a series of units as required by different designs.

[0006] In summary, it involves the creation of a production model whose functions satisfy a series of requirements of different kinds as described above, developing a module as described below the essence of which is set out in Claim 1.

## DESCRIPTION OF THE INVENTION

[0007] The object of the present invention is to provide an industrialised module that serves as a construction unit for creating any type of building by means of the juxtaposition of said units. The particularity of the module is that it satisfies a series of requirements related to habitability and safety reinforcement, since the use for which it is intended is required to meet certain highly demanding technical requirements.

[0008] The modules comprising the invention are provided with all the elements necessary to allow for any requirement of use. The modules may be used to form anything from a simple warehouse to homes with a high degree of comfort. The modules are sized to comply with any legislative consideration with regard to size of spaces, lighting, ventilation and thermal and acoustic insulation, and are capable of accommodating any type of electrical or plumbing installation, or any that may be requested in concealed, accessible and protected form, within the parameters of international regulations.

The most important feature of the module lies in its safety functions.

[0009] It comprises a reinforced module capable of resisting major shocks and thus guaranteeing the safety of the occupants. The facades and roof of the module are reinforced, with all walls linked to the exterior of the construction protected.

[0010] Reinforcement of the facades has been achieved by incorporating sheet steel of at least 3 mm in thickness into the envelope, which can be modified to meet greater safety requirements simply by increasing said thickness. The sheets are arranged in such a way as to form a construction element like any other, capable of serving as a support for other construction elements such as finishes, woodwork, installations, etc.

[0011] A design is achieved of reinforcing sheet capable of being incorporated with standard norms of modulation, making it highly compatible with the standardised dimensions of all products on the market.

Another of the design challenges satisfied by the module comprising the invention is reinforcement of the roof. The covering structure is capable of resisting a permanent load of 22 tonnes, allowing a safety cushion to be installed consisting of sand bags with thicknesses of up to 60 cm, thus guaranteeing that strong shocks are absorbed without altering the stability and safety of the dwelling. For greater safety the module has two roof slabs spaced in such a way that a free space is formed between them to absorb possible warping that might affect the habitable area.

[0012] The module has been designed in such a way as to enable some of the elements comprising the structure to be transferred in assembled form from the factory, thus minimising assembly times and the resources and personnel required for on-site construction.

[0013] Once the pillars holding up the structure have been erected, the lower floor slab and the double roof

slab will be fitted into the top of the pillars in a fast and effective process and with a degree of precision that will allow perfect structural stability. Finally, the trusses or latticework crowning the roof, which will provide support to the roof finishing, will be installed. Once the structure has been installed, the other elements comprising the module will be incorporated simply until finishing.

**[0014]** The pillars are designed in such a way that, in addition to their structural function, they can accommodate concealed installations such as downspouts for water collecting on the roof and other installations running through the cavity in the facade walls. In turn, they act as a support for the ground and roof slabs which will be joined to them via bushings allowing the slab to be threaded along the pillar.

**[0015]** The required damping in the roof has been achieved by means of a double slab. These two slabs are spaced at a distance of 20 cm, allowing considerable warping resulting from shock on the upper slab to be minimised by being transmitted to the lower slab.

**[0016]** Because the enclosing elements of facades and side walls are in sheet steel of a minimum thickness of 3 mm, it is difficult to ensure they can be installed manually on site. In principle, this means that their size must be limited to allow this goal to be achieved. The dimensions must be modular and compatible with norms established by other elements forming part of the module with standard dimensions. This element has tray dimensions of 50 cm in width by 2.50 m in height, and a weight of approximately 45 kg, allowing manoeuvrability and manual installation on site. This configuration allows continuous facade walls to be created simply by juxtaposing elements, also enabling openings to be provided, be they windows or doors, simply by altering the length. They are designed to accommodate the facade finish, since when the two are joined, a strip is created to which it will be possible to bolt or adhere any type of finish. These elements will be anchored to the edges of the upper and lower slabs to form a continuous wall providing the entire assembly with the required reinforcement. Importantly, in this way integration is achieved within the facade wall. The reinforcement is arranged as a sheet in the wall which together with the insulating panel and the cavity provided between the two elements gives an optimal functional response to the requirements demanded.

In order to provide a structural response to the constraints arising from the strong loads caused by the placing of sand on the roof and the condition of damping against shocks, the prefabricated structures have been rearranged in order to allow all elements to be adapted to the required specifications, without sacrificing the design philosophy. The structural calculation requires pillars and slabs designed to warp within very restricted limits, given that the other elements forming the module remain unaltered by the effect of the loads.

**[0017]** Unless otherwise indicated, all technical and scientific elements used in this specification have the meaning habitually understood by a person skilled in the

art to which this invention pertains. In the practice of the present invention, similar or equivalent procedures and materials to those described in the specification may be used.

**[0018]** Throughout the description and the claims the word "contains", "comprises" and any variations thereon shall not be intended to exclude other technical characteristics, additives, components or steps. For experts in the field, other objects, advantages and characteristics of the invention will emerge partly from the description and partly from practice with the invention.

## DESCRIPTION OF FIGURES

**[0019]** To complete the description made herein and in order better to aid understanding of the characteristics of the invention, according to a preferential example of a practical embodiment thereof, this description is accompanied by a set of drawings showing as follows in indicative, but not limitative terms.

Figure 1 shows a general perspective view of part of the structure of the industrialised module comprising the invention.

Figure 2 shows a cross-section view of the module.

Figure 3 shows a lengthwise cut-away view of the module.

Figure 4 shows a perspective detail of a pillar from the module.

## PREFERRED EMBODIMENT OF THE INVENTION.

**[0020]** According to the figures, one preferred embodiment of the proposed invention is described below.

**[0021]** As shown in Figures 1 to 3, the industrialised module forming the invention comprises:

- A roof made with three levels, a first level (1), followed by a second level (2) and finished with a third level (3)
- A series of pillars (16) joined at their upper ends to the third level (3) and at the lower end to the ground and to
- A lower slab (17) joined to the pillars and further supported by a series of central supports (18)

**[0022]** The first level (1) of the roof comprises a perimeter frame (4) and a first ribbed sheet (5) whose function is to allow rainwater to run off via the pillars (16). The roof is lean-to, with a single pitch of 4%.

**[0023]** The second level (2) of the roof comprises a first perimeter frame (8) preferably, of standard IPE steel profile and a series of first tubular crossbeams (9) on which a second ribbed sheet (10) is placed, leaving the first slab level joined to the second level by means of a

series of side lattices (7) and intermediary lattices (6).

**[0024]** The second ribbed sheet (10) may have a thickness of 0.6 mm and will serve to support the load for the upper reinforcement consisting of a cushion of sand bags with a thickness of 60 cm.

**[0025]** The third roof level (3) comprises a second perimeter frame (11) and a series of second tubular cross-beams (12) under which thermal and acoustic insulation in mineral wool (13) is laid under which a waterproof wooden board (14) is laid, and in turn, under the latter, a series of folded sheet slats (15) forming a false ceiling.

**[0026]** The facades and side walls are made with sandwich panels (19) formed by a steel sheet, followed by a core of high-density polyurethane foam, closed off with a second steel sheet. In one possible embodiment the thickness of the different elements might be as follows: for the external steel sheets a thickness of 0.5 mm; for the internal insulation, a thickness of 60 mm.

**[0027]** This arrangement achieves 0.32 W/m<sup>2</sup> K of heat insulation, between 30 and 35 DB of acoustic insulation depending on the frequency and a fire classification of B s3, d0.

**[0028]** The sandwich panel (19) can be covered externally with a phenolic board (20) 6 mm in thickness, and internally by a pillar finish (21) in white lacquered sheet.

**[0029]** The flooring is in synthetic wood parquet which in one possible embodiment might comprise:

- a wood laminate (22) of 7 mm in thickness
- followed by a fire-resistant MDF board (23) of 25 mm in thickness
- followed by mineral wool heat insulation (24) of 100 mm in thickness
- followed finally, a waterproof wooden board (25) of 8 mm in thickness.

**[0030]** The entire interior can be protected with a skirting board (26).

**[0031]** Figure 4 shows a depiction of a pillar (16) which, as can be seen, is a hollow structure which allows concealed passage of downspouts for water gathered on the roof and accommodation of other installations running through the cavity of the facade walls. In turn, they act as a support for the ground and roof slabs which will be joined to them via bushings allowing the slab to be threaded along the pillar. At the upper end of each pillar (16) there is a connection head (16.1), while at the lower end there is a base (16.2) connecting to the ground and to the lower slab (17).

**[0032]** Other construction elements are:

Partition walls: Formed by sandwich panel sheet of 0.5 mm in thickness, polyurethane foam core of 60-40 mm in thickness and sheet of 0.5 mm in thickness. This arrangement achieves 0.46 W/m<sup>2</sup> K of heat insulation, between 25 and 30 DB of acoustic insulation, depending on the frequency, and a fire classification of B s3 d0.

**[0033]** Exterior and interior doors: The exterior access door to the dwelling is provided in panelled aluminium

with a safety lock. The interior doors envisaged are of aluminium frame with galvanised steel sheet, white with PVC handles.

**[0034]** Windows: Sliding windows with 2 aluminium sheets and double glazing, thickness 4/6/4 mm.

**[0035]** Pack of sanitary appliances and taps. Sanitary appliances are in white porcelain, of the Roca brand or similar, with mixer taps in wash-hand basins and sinks and double taps in the shower. A toilet of the same material characteristics is included.

**[0036]** Plumbing and electrical installations. The plumbing installations are made as per legislation using copper pipes. The predicted drainage is limited to evacuation from the toilet and kitchen sink by means of 90 mm diameter PVC pipes.

**[0037]** All conduits will be hidden and the possibility is envisaged of installing an electric water heater as an improvement to ensure a supply of domestic hot water.

**[0038]** Connections will be made by the fitter/developer. Drainage will be installed by the customer in the foundation bed.

**[0039]** The electrical installation will be made with concealed corrugated pipe and fitted mechanisms and junctions. The sections of the conductor filament meet the specifications of the Low Voltage Electrotechnical Regulations (Reglamento Electrotecnico de Baja Tension) (RD 2143/1973), for a basic degree of electrification.

**[0040]** Three circuits are installed:

- C1.- 10 amp lighting
- C2.- 16 amp sockets and general use
- C3.- Cooker 25 amps

**[0041]** Having sufficiently described the nature of the present invention, and the means of implementing it, it is noted that within the same essence, it may be made in other embodiments differing in detail from that indicated herein as an example, and to which the protection obtained shall equally extend, provided that it does not alter, change or modify its basic principle.

## Claims

1. Industrialised module for prefabricated housing solutions **characterised by** comprising:

- A roof made with three levels, a first level (1), followed by a second level (2) and finished with a third level (3)
- A series of pillars (16) joined at their upper ends to the third level (3) and at the lower end to the ground and to
- A lower slab (17) joined to the pillars and further supported by a series of central supports (18)

where;

- the first level (1) of the roof comprises a perimeter frame (4) and a first ribbed sheet (5),
  - The second level (2) of the roof comprises a first perimeter frame (8) and a series of first tubular crossbeams (9) on which a second ribbed sheet (10) is positioned, leaving the first slab level joined to the second level by means of a series of side lattices (7) and intermediary lattices (6).
  - The third roof level (3) comprises a second perimeter frame (11) and a series of second tubular crossbeams (12) under which thermal and acoustic insulation in mineral wool (13) is laid under which a waterproof wooden board (14) is laid, and in turn under the latter a series of folded sheet slats (15) forming a false ceiling.
2. Industrialised module for prefabricated housing solutions in accordance with Claim 1, **characterised by** the fact that the thickness of the second ribbed sheet (10) may be 0.6 mm and will serve to support the load for the upper reinforcement consisting of a cushion of sand bags with a thickness of 60 cm.
3. Industrialised module for prefabricated housing solutions according to any of the above claims, **characterised by** the fact that the facades and side walls are made with sandwich panels (19) formed by a steel sheet, followed by a high-density polyurethane foam core, closed off by a second steel sheet.
4. Industrialised module for prefabricated housing solutions in accordance with Claim 3, **characterised by** the fact that the thickness of the different elements of the sandwich panel (19) is as follows: for the external steel sheets, 0.5 mm; for the internal insulation, 60 mm.
5. Industrialised module for prefabricated housing solutions in accordance with Claims 3 or 4, **characterised by** the fact that the sandwich panel (19) is externally covered by a phenolic board (20) of 6 mm in thickness, and internally by a pillar finish (21) in white lacquered sheet.
6. Industrialised module for prefabricated housing solutions in accordance with any of the above claims, **characterised by** the fact that the module has flooring which is a synthetic wood parquet comprising:
- A wood laminate (22) of 7 mm in thickness
  - Followed by a fire-resistant MDF board (23) of 25 mm in thickness
  - Followed by mineral wool heat insulation (24) of 100 mm in thickness
  - And finally, a waterproof wooden board (25) of 8 mm in thickness.
7. Industrialised module for prefabricated housing solutions in accordance with any of the above claims, **characterised by** the fact that the pillars (16) have a hollow structure to accommodate downspouts and installations, having at their upper end a connection head (16.1), while at the lower end they have a base for connection (16.2) to the ground and to the lower slab (17).

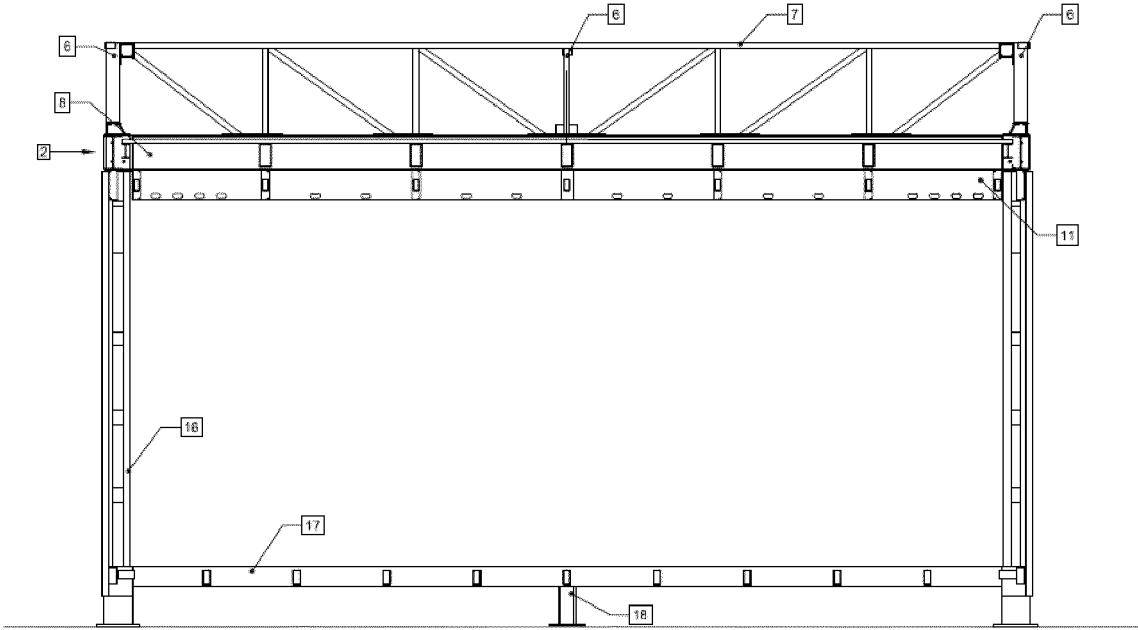


FIG. 1

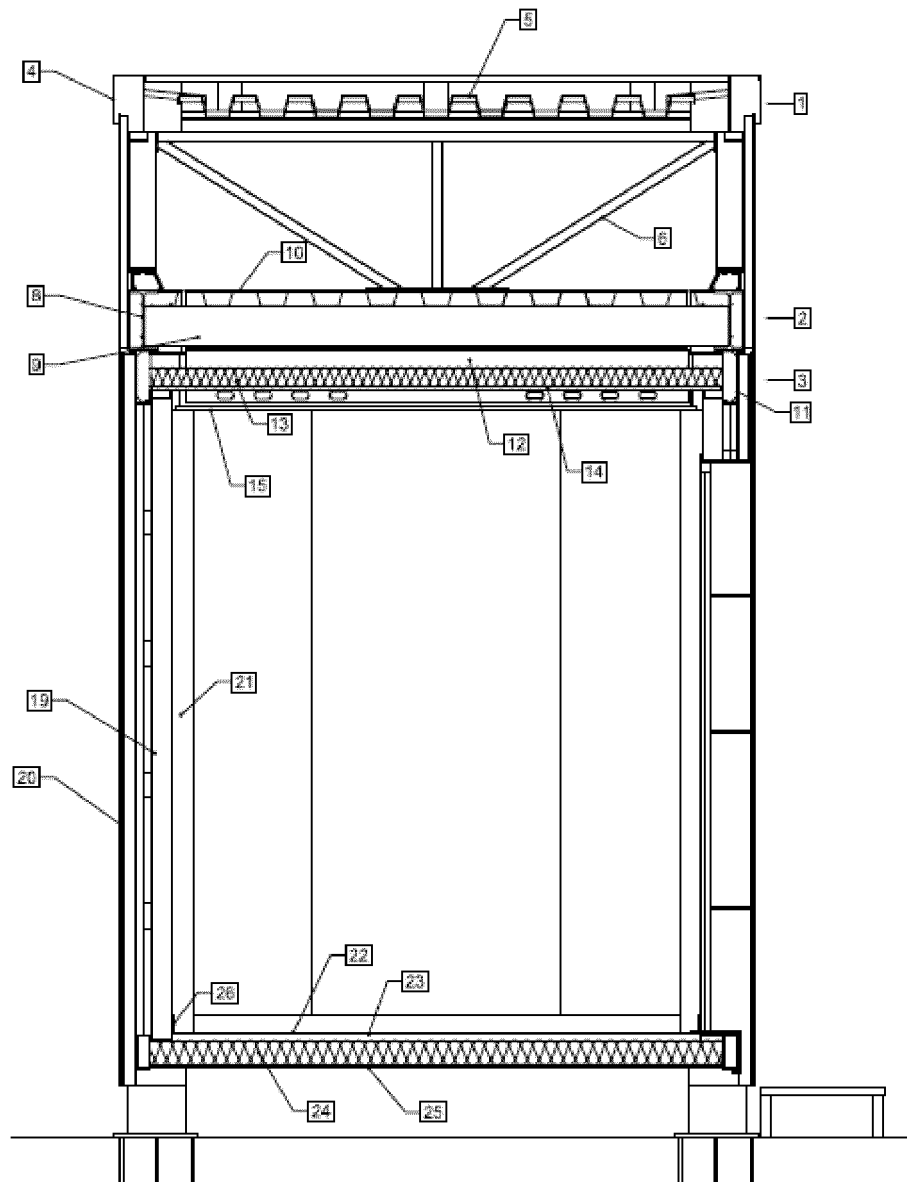


FIG. 2

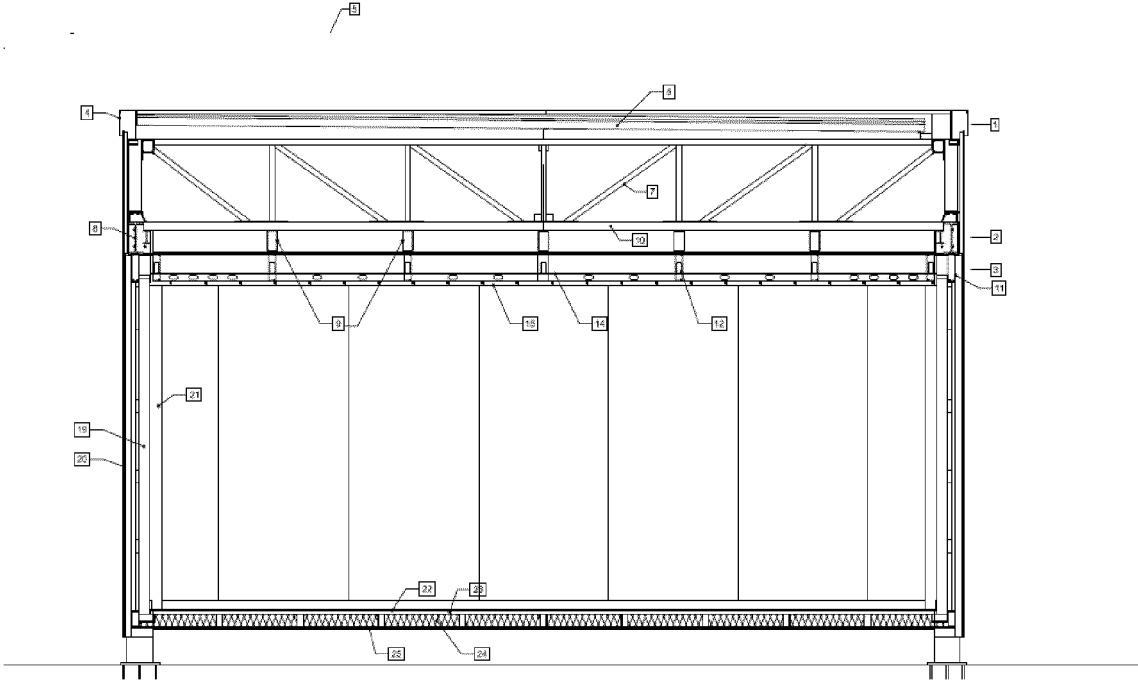


FIG. 3



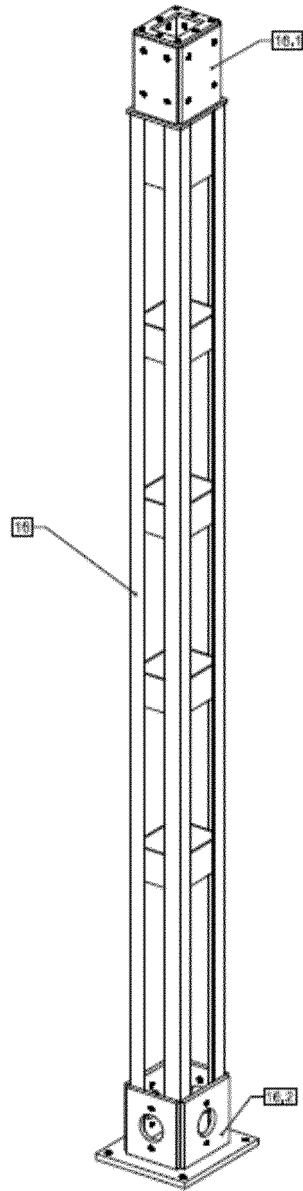


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ES2017/070030

## A. CLASSIFICATION OF SUBJECT MATTER

E04B1/343 (2006.01)

E04H9/14 (2006.01)

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, E04H

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)

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\* Special categories of cited documents:

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## INTERNATIONAL SEARCH REPORT

International application No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2017/070030

Information on patent family members

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