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

(11) EP 2 738 316 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
04.06.2014 Bulletin 2014/23

(21) Application number: **12818452.0**

(22) Date of filing: **23.03.2012**

(51) Int Cl.:
E04B 1/348 *(2006.01)*

(86) International application number:
PCT/ES2012/070199

(87) International publication number:
WO 2013/014305 (31.01.2013 Gazette 2013/05)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **28.07.2011 ES 201100888 P**

(71) Applicant: **Elipe Maicas, José Carlos**
46023 Valencia (ES)

(72) Inventor: **Elipe Maicas, José Carlos**
46023 Valencia (ES)

(54) MODULAR CONSTRUCTION SYSTEM

(57) The invention is in the field of construction of modular buildings for residential, hotel, educational, or hospital use.

The precast concrete modules comprising the building consist of three basic parts:
1 - Base: It is the floor of each module. It has four corner castings at the bottom.
2 - Box: It is the celling, the walls and the façade of each module. It has four corner castings at the top.
3 - Corridor: It is made up of a slab of equal width as the base and variable length according to regulations and/or building design requirements.

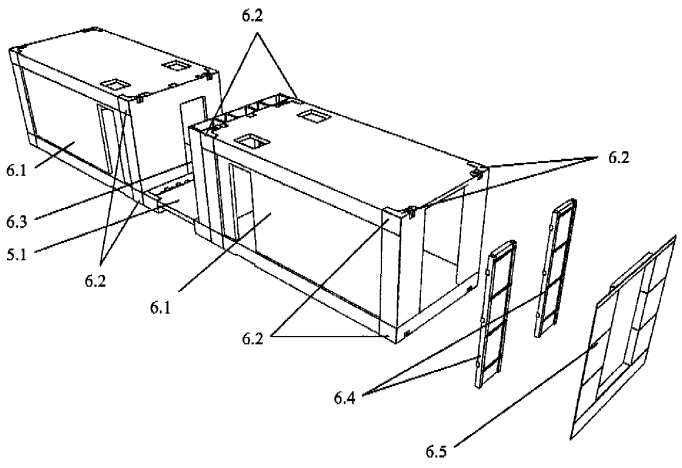
The base and the box are joined, forming a single rigid, monolithic piece. For this purpose, there are reinforcing bars in the base that will overlap the reinforcing bars of the box, thus giving continuity to the bars and ensuring the strength of the concrete at the joint between base and box.

A building is made up of different modules placed directly on top of each other and side by side. Neoprene bands are used to ensure a uniform contact between adjacent modules and to prevent the contact of concrete elements of different modules.

The stability of the resulting building against unlikely situations Is ensured by two types of pieces: stackers and turnbuckles. Like the corner castings, these pieces are inherited from the system for transport of containers used in cargo ships.

In the case of a residential building, the grouping of modules gives rise to an apartment, and the grouping of apartments, plus the vertical communication modules (staircase and elevator modules) gives rise to a building.

FIGURE 6



EP 2 738 316 A1

Description

STATE OF THE ART

[0001] The invention is in the field of modular construction, particularly In the construction of modular buildings for residential, Individual or collective use.

BACKGROUND OF THE INVENTION (PRIOR ART)

[0002] Despite living in an advanced society that has made significant achievements In food, health, education, housing, ... housing has not advanced at a similar pace and the quality of life of many people are determined by the quality of their housing.

[0003] Current housing problems:

- High prices hinder the development of families and condition their life for many years during which they have to pay back their mortgages.
- Low-tech: We are surrounded by technology, but the current homes are not ready to incorporate It. Not only that, there is no space reserved for the installation of new technologies, what implies costly adaptation works or major changes in the distribution thereof.
- Little sensitivity to the environment: uncontrolled water and electricity consumptions, poor thermal and acoustic insulation, constructive processes that generate large quantities of waste, ...
- Very low-tech construction process: manufacturing defects, slow and expensive implementation, low-skilled workforce, all of what gives rise to claims by the client due to low quality results.
- Obsolete housing: Current housing does not offer alternatives to suit the different family lifestyles in today's society. Houses, today, are not built according to the requirements of today's families.

[0004] The solution to the housing problem is to rethink the whole process of design and construction, incorporating processes of R & D & I. It is necessary to analyze, from the beginning, all the variables involved, taking advantage of new technologies, in order to design buildings that are economic, technological, sustainable, and with enough variety of typologies to satisfy current market demands.

[0005] Currently, there are some examples of prebuilt modular construction based on metal and concrete structures.

[0006] The documents EP1700964 and ES2303457A1 show a modular system consisting of construction modules of high-strength reinforced concrete, that can be stacked vertically and placed side by side; the system is preferentially to be used for residential buildings.

[0007] Each module is a monolithic structure consisting of a horizontal slab, four vertical posts at the corners, four upper perimeter beams and a slab resting on them as ceiling.

[0008] The modules include attachment devices for stacking, elements for the lateral connection between modules and/or horizontal and vertical bars for tightening the structure.

DESCRIPTION OF THE INVENTION

[0009] The invention is a new concept of modular building, with different finishing alternatives for both the inside and the outside of the building. The modular building should be configurable from a computer program that allows the customization of the different elements of the home and the evaluation of Its cost in real time.

[0010] The invention allows the construction of buildings preferably for residential use (either individual houses or condominium type buildings), but it also applies to the construction of hotels, schools, hospitals and residences for the elderly.

[0011] THE MODULAR CONSTRUCTION SYSTEM takes place entirely in a factory, including the deployment of all utilities and the installation of new technology elements. Which utilities and what technologies are included in the building is decided in the project design, selecting them from a range of alternatives, which vary in cost and design. The buyer can also specify elements to be incorporated later on as a kit, which the own buyer can install in the register provided with no need of further works.

[0012] The invention is based on prebuilt independent modules of reinforced concrete, which are the basic units of the building; each module is designed for a specific functionality in the home. For Instance, for residential housing, the modules available are the bedroom modules (N1, N2), the service module (kitchen + bathroom) (S), the sitting modules (D, D/N), the terrace module (T) ...

[0013] By grouping several modules, specific housing layouts are obtained; a building will result of the grouping of several apartments.

[0014] The assembly of the building consists of the following phases:

1 -. Earthworks
2 - Foundation
3 - Construction of sanitation and plumbing connections
4 - Placement and anchoring of the fully finished modules according to the building design.
5 - Connecting of building utilities to the network.

[0015] The on-site work is simplified, avoiding formwork, concrete handling, masonry, ... On site there is only need for the machinery necessary to lift and place the modules and the labor for the final anchoring between modules.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For better understanding of what is described herein, some drawings are provided showing: the implementation process, the design of each module, the grouping of the different modules into different types of housing, the grouping of the housing units into different types of buildings, and the grouping of the buildings into different types of blocks (in line, compact, and closed).

- **Figure 1** is a perspective view of the base of the housing module showing the basic components of this piece: slab (1.1), side low walls (1.3), corner castings (1.4) and register spaces for utilities (1.5).
- **Figure 2** is a perspective view of the corner casting of the base module (1.4) with steel bars welded to it (2.1) to ensure its anchorage at the base.
- **Figure 3** is a perspective view of the structure of the housing module showing the basic components of this piece: Slab (3.1), pillars with an L section (3.4), side walls (3.6), side beams (3.7) and corner castings (3.5).
- **Figure 4** is a perspective view of the corner casting of the housing module (3.5) with steel bars welded to it (4.1 and 4.2) to ensure its anchorage to the structure.
- **Figure 5** is a perspective view of the corridor slab (5.1) and of the support system at the base of the housing module (5.3 and 5.5)
- **Figure 6** is a perspective view of two housing modules (6.1), with the corridor (5.1) and with the mounting system for the facade (6.4 and 6.5)
- **Figure 7** is a perspective view of a building made of housing modules showing the elements to join the modules: stackers (7.1) and turnbuckles (7-2).
- **Figure 8** is a perspective view of the roofing module showing the basic components of this piece: A base module (same as Figure 1) and parapet (8.1)
- **Figure 9** is a perspective view of a cross-section of the staircase module, showing its basic components: Base (9.1) with transverse support beam (9.4), side walls (9.2) with transverse support beam (9.5) and precast concrete steps (9.3).
- **Figure 10** is a perspective view of a cross-section of the elevator module showing Its basic components: A base module (10.1) and vertical structure module (10.2)
- **Figure 11:** Example of plant for a block of flats, including modules for stairs and elevator.
- **Figure 12** Is a perspective view of a linear block
- **Figure 13** is a perspective view of a compact block type
- **Figure 14:** A perspective view of a closed block.

DESCRIPTION OF THE BASIC UNIT

[0017] Herein the basic unit module will be described. It is composed of three parts:

1 -.. Base (Figure 1) of reinforced concrete, it is the floor of each module. It is made up of a slab (1.1) and four "low walls" on each side of the slab (1.3). Above the base, the box will be built with the appropriate formwork using reinforced concrete (Figure 3). The ultimate goal is to ensure that base (Figure 1) and box (Figure 3) be joined constituting a single rigid, monolithic piece (Figure 6). For this purpose, the base (Figure 1) will have bar reinforcement (1.2) that will overlap with the box framework, giving continuity to the steel framework and ensuring the strength of the concrete at the joint between base (Figure 1) and box (Figure 3). Four corner castings are placed in the shorter sides of the low walls that run along the perimeter on the bottom of the slab (1.3) (base corner casting) (1.4) so that the four corner castings are placed on the corners of a rectangle of 2.438 by 6.058 meters; these dimensions coincide with the standard size of conventional trailer containers. The corner castings of the base (1.4) not only facilitate the transport and handling of the piece but also the connection between adjacent modules, giving unity to the whole building. The long low walls under the base have recesses (1.6) to carry the utilities from one module to another In the same housing. To ensure a good bond between the corner casting and the base itself, the corner casting has welded reinforcement bars that will bind with the framework of the base (Figure 2). On one of the short sides of the base there Is a series of holes to conduct the utilities (1.5), these holes are closed by a beam (5.5) that will serve as support for the corridor slab (Figure 5).

2 -. Box (Figure 3). It is made of reinforced concrete and forms the roof, walls and side walls of each module. It consists of an upper slab (3.1), four lateral walls (3.6), which may Incorporate four hollow pillars, with "L" section, at the corners (3.4) and two beams at the long sides (3.7) that give greater rigidity to the ensemble for the purpose of absorbing the stresses that the module will be subjected during transport and hoisting. The top slab has two holes that act as registers (3.2) to access the chamber that is created between the bottom slab of the base (1.1) of a module and the top slab of the box of another module (3.1), when modules are stacked. This chamber serves to conduct the utilities. It also has a number of recesses (3.3) to run connections for the utilities that go over the box and the general distribution lines that run through the base (1.5). Each one of the pillars has a corner casting on its top side (3.5). The four corner castings must be located in the corners of a rectangle of size 6.058 by 2.438 meters, coinciding with the standard measures used in trailer containers, and also with the measures of the corner castings in the base (1.4). The corner castings of the box (3.5) not only facilitate the transport and handling of the piece but also the connection between adja-

cent modules. The box corner castings (3.5) will connect with the base corner castings (1.4) of the upper module and with the box corner castings of the adjacent modules using special turnbuckles (7.1) and stackers (7.2) pieces (to be described later). To ensure the firm attachment of the corner castings to the box, two steel plates are welded to each corner casting and then four reinforcing bars are welded to the plates; these bars will form part of the reinforcing of the box (Figure 4).

The reinforcing bars from the base (1.2) overlap with the reinforcing bars of the pillars and the side walls of the box ensuring the union between base (Figure 1) and box (Figure 3). In this way, the final module is a monolithic structure of high strength (6.1) that can be stacked for the construction of complete buildings.

The final measures of this module can be modified according to the requirements and needs of the user. The formwork will have to be adapted to the specific design desired. The only constant In any module would be the positions of the corner castings to ensure easy transport and handling by conventional means.

Each of these concrete parallelepipeds called "modules" has a specific function in the house (Figure 11). There Is a service module with kitchen and bathroom (S), a day module (D, D/N, T), a night module (N1, N2,...)

All modules can incorporate an opening In the backside, accessible from the corridor, with a register cabinet to meter the utilities that go Into the house and which run through the holes (1.5) under the base of the modules (Figure 1).

This module design (6.1) that incorporates an opening for a cabinet with enough space to run all the forecasted utilities and their corresponding meters (6.3) gives great flexibility in organizing different types of housings at different levels. For Instance, there can be a floor with two apartments with three bedrooms, another floor with four studios, and another floor with two apartments with one bedroom plus a studio; and the utilities will be easily metered and all conductions will be well ordered and vertically aligned.

3 -. Corridor (Figure 5). It is made of reinforced concrete. It consists of a slab of the same width as the base and variable length according to regulations and specific construction requirements (5.1). It rests on the beams (5.5) of the two bases of the modules In between which the corridor runs. Neoprene bands are used to avoid the direct contact between concretes of different elements and to ensure a homogeneous distribution of loads between the corridor slab and the module base beams.

The exterior façade, the interior dividing wall between modules, and the dividing walls between modules and corridor are made of a plate of reinforced concrete (3.6). These concrete plates will act also as Interior surface finishing.

The elements for thermal and acoustic insulation (6.4), if necessary by regulation, as well as the façade siding (6.5), if planned and budgeted, will be placed on the outside of the module (6.4).

Communication between modules within an apartment is through frames or openings (11.3) located on the vertical walls (3.6) of the box. In order to hide the joints between modules and to ensure water tightness a metal section is inserted in between (11.1).

DESCRIPTION OF THE ANCHORAGE AND CONNECTION SYSTEMS USED TO CONSTRUCT BUILDINGS FROM MODULES

[0018] The different modules that will make up are building are laid out on the horizontal plane and stacked vertically. As already explained earlier, between the base slab of a module and the top slab of the module underneath there are chambers through which utilities run and that can contain acoustic and thermal insulation elements If necessary.

[0019] At the base of the pillars, and on the lateral faces of pillars pertaining to adjacent modules, a neoprene band (6.2) is placed to prevent noise transmission between modules and also to avoid the contact between concrete elements of different modules.

[0020] The stability of the resulting building against accidental or unlikely events (explosions, earthquakes, ...), is guaranteed by two types of pieces for anchoring and connection between modules, which, like the corner castings (1.4 and 3.5), are based on similar pieces used In harbors for the handling of containers:

1 - Stackers (7.1): They restrict the horizontal movement but not the vertical one. Each stacker Is made of a plate (7.1.1) and four cones (7.1.2) welded to the plate, two cones on the upper side and two on the lower side. This piece is inserted directly into the lower openings in the corner castings of the base (2.3) and the upper openings of the corner castings of the box (4.3).

2 - Turnbuckles (7.2): They restrict the vertical movement and give unity to the whole building. Each turnbuckle is made of a tie bar (7.2.3), a buckle at each end (7.2.2) and the fitting piece with the corner casting (7.2.1). Its geometry allows its use as a horizontal tie bar underneath the corridor slab, and as a vertical tie bar, either on the façade or on the corridor (Figure 7).

DESCRIPTION OF THE MODULES USED FOR VERTICAL COMMUNICATION

[0021] Vertical communication occurs through two new modules: the staircase and the elevator modules.

Both are designed as modules with the same features as the house modules regarding the manufacturing process, materials, geometry and dimensions. The construction, transportation and placement of precast elements (stairs and elevator) are similar to the rest of the house modules.

[0022] The staircase module and the elevator module become part of the building as one more place of the series, as If it were a house module, since it has identical dimensions (Figure 9 and 10).

[0023] The position and number of stairs and elevators do not depend on geometrical constraints but only on regulations or design requirements. The elevator module may not be necessary for low buildings, or can be placed on site without the elevator, to be added in the future.

1 - STARICASE MODULE (Figure 9). It consists of three concrete pieces:

[0024]

1.1 Base (9.1): it has the same geometry as the housing modules (Figure 1). It has an opening on the slab (9.7) on which the stringers of the ladder (9.3) rest. The opening is flanked by three low walls (two longitudinal ones and a transversal one) and a cross beam (9.4) with a recess in which the staircase stringer rests (9.3).

1.2 Box (9.2). It has the same geometry as the house module box. It has an opening on the top slab (9.6) coinciding with the opening of the base (9.7) in which the staircase stringer is placed. There is a cross beam (9.5) on the short side of the box placed at half the height of the box; this beam serves as intermediate support for the stair stringers (9.3). The beam also marks the opening that will be used for lighting and ventilation of the module (Figure 9).

1.3 Stair stringer (9.3): It is made of precast concrete and placed through the openings of the base (9.7) and box (9.6). It rests in a series of cross beams (9.4 and 9.5) that guarantee the stability of the element.

[0025] The vertical anchoring between the different elements that make up the staircase module, as well as the horizontal anchoring with the adjacent modules is done with the same system as the other modules, already described before (Figure 7).

2 - ELEVATOR MODULE (Figure 10) It consists of two concrete pieces:

[0026]

2.1 Base (10.1): it has the same geometry as the housing modules (Figure 1). The slab has two openings (10.4) one for the elevator itself, and the other for the forced ventilation of the garage, if any, The elevator can be placed during construction or after.

2.2 Box (10.2): It has the same geometry as the box modules for the apartments. It has two openings on the top slab (10.3) coinciding in position with the openings of the base (10.4).

[0027] The vertical anchoring between the elements that make up the elevator modules, as well as the horizontal anchoring with the adjacent modules Is done with the same system as the other modules, already described before (Figure 7).

DESCRIPTION OF THE MODULES TO CONFIGURE THE ROOF OF THE BUILDING

[0028] The roof is made up of the same base elements used for the house modules (Figure 1).

[0029] Four low walls (8.1) are built on the perimeter of a base slab (1.1). These low walls are the same as the ones of the base used for the housing modules (1.3). The roof base is symmetrical in the plane of the slab (1.1). The low walls act as parapets and partition the roof. At the locations In which the rain collectors are running there are openings to connect with the general collector network (8.3). In this way, there is no need to perforate the base, thus avoiding water percolation into the apartments.

[0030] Four corner castings (8.2) are placed on the upper face of the low walls along the short sides of the roof base (1.3 and 8.1). The corner castings must be located in the corners of a rectangle of 6.058 by 2.438 meters, so that they can be lifted and handled with the same means using for container handling in harbors.

[0031] Finishing pieces (8.4) are placed on top of the joints between adjacent roof modules (8.1) to ensure water tightness (Figure 8).

[0032] The system allows for different types of roofing, depending on the intended use for this area (green roof, gravel, walkable, ...).

[0033] The horizontal anchoring system between these modules, and the vertical anchoring with the modules below is the same as in the home modules as already described before (Figure 7).

DESCRIPTION OF BUILDING TYPOLOGY

[0034] The modules described for the MODULAR CONSTRUCTION SYSTEM can be freely combined, both horizontally and vertically. This flexibility permits a building design tailored to the specifics of each case:

Plot dimensions and slopes
Building typologies allowed by the urban planning regulations
Market demand
Economic resources
Deadlines
The combination of the modules described above allows, among others, the following building types:

1 - Detached house:

[0035] It corresponds to a single family detached house, generally found In residential areas.

[0036] The modules can be arranged aligned next to each other, or they can be placed using the corridor module to organize the house around it, with rooms on both sides of the corridor.

[0037] This system would permit the addition of new modules afterwards to enlarge the house size.

[0038] The final look of the house will depend on the type of façade finishing chosen: precast panels, curtain wall, light panels...

2 - Linear block (Figures 11 and 12):

[0039] It could correspond to attached family houses, or condominiums.

[0040] For this typology, house modules are aligned along both sides of a central corridor.

[0041] The length and number of floors of the block depends on regulations and customer needs.

[0042] The staircase modules and the elevator modules (if needed) will be placed at the extremes of the block, as just another module, not interfering with the house modules.

[0043] Depending on the number of apartments, there is a need to reserve at least a module for the utilities (water and electricity).

[0044] The final look of the house will depend on the type of façade finishing chosen: precast panels, curtain wall, light panels...)

3 - Compact Block (Figure 13):

[0045] It corresponds to the typical apartment block.

[0046] The house modules are laid out around a central area with the staircase module (Figure 9) and the corridor (5.1).

[0047] Around this central space, six apartments are laid out in each floor.

[0048] The types of apartments that can be included in this arrangement are numerous, with different combination of apartment sizes per floor. This possibility to alternate the plan distribution of the apartments allows the incorporation of terraces, equivalent in size to a single module, giving its own look to the building.

[0049] On the ground floor, there must be a module reserved for the entrance hall, and depending on the number of apartments of the building, at least, another module for the utilities (water, electricity, telephone, fiber,...)

[0050] The final look of the building will depend on the type of façade finishing chosen. This finishing could be different from the finishing used for the module sides that look Into the Inner patio.

4 - Closed block (Figure 14):

[0051] It corresponds to a block with an Inner patio large enough to include a common are for sports, games or leisure.

[0052] A closed block can be made up by laying out linear blocks along the sides of a rectangle (Figure 11 and 12). Four such linear blocks are arranged leaving a common central space that can contain pools, gardens, sport courts, ...

[0053] For each stairwell module there must be a module for utilities (water, electricity, telephone, fiber, ...).

[0054] The final look of the building will depend on the type of façade finishing chosen. This finishing could be different from the finishing used for the module sides that look into the inner common area.

5 - DESCRIPTION OF A WAY TO BUILD

[0055] The system consists of modular elements of high strength reinforced concrete (6.1). The construction of these elements Is precast In the factory using specialized formwork that can be reutilized multiple times.

[0056] The formwork is made up for inner and outer plates. These plates are put in place and removed using hydraulic devices.

[0057] The formwork Is designed to build the elements explained in the paragraphs describing the invention.

[0058] Once the element has been precast, and depending of whether it corresponds to a service module, a day module or a night module, the necessary installations will be mounted. Each module is ready to be transported to its destination, incorporating from factory all the finishing, including the necessary installations.

[0059] The living modules will be complemented by other modules to make up a building. All installations will be Integrated from factory, including sanitary, electric, home automation, heating, air conditioning, and others.,. The modules make up rooms ready to be lived in, with all the utilities and finishing ready for their use.

[0060] The modules for vertical communication use the same type of formwork as the living modules, but adapted to the variations that they have in their geometry; so that, the stairs can be placed in the staircase module, and the elevator machinery and other installations are placed In the elevator module.

[0061] The resulting buildings are the combination of industrialized modules. Their weight and size allow transportation by conventional means.

Façade

[0062] Each house module is made up of two parts, a "base" (Figure 1) and a "box" (Figure 3), rigidly joined (6.1) with the appropriate overlap of reinforcing bars from each part (1.2).

[0063] The closure of the façade Is made up of an interior concrete sheet (3.6) that comes from the formwork

of the box (Figure 3). In the interior of the module, there is an optimal finishing surface, ready to be painted, in case that the concrete is not to be seen. On the exterior, it serves as support for the thermal insulation (6.4) as required by regulations; it also serves as support for a final siding (6.5) that will be made up of different types of panels depending on the final look desired: phenolic panels, aluminum panels, ceramic panels, precast panels, curtain walls,...

[0064] Each module that faces the building façade will have a siding according to the design blue prints.

Roofing

[0065] The roofing is made up of "base" elements (Figure 1) identical to the housing module "bases", and with the same dimensions as the modules on which they rest.

[0066] At those locations in which the pluvial collectors run down the building, there are holes (8.3) to connect them directly to the general rain collector network. In this way, there is no need to perforate the bases and thus avoiding water percolation into the building.

[0067] The system permits different types of roofing, such as a simple one, to be used as a service zone, a gardened roof with a water tank, or a wooden terrace for the apartments.

6.- INDUSTRIAL IMPLEMENTATION

[0068] The previous sections describe the modular construction systems. From these descriptions, the potential industrial uses and applications can be derived.

Claims

1. A construction system of precast reinforced concrete wherein it comprises:

- Housing module (6.1) comprising

• A "base" or floor of the module comprising
A reinforced concrete slab (1.1)
Four "low walls" of reinforced concrete (1.3) on the sides of the slab (1.1)
Four corner castings embedded in the base of the "low walls" (1.4)
Reinforcing bars to overlap with those of the box (1.2) so that the assembly of base plus box becomes a rigid and strong module.
• A "box" or ceiling and walls of the module comprising:

A reinforced concrete slab (3.1)
Four vertical concrete walls that form a rectangular parallelepiped and that have holes (3.6)
Four pillars with an "L" section of reinforced concrete (3.4)
Four corner castings embedded in the head of the pillars (3.5)

• Neoprene bands on pillar heads and in between modules (6.2)
• Thermal insulation on those box walls that face the outside (6.4)
• Various types of exterior siding on the façades (6.5)
• A concrete slab making up a corridor (5.1), which rests on the base of adjacent house modules.

- Roofing module, comprising
A "base" or floor of the module
Parapets delimiting the module (8.1).
Finishing metal plates covering the joints of adjacent modules (8.4).
- Special elements to anchor together the modules
Stackers (7 .1)
Turnbuckles (7 .2)
- Vertical communication modules, stairs or elevator comprising
A "base" module floor (9.1 and 10.1)
A "box" or ceiling and walls of the module (9.2 and 10.2)

2. The construction system of claim 1, wherein the reinforced concrete slab of the base (1.1) has, in its entire perimeter, reinforcing bars (1.2) that will overlap the reinforcing bars of the box, thus resulting In a rigid union. In this way, the resulting module is a single monolithic structure of high strength and capable to be piled (6.1) to make up whole buildings.

3. The construction system of claims 1 and 2, wherein the low walls that delineate the slab on its lower side (1.3) are flush with the upper side of the slab (1.1).

4. The construction system of claims 1-3, wherein the low walls (1.3) hang from the slab underside (1.1) with the purpose of creating a chamber between the base of a module (1.1) and the slab of the module underneath (3.1) through which to run the utilities and place the necessary insulation.

5. The construction system of claims 1-4, wherein the low walls located on the long sides of the base (1.3) have a recess (1.6) for the crossing of the utilities from one module to another.

6. The construction system of claims 1-5, wherein the low walls (1.3) located at the lower side of the slab, have embedded corner castings (1.4), arranged so that handling and transport by conventional means Is guaranteed.

7. The construction system of claims 1-6, wherein the corner castings (1.4) are arranged so that they are placed in the corners of a rectangle measuring exactly 6.058 by 2.438 m., coinciding with the positions of the corner castings in cargo containers.

8. The construction system of claim 1-7, wherein the corner casting of the base (1.4) has four reinforcing bars welded to it (2.1), one in each corner of the cast, which are embedded in the low walls of the base (1.3) guaranteeing that they cannot be removed due to the loads that will appear during handling and construction, and that they will last over the life of the building.

9. The construction system of claims 1-8, wherein, attached to one of the shorter sides of the base, there are:

   Two principal longitudinal beams (5.3) along the longer sides of the base.
   Several secondary longitudinal beams (5.4) in between and parallel to the principal longitudinal beam (5.3).
   A cross beam (5.5).

10. The construction system of claim 1-A, wherein the principal longitudinal beams (5.3) are an extension of the long sides of the base and its width is equal to the sum of the height of the low walls (1.3) plus the thickness of the base slab (1.1)

11. The construction system of claims 1 - 10, wherein the ends of the cross beam (5.5) are supported on the principal longitudinal beams (5.3), so that the bottom faces of both beams are flushed, and the height of the cross beam is equal to the height of the low walls (1.3), therefore, allowing support for the corridor slab (5.1).

12. The construction system of claims 1 to 11, wherein the secondary longitudinal beams (5.4) are arranged perpendicular to the cross beam (5.5), creating a series of openings (1.5) through which the building utilities will run, and with a height equal to that of the low walls of the base (1.3).

13. The construction system of claim 1, wherein the concrete slab of the box (3.1) has two openings (3.2) that allows access to the chamber created when a module base is laid on top of a box.

14. The construction system of claim 13, wherein the box concrete slab (3.1) has a number of recesses (3.3) that serve as guides to join the utilities in the box with the general utilities that run through the holes In the module base (1.5).

15. The construction system of claim 13-14, wherein the upper face of the box pillars, with an "L" cross-section, (3.4) is flushed with the upper side of the box slab (3.1).

16. The construction system of claims 13-15, wherein each one of the "L" section pillars of the box (3.4) has, embedded on its upper face, a corner casting (3.5) to facilitate handling and transportation by conventional means.

17. The construction system of claims 13-16, wherein the corner castings (3.5) are located on the short sides of the box, flushed with the interior face of the pillars (3.4), so that they form a rectangle of size 6.058 by 2.438 meters, exactly as in the cargo containers.

18. The construction system of claims 13-17, wherein the corner casting (3.5) has two welded steel plates (4.5) onto which four reinforcing bars are welded, two in each plate, (4.1) and tied together with corrugated steel (4.2), which embedded In the box concrete pillars cannot be removed due to the loads encountered during handling and will last over the life of the building.

19. The construction system of claims 13-18, wherein on the long sides of the box, In between the pillars (3.4), there are reinforced concrete walls (3.6), thinner than the pillars (3.4), and flushed with them on the inside, so that, in between modules (6.1), there Is a chamber to accommodate the acoustic and thermal insulation.

20. The construction system of claims 13-19, wherein along the long sides of the box, there are beams (3.7) of the same width as the pillars (3.4) but thicker than the box slab (3.1) to provide stiffness against the stresses caused during handling and transportation of the modules.

21. The construction system of claim 13-20, wherein the short sides of the box between the pillars (3.4) have reinforced concrete walls (3.6), which are thinner than the pillars (3.4), which are aligned with the pillars on its outer face, which act as exterior enclosure or as dividing wall between the house module (6.1) and the corridor (5.1), besides serving as support for the thermal and acoustic insulation (6.4) of both enclosures and as support for the final exterior enclosure (6.5).

22. The construction system of claims 1-20, weherein the reinforcing bars In the base (1.2) will overlap the reinforcing bars of the pillars (3.4) and of the box walls (3.6) so that, when casted, they will Join monolithically resulting in a single piece (6.1) stiff enough

to absorb the loads that will appear during manufacturing and over its lifetime.

23. The construction system of claims 1-22, wherein the pillars (3 4.), on their top and sides have neoprene bands (6.2) to ensure the correct contact and leveling for both the upper modules and the side modules, avoiding direct contact between concrete of different pieces.

24. The construction system of claims 1-23, wherein the external enclosure Is made with cladding (6.5) that Is held to the concrete wall by a metallic structure. The external enclosure can change as a function of the material selected. The necessary thermal insulation (6.4) is placed in between the external enclosure (6.5) and the concrete wall (3.6).

25. The constructive system of claims 1-24 wherein the slab corridor (5.1) has slits at the corners (5.2) for its placement on top of the cross beam of the module base (5.5), fitting between the two principal longitudinal beams of the module base (5.3).

26. The construction system of claim 25, wherein the thickness of the corridor slab (5.1) coincides with the thickness of the base slab (1.1) so that the top face of both slabs are at the same level, eliminating any unevenness between corridor (5.1) and the house module (6.1).

27. The construction system of claim 25-26, wherein neoprene bands are used on the base cross beam (5.5) to ensure the correct support and leveling of the corridor slab (5.1) on the housing modules (6.1)

28. The construction system of claims 1-27, wherein a cabinet (6.3) is built to protect all utilities and other installations that are located in the holes (1.5) between the primary longitudinal beams (5.3), the secondary beams (5.4) and the cross beam (5.5) of the base slab. All installation holes (1.5) are accessible from the corridor (5.1).

29. The construction system of claim 1, wherein the stackers (7.1) are made of a plate of cast Iron (7.1.1) and four cones of cast iron (7.1.2) welded to the plate (7.1.1) on both sides, two by two.

30. The construction system of claims 1 - 29, wherein corner casting of the base (1.4) has a hole on its lower face (2.3) to introduce one of the cones (7.1.2) of the stacker (7.1) preventing the horizontal displacement of adjacent modules (6.1).

31. The construction system of claims 1 - 30, wherein the corner casting (3.5) of the box has a hole on its upper face (4.3) to introduce one of the cones (7.1.2) of the stacker (7.1) preventing the horizontal displacement of adjacent modules (6.1).

32. The construction system of claim 1 - 31, wherein the turnbuckles (7.2) have a rod (7.2.3), two buckles (7.2.2) plus the fitting pieces (7.2.1)

33. The construction system of claims 1 - 32, wherein the corner casting of the base (1.4) has a hole in its front face (2.2) in which to introduce the fitting end of the turnbuckle (7.2.1) to prevent vertical displacements of adjacent modules and giving unity to the whole.

34. The construction system of claims 1 - 33, wherein the corner casting of the box (3.5) has a hole In its front face (4.4) In which to introduce the fitting end of the turnbuckle (7.2.1) to prevent vertical displacements of adjacent modules.

35. The construction system of claim 1, wherein the roof module has a parapet of reinforced concrete (8.1) along the perimeter of the base to which is joined by the overlap of the reinforcing bars In both parapet and base (1.2).

36. The construction system of claim 35, wherein the parapet on the short sides of the roof module (8.1) have embedded, on their top side, two corner castings (8.2) placed to guarantee its handling and transport by conventional means.

37. The construction system of claims 35 -36, wherein the corner casting of the roof (8.2) are placed on the corners of a rectangle of 6.058 by 2.438 meters, coinciding with the position of the corners In cargo containers, so that they can be moved, lifted and manipulated by conventional means.

38. The construction system of claims 35-37, wherein the roof module has a circular hole (8.3) in the parapet (8.1) aligned with the hole through which utilities run (1.5) aimed at connecting each roof module with the rain collector network.

39. The constructive system of claims 35-38 wherein the roof module has finishing elements (8.4) placed on top of the lateral low walls (8.1) to ensure water tightness in the joint between roof modules.

40. The construction system of claims 35-39, wherein each roof module Is designed with a slope, with the necessary lining to ensure imperviousness, thermal insulation, and a final finishing, all of which will depend on the final solution chosen (gravel roof, walkable roof, tiled roof, wooden roof, ...)

41. The construction system of claims 1-39, wherein the

housing modules (6.1) include internal walls (11.2) for the house partitioning Into rooms.

42. The construction system of claim 1-41, wherein the house modules (6.1) have Interior plates (11.1) which are embedded in the frames of the openings between modules (11.3) acting as seals.

43. The construction system of claim 1, wherein the staircase module is a parallelepiped with a base (9.1), a box (9.2) and precast concrete stair stringers.

44. The building system of claim 43, wherein the base (9.1) has a cross beam (9.4) which bounds the stairwell and gives support to the precast staircase stringer (9.3).

45. The construction system of claims 43-44, wherein the croos beam (9.1) has a height equal to the height of the base (9.1) minus the thickness of the base slab, leaving a step towards the stairwell in which the stair stringers (9.3) will rest.

46. The construction system of claims 43-45, wherein the concrete slab of the base of the staircase module (9.1) has vertical reinforcing bars along its perimeter which will overlap with the reinforcing bars of pillars and walls of the box (9.2) thus forming a stiff union. In this way, the result is a module with a monolithic structure of high strength and that can be stacked for the design of whole buildings.

47. The construction system of claims 43-46, wherein the box in the staircase module (9.2) has a hole (9.6) coinciding with the hole of the base (9.7) and which allows the placement of the precast stair stringers (9.3).

48. The construction system of claims 43-47, wherein the box of the staircase module (9.2) has a cross beam (9.5) located half way up on the short side of the box (9.2) next to the hole (9.6) that is used as intermediate support for the precast staircase stringer (9.3).

49. The building system of claims 43-48, wherein the low wall on the short side of the staircase module (9.2) has a hole (9.8) under the cross beam (9.5) in which the stringer rests, that serves for lighting and ventilation.

50. The construction system of claims 43-49, wherein neoprene bands are used on the corss beam of the staircase base (9.4) and on the cross beam of the staircase box (9.5) to ensure good support and leveling of the stair stringers.

51. The construction system of claim 1, wherein the elevator module is a parallelepiped made up of a base (10.1) and a box (10.2), both of concrete.

52. The construction system of claim 51, wherein base slab (10.1) has two openings (10.4) for the placement of the elevator and of the forced ventilation ducts for the garage and ground facilities.

53. The construction system of claims 51-52, wherein the reinforced concrete slab of the elevator module base (10.1) has, along its perimeter, reinforcing bars (1.2) that will overlap with the reinforcing bars of the pillars and walls of the box (10.2) for a stiff union. In this way, the final module Is a monolithic structure of high strength that can be stacked for the construction of buildings.

54. The construction system of claims 51-53, wherein the slab of the elevator module box may have two openings (10.3) exactly over, and of the same size and shape as, the ones in the base (10.4).

55. The construction system of claims 1-54, wherein the combination of different types of housing modules (6.1) will result in different apartment/house typologies

56. The construction system of claims 1-55, wherein the combination of the different apartments of claim 55, together with the vertical communication modules, stairs and/or elevator, will results in different types of buildings and building blocks, lineal, tower, closed block,...

FIGURE 1

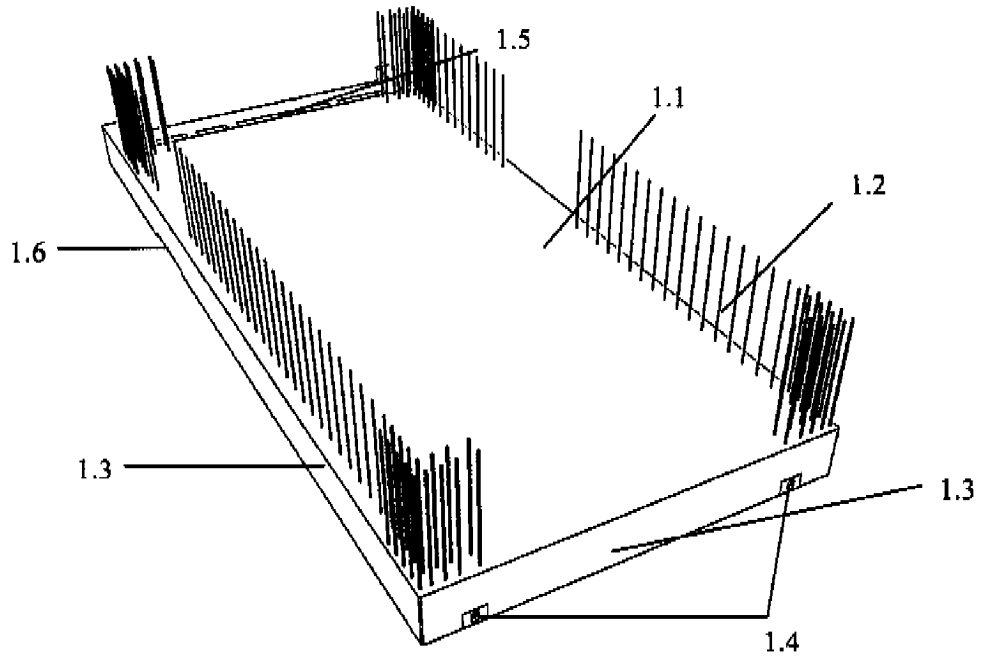


FIGURE 2

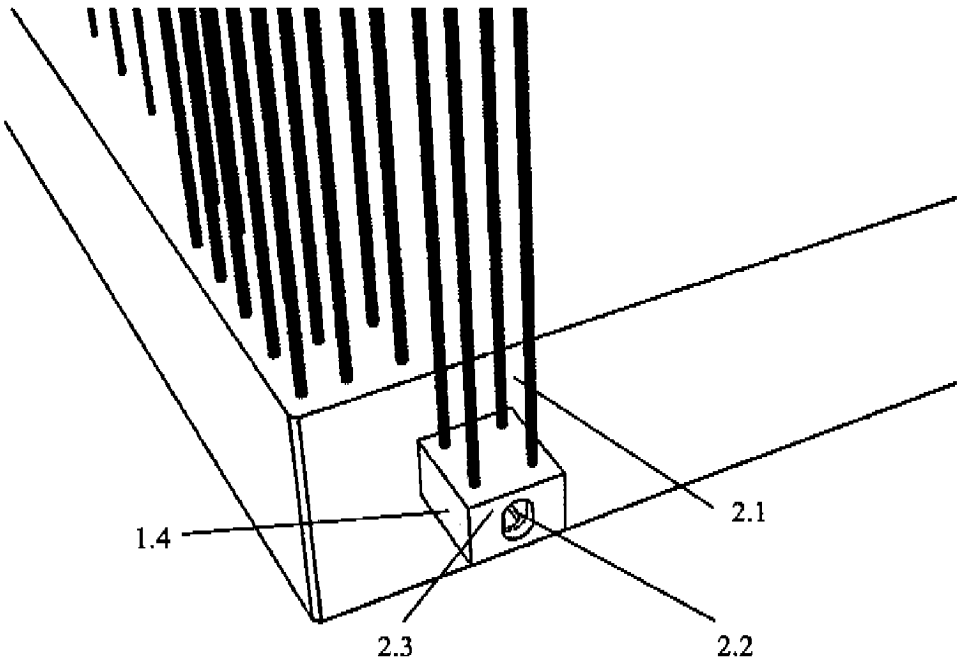


FIGURE 3

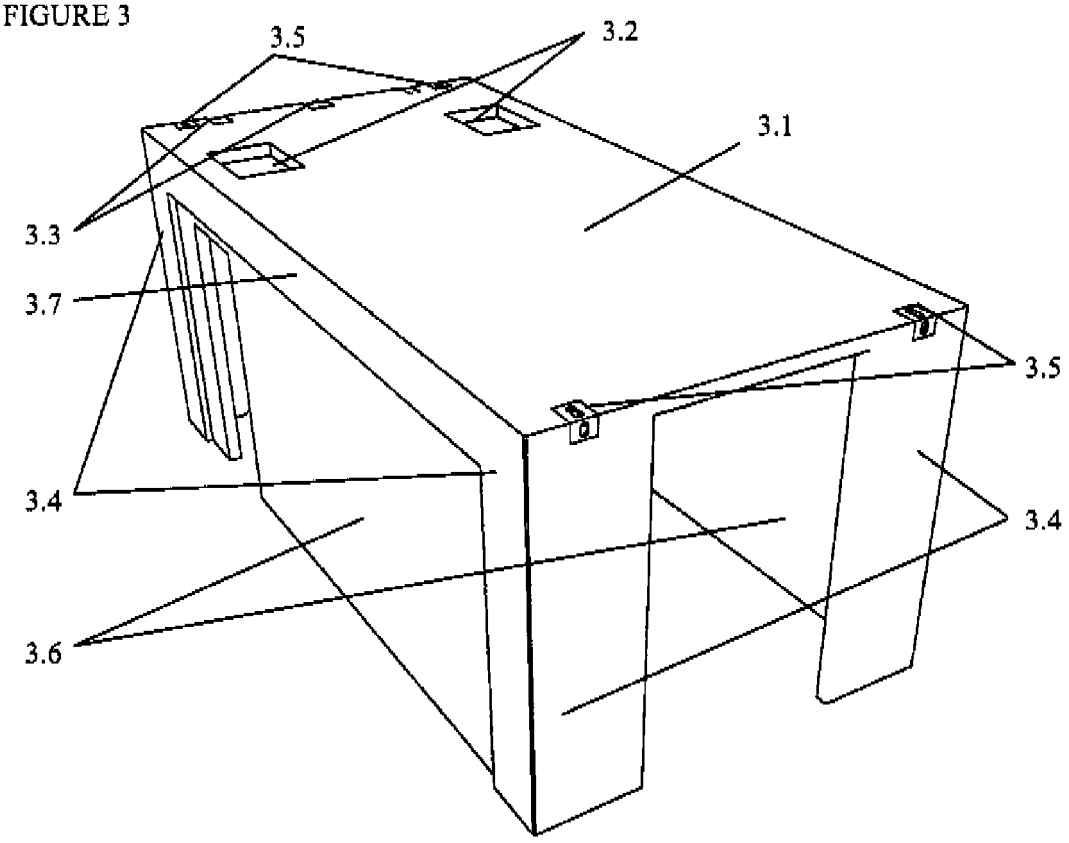


FIGURE 4

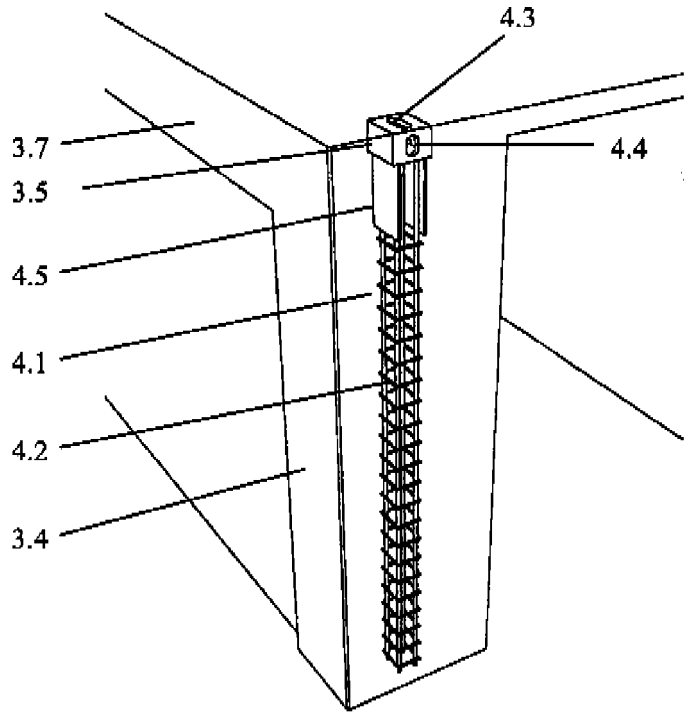


FIGURE 5

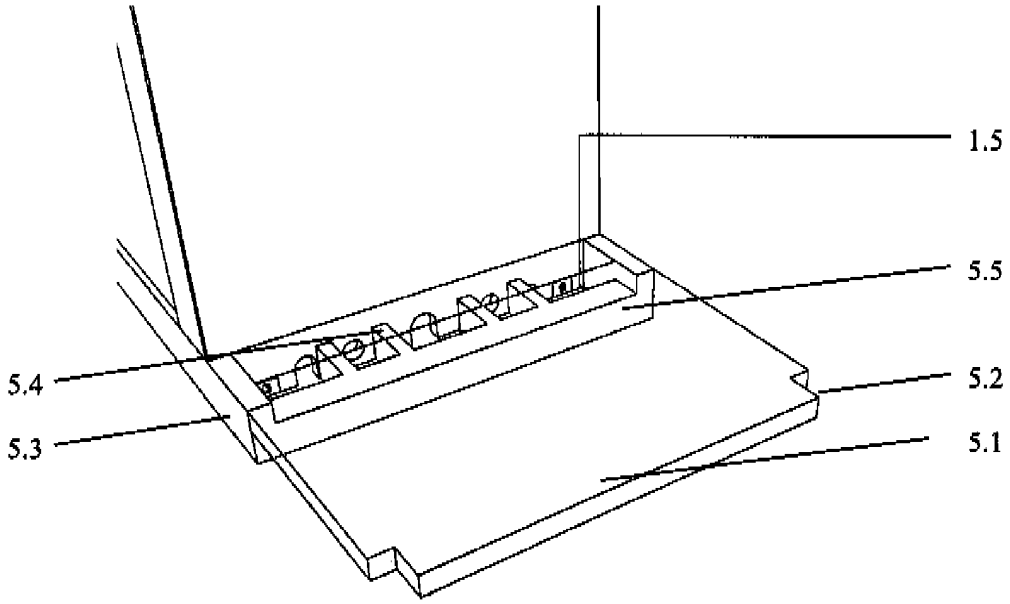


FIGURE 6

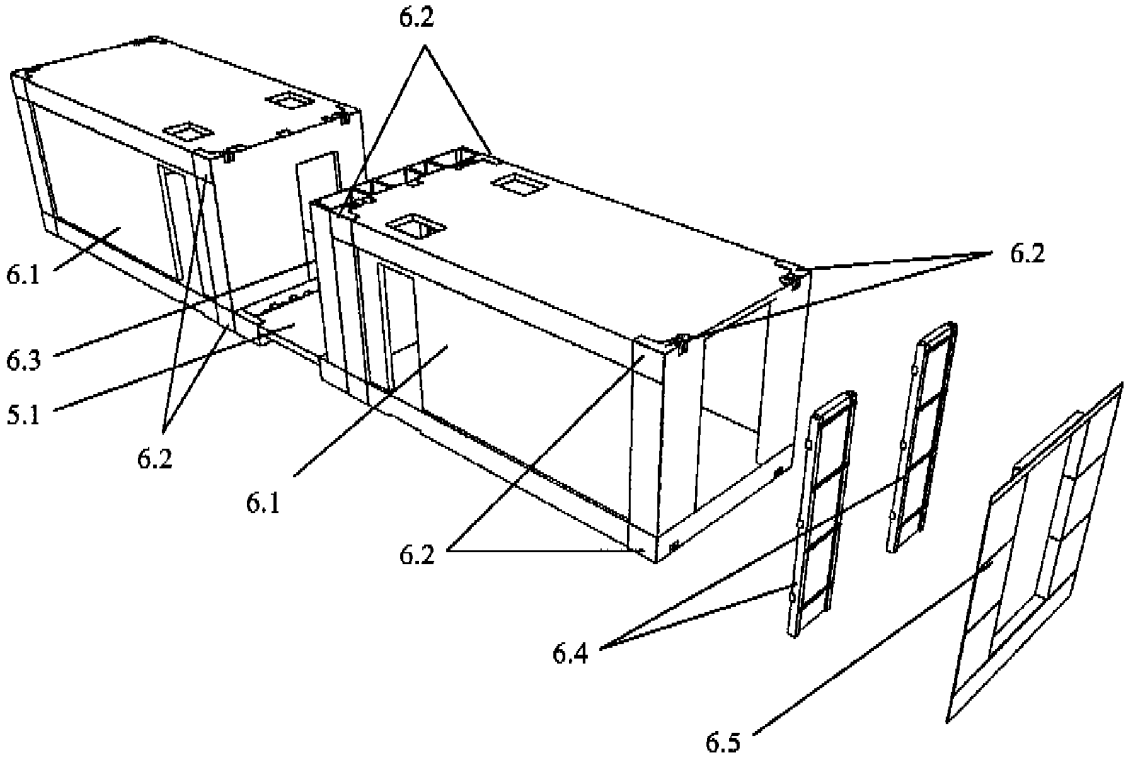


FIGURE 7

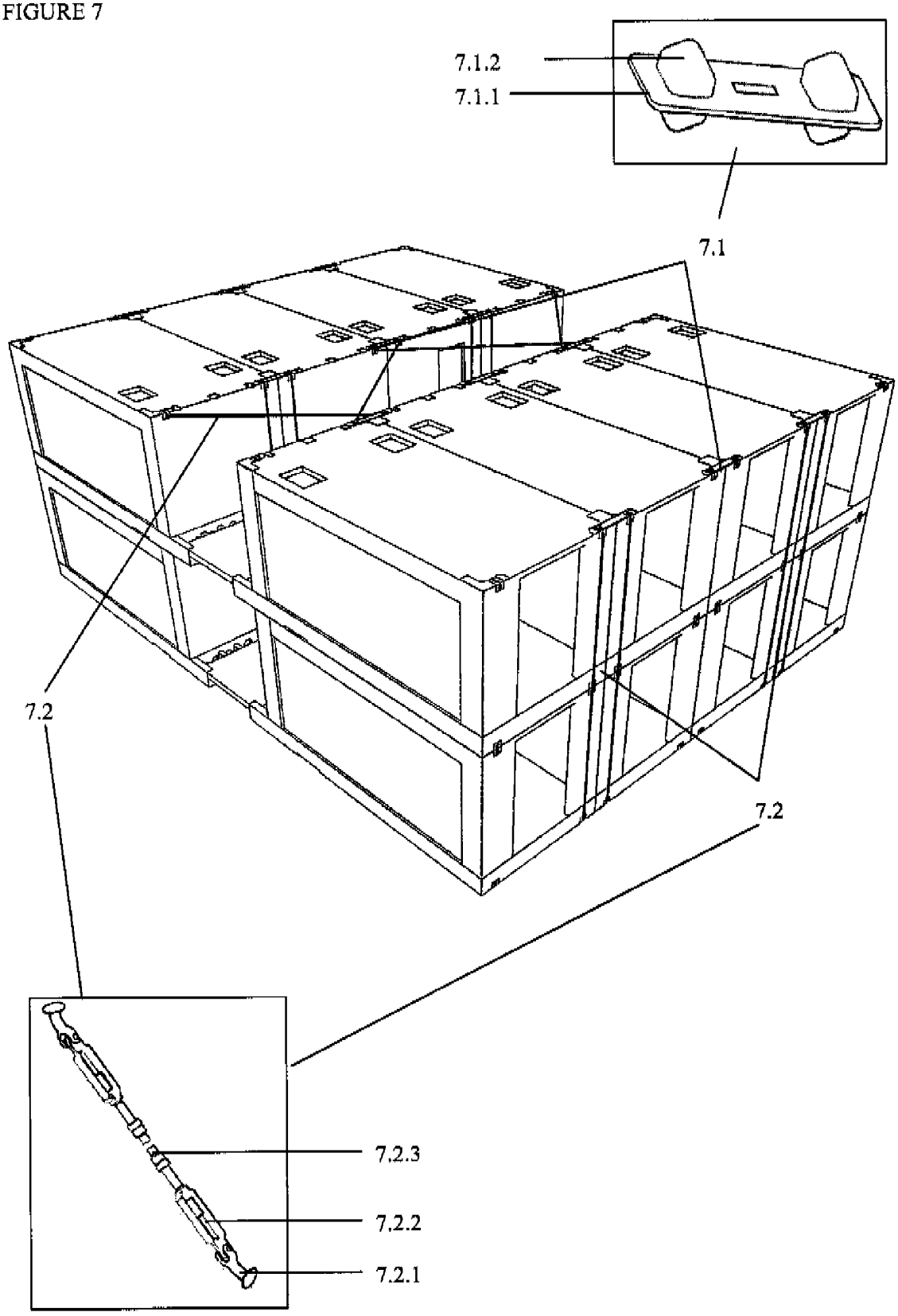


FIGURE 8

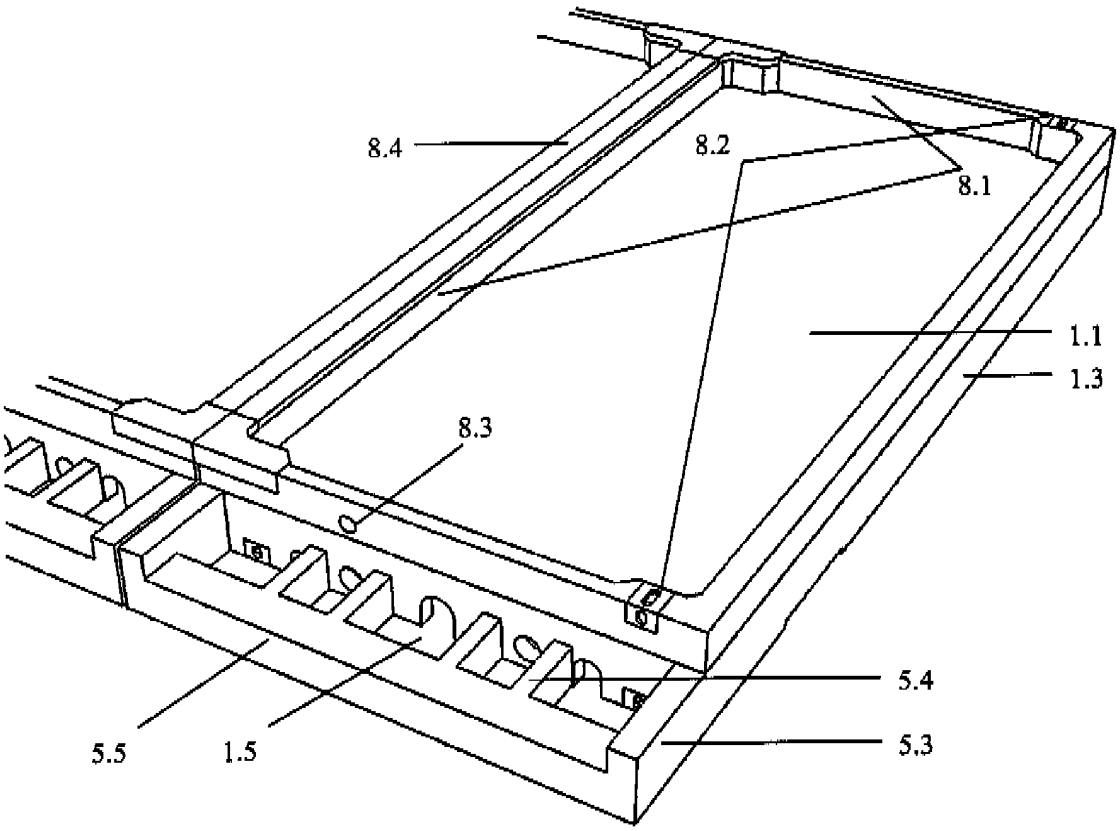


FIGURE 9

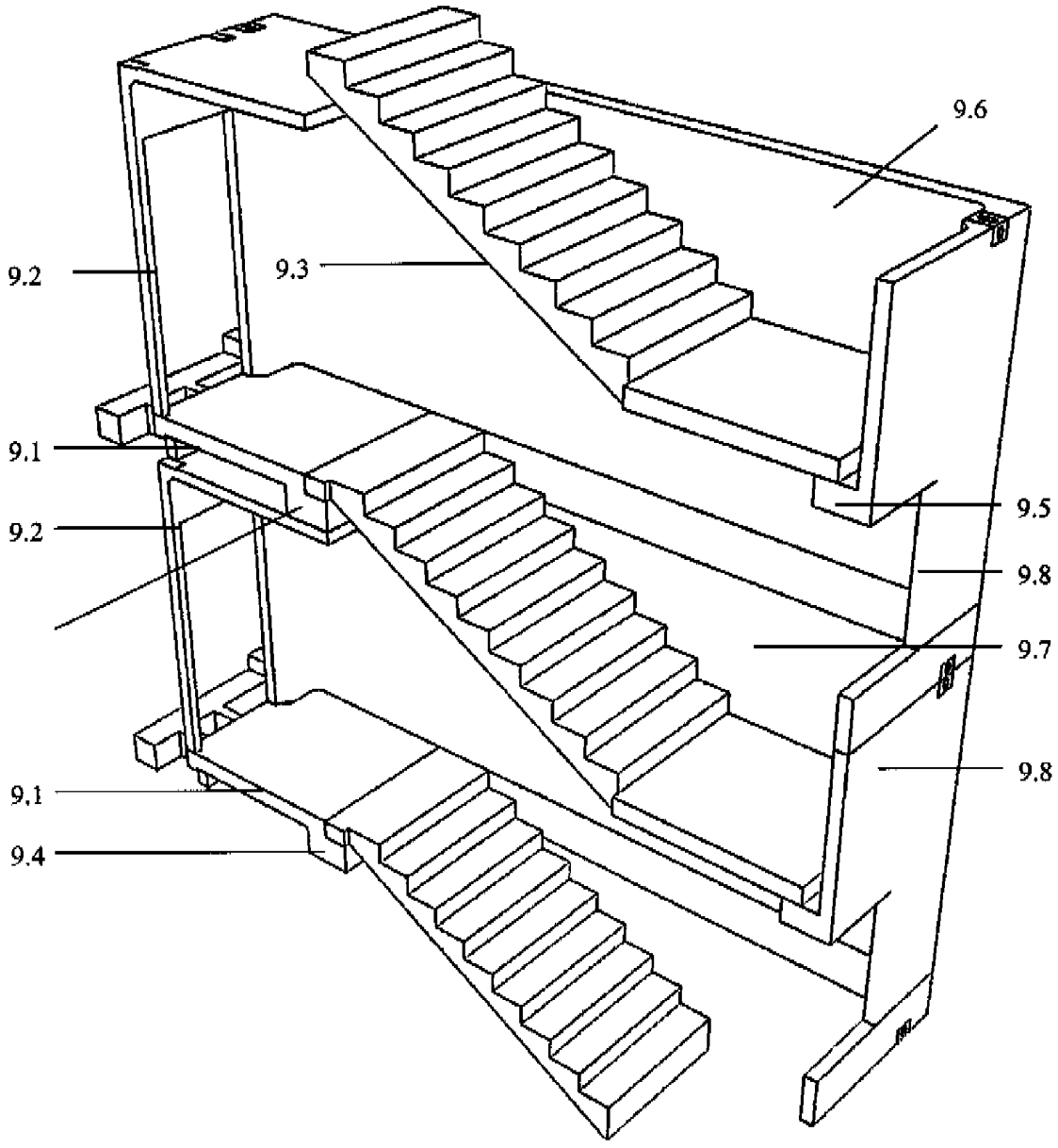


FIGURE 10

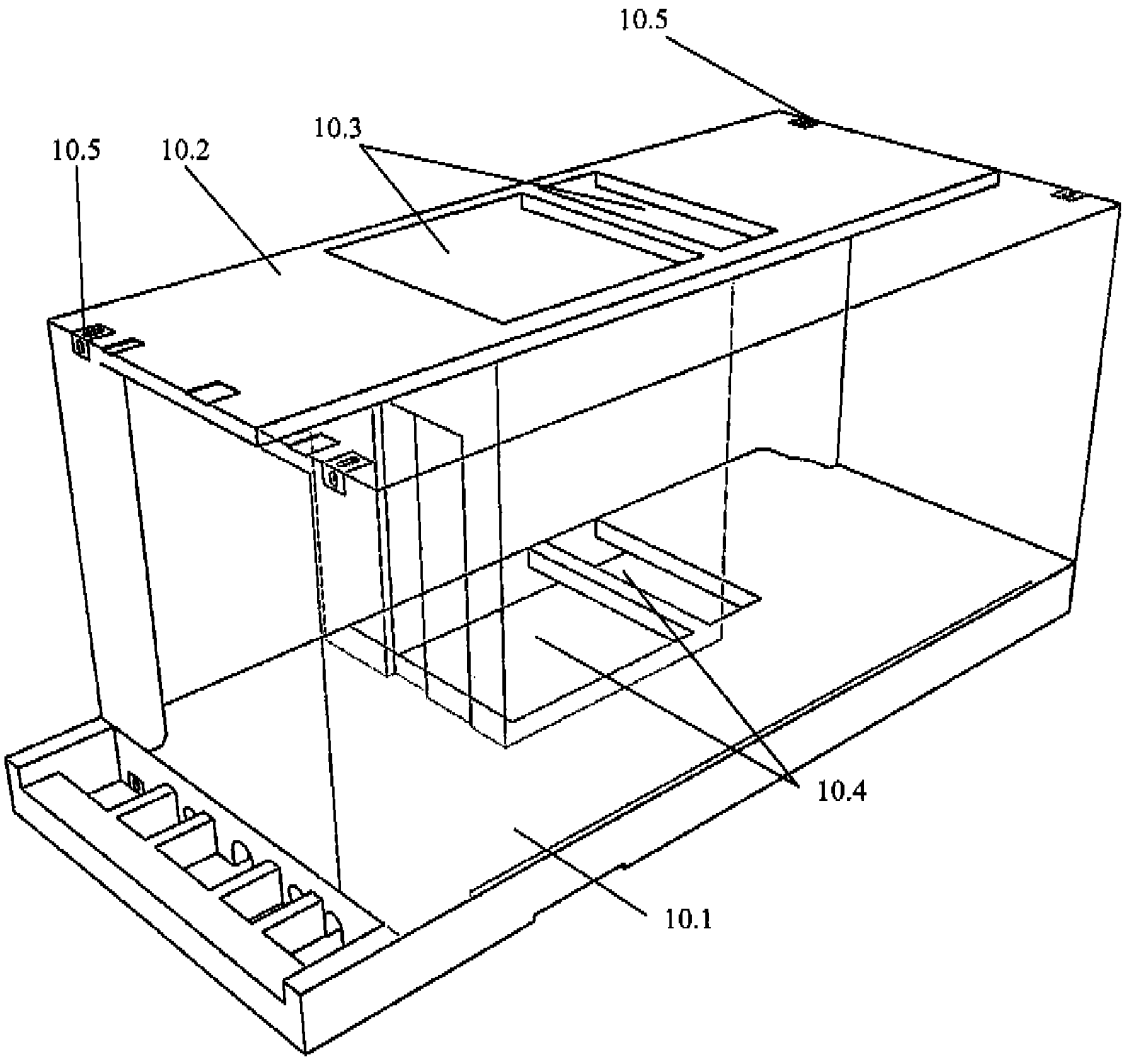


FIGURE 11

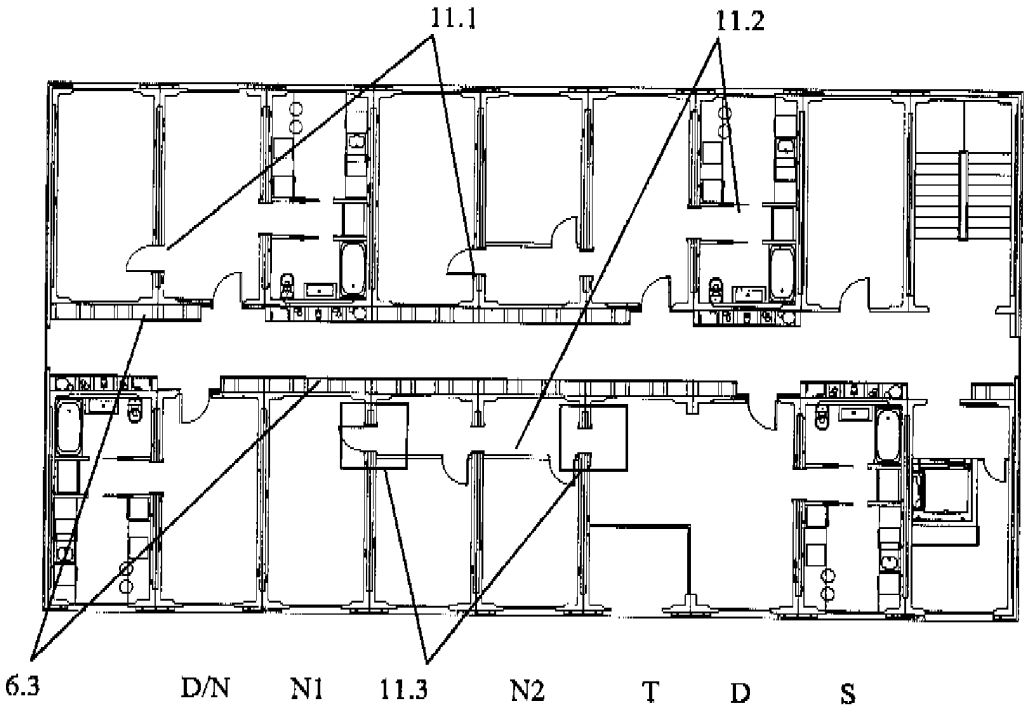


FIGURE 12

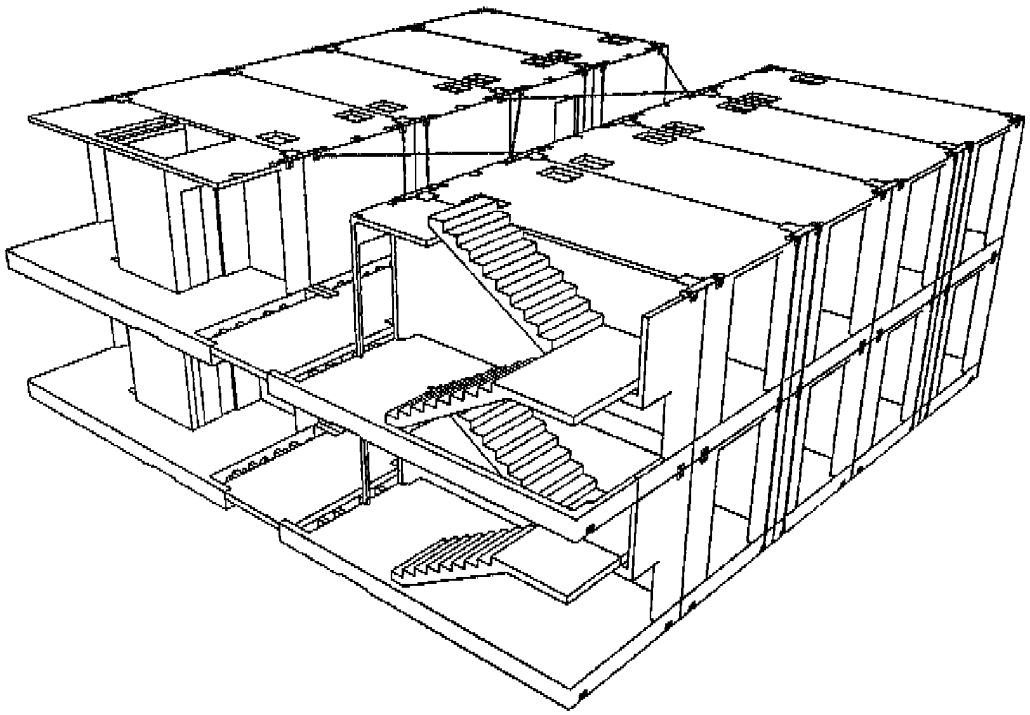


FIGURE 13

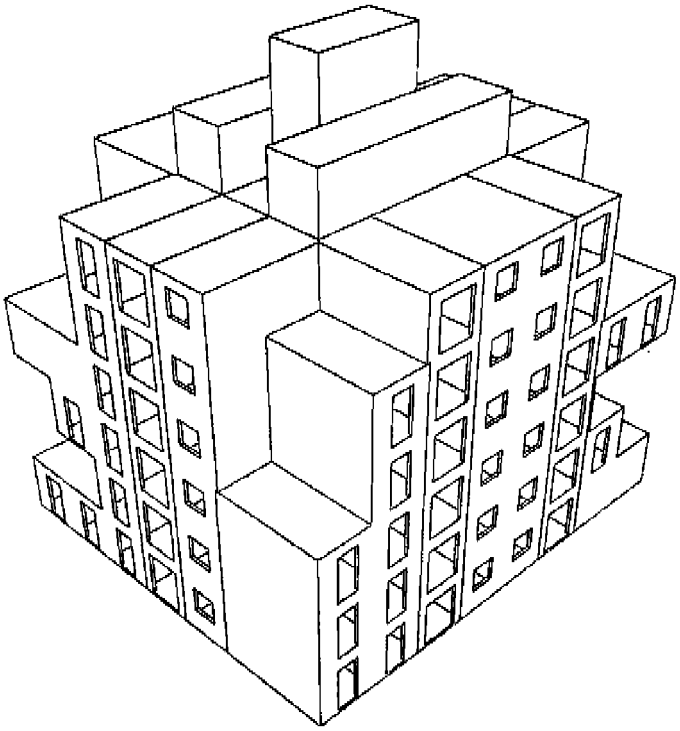
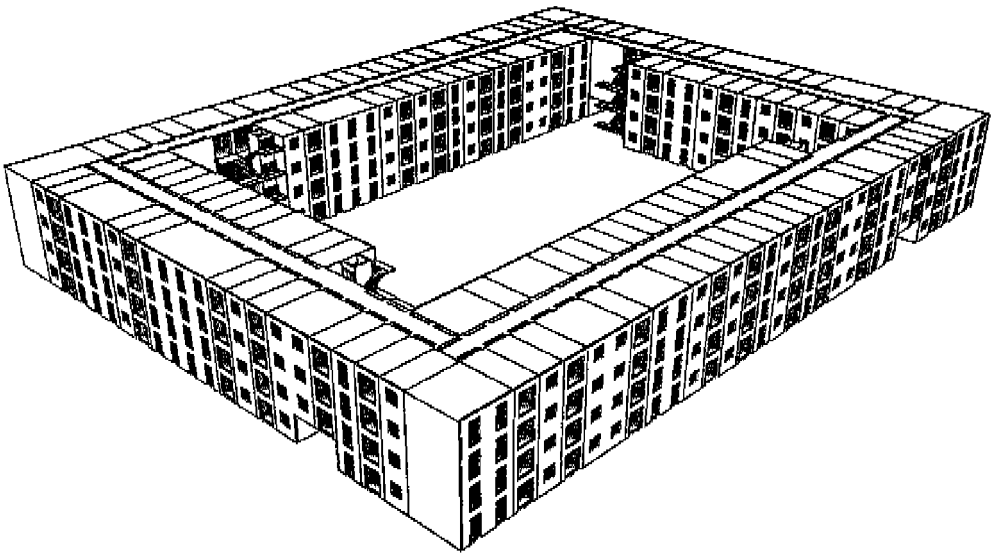


FIGURE 14



INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2012/070199

A. CLASSIFICATION OF SUBJECT MATTER

E04B1/348 (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

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)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ES 2284306 A1 (COMPACT HABIT S L) 01/11/2007, column 1, line 43 - column 4, line 17; figures 1 - 24.	1-56
A	EP 1184521 A1 (BAUR THIERRY ET AL.) 06/03/2002, column 1, line 3 - column 3, line 53; figures 1 - 16.	1-56
A	FR 1481428 A (COTTBUS WOHNUNGSBAU) 19/05/1967, pages 1 - 4; figures 1 - 4.	1-56
A	US 3871146 A (HAMY NORBERT) 18/03/1975, column 2, line 8 - column 4, line 58; figures 1 - 14.	1-56

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance.
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure use, exhibition, or other means.
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other documents , such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16/07/2012	**(23/07/2012)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer M. Revuelta Pollán Telephone No. 91 3496824

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2012/070199

C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2430487 A1 (MAIOLI AMOS) 01/02/1980, page 1, line 1 - page 3, line 9; figures 1 - 6.	1-56
A	WO 9840573 A1 (CONCRETE VOLUMES SWEDEN AB ET AL.) 17/09/1998, page 2, lines 8 - 29; figures 1 - 6.	1-56
A	US 4599829 A (DIMARTINO SR JOHN M) 15/07/1986, column 2, line 1 - column 3, line 34; figures 1 - 14.	1-56

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ES2012/070199

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
ES2284306 AB	01.11.2007	US2006196132 A	07.09.2006
		US7594361 B	29.09.2009
		EP1700964 A	13.09.2006
		EP20060004289	02.03.2006
EP1184521 A	06.03.2002	EP20010440287	30.08.2001
		FR2813623 AB	08.03.2002
FR1481428 A	19.05.1967	NONE	
US3871146 A	18.03.1975	NONE	
FR2430487 AB	01.02.1980	DE2926969 A	31.01.1980
		IT1103969 B	14.10.1985
WO9840573 A	17.09.1998	SE9700843 A	11.09.1998
		SE9700843 L	11.09.1998
		AU6428598 A	29.09.1998
		SE508852 C	09.11.1998
US4599829 A	15.07.1986	NONE	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1700964 A **[0006]**
- ES 2303457 A1 **[0006]**