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(54) **PLATFORM FOR A BALCONY AND METHOD FOR ITS MANUFACTURE**

(57) Balcony slab (1), for a suspended balcony, which comprises a matrix structure consisting of a filler substance and reinforcing steel, in which there is at least a flat surface, which forms the upper surface of the slab, and an under-surface on the opposite side to the upper surface, and wall brackets (7) for attachment to the wall and suspension points at a distance from these, in which there are tension-rod lugs (5) for suspending the balcony slab. The flat surface of the balcony slab (1) is encircled by an edge (20), which protrudes outwards from the under-surface of the slab, and in its under-surface are at

least two cross-wise webs (21), which webs (21) extend over the area on the under surface delimited inside the edge (20) and are oriented outwards. The edges of the balcony slab (1) are encircled by a steel C-profile frame (2), in which the opening of the C of the profile faces in the direction of the centre of the balcony slab (1), and which forms, together with the filler substance, the edge (20) of the balcony slab (1). The tension-rod lugs (5) of the balcony slab (1) are joined by a reinforcing profile and its steel components are of stainless steel.

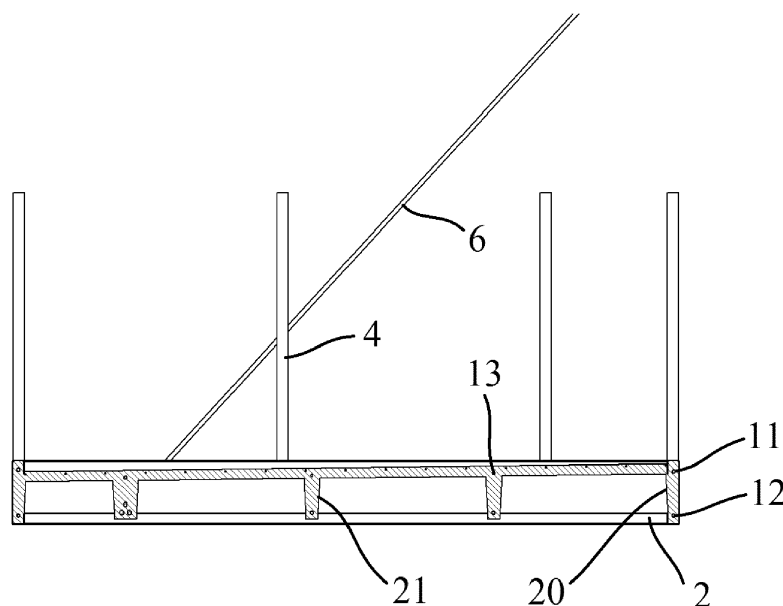


Fig. 9

Description

Field of the invention

[0001] The invention relates to a reinforced concrete slab for a suspended balcony.

[0002] In particular, the invention relates to a composite structure made from steel and concrete for forming a suspended balcony.

[0003] The invention also relates to a method for manufacturing a balcony slab for a suspended balcony.

Background

[0004] Various concrete slab structures can be used to create the ground floors, intermediate floors, balconies and other such structures of buildings, in which a load-bearing structure extending over a specific span is required. Steel reinforcement is usually used in concrete slabs, the mass of which can be reduced by means of various hollow cores or rib and web structures. The slabs are usually made in a prefabricated-unit factory, either to standard dimensions or, if necessary, to dimensions desired by the customer. The use of concrete-slab structures is well known in building technology.

[0005] Suspended balconies are balconies that are suspended from the frame of a building on tension rods. The suspension can also be made using reveal walls from load-bearing partitions.

[0006] Among the benefits of a suspended balcony is the fact that it can be located more freely, so that even individual balconies are possible on a facade. Balconies suspended in storeys also do not cause indirect action through thermal movements.

[0007] Suspended balcony systems are also available as fibre-reinforced-concrete solutions, in which the balcony's own weight has been reduced by exploiting fibre-reinforced concrete.

[0008] The suspension rod can be inside or outside the balcony. The use of external tension rods is limited mainly by townscape factors. Rods made from stainless steel should be used as tension rods, making it possible to achieve sufficient fire resistance without separate fire protection. Ready-to-use tension-rod systems or solutions relating to standard balcony systems are generally used as tension-rod solutions.

[0009] The tensions rods are attached, for example, to a steel profile (e.g., a square tube) in the slab, in which the attachment components are ready. The tension rod is anchored in the load-bearing frame of the building (either to load-bearing partitions, to the load-bearing internal skin of the outer skin, or a floor), or to a separate load-bearing external skin.

[0010] The rear edge of the balcony slab is supported on the frame of the building or its load-bearing external skin, by means of steel components. In the simplest solution, the concrete balcony slab has a steel profile at the rear edge of the slab, which is supported on the floor.

When using load-bearing reveals for the suspension, they should be carried by suspension from load-bearing partitions by steel components. Steel running through thermal insulation should be stainless.

Summary of the invention

[0011] Traditional reinforced concrete slab structures are quite massive. Thus, their manufacture requires a great deal of raw material, which is expensive to transport and required effective transfer devices for moving and installing the slabs on the building site. The supporting and carrying structures of the massive and heavy slabs must also be sturdy. The features are emphasized in protruding structure such as balconies.

[0012] For the aforementioned reasons it would be preferable to create a lighter slab solution than previously.

[0013] The invention relates to a reinforced-concrete slab, by which a suspended balcony is formed.

[0014] With the aid of other features and embodiments of the invention, a balcony is created, which can be integrated with a set of air-heating ducts or some other heating system.

[0015] According to one feature of the invention, a method is created for forming a reinforced-concrete slab for a balcony.

[0016] According to one embodiment of the invention, a balcony slab is created, in which insulation is integrated in the slab, which insulation forms the shape of the underside of the slab.

[0017] According to one feature of the invention, a composite-structure slab is created consisting of steel profiles, reinforcement, and concrete, with the aid of which a lightweight-structure suspended balcony, or similar protruding structure forming a load-bearing level can be formed.

[0018] The invention is based on the fact that the slab forming the balcony floor is of concrete or other filler and comprises at least a flat surface, which forms the upper surface of the slab and the under surface on the opposite side to the upper surface, and an edge running round the flat surface, which extends outwards from the slab. On the under surface of the slab there are at least two cross-wise webs, which extend over the area delimited by the edge in the under surface and point outwards. The edge of the slab is encircled by a C-profile frame pointing inwards relative to the edge, which forms together with the filler the edge of the balcony slab and a reinforcement profile, to which the suspension points are attached, is arranged between the slab's suspension points. The reinforcement of the balcony slab is of stainless steel.

[0019] According to one embodiment of the invention, reinforcement, in which at least one piece of reinforcing steel is located in the area of at least one flange of the C-profile, is arranged inside the C-profile frame.

[0020] According to one embodiment of the invention, in the reinforcing steel arranged in the area of the flange

of the C-profile there is at least one attachment and this attachment is also joined to the C-profile in order to form an attachment point for handrail posts or other equipment of the balcony.

[0021] According to one embodiment of the invention, the transverse reinforcing profile is a lattice structure.

[0022] According to one embodiment of the invention, in at least one side of the C-profile frame encircling the edge of the slab there are openings for feeding concrete inside the profile through these openings.

[0023] According to one embodiment of the invention, the openings in the C-profile frame are on the edge of the balcony slab facing towards the wall of the building.

[0024] According to one embodiment of the invention, the attachment lugs of the balcony slab on the side of the building are attached to the reinforcing structure inside the C-profile.

[0025] In the method for manufacturing a balcony slab, reinforcement is prepared, which is fitted inside the C-profile frame. Openings are formed in one side of the C-profile frame for feeding the concrete mass into the frame and the open sides of frame are closed using a flat mould-board and the slab's concrete is poured to fill the mould from the openings on the side of the C-profile frame of the mould forming a web structure.

[0026] According to one embodiment, several casting moulds are set against one another and the openings of the C-profile are placed upwards and the several moulds are filled at the same casting.

[0027] Considerable advantages are gained with the aid of various embodiments of the invention.

[0028] By means of a grid-type stainless-steel (SST) reinforced mould-cast balcony, a structure load of less than 2 kN/m² is achieved, to which the minimum live load for a balcony of 2.5 kN/m² is added. The reduction in total load is important for the attachments anchored in the wall. Thanks to the reinforcement made with stainless steel, the required protection thickness is less than when using a conventional reinforcement of structural steel. The protection thickness using stainless steel is at least 10 mm, or equal to the diameter of the reinforcement, when concrete is used as the casting mass. This reduces the amount of concrete required and thus the load acting of the wall of the building. Instead of concrete, lightweight concrete can also be used as the casting mass, in which the aggregate is at least partly replaced with, for example, EPS or cellular glass filler and/or fibre reinforcements. Substances other than concrete can also be used as the binder in the casting mass. In addition, stainless steel reinforcement retains its strength in a fire significantly better than structural steel (e.g., A500HW).

[0029] The stainless C-profile in the edge of the balcony slab has aesthetic (withstands environmental stresses), fire-resistance related, structural-strength increasing, handrail attachment simplifying, installation lifting facilitating, and finishing on site reducing, roles. The C-profile is made from 1.5 - 4.0-mm stainless-steel plate and according to the dimensioning of the reinforcement

made from stainless steel.

[0030] The combination of stainless steel and concrete is flexible when implementing various architectonic balcony structures, such as aesthetic handrail and glazing solutions. Handrail units can also be made to form heating units for the balcony.

[0031] A concrete grid structure reinforced with stainless steel is durable and non-flammable, nor does it contain, for example, terrace panels and mats made from wood, plastic, or aluminium, which are problematic in terms of fire. The structure is maintenance-free and weather resistant.

[0032] Other objectives and features of the invention are depicted in the following detailed description, with the aid of the accompanying drawings. It should be understood that the drawings and description are only intended to describe the invention and not to restrict it. For a definition of the invention, please familiarize yourself with the Claims.

Description of the figures

[0033]

Figure 1 shows one balcony slab according to the invention, together with a handrail and attachments. Figure 2 is a detail of the steel structure of the balcony slab of Figure 1.

Figure 3 shows the reinforcement and C-profile frame of the balcony slab of Figure 1.

Figure 4 shows the reinforcement and C-profile frame of the balcony slab of Figure 1, as well as the surface reinforcing mesh of the slab.

Figure 5 shows one embodiment of the reinforcement of the balcony slab.

Figures 6 and 7 show some details of the invention. Figure 8 shows the balcony slab schematically, seen from its under surface.

Figure 9 is a cross-section of one balcony slab according to the invention.

Figure 10 is a cross-section of another slab according to the invention.

Figure 11 shows the balcony slab of Figure 1 from another direction.

Figure 12 shows the steel structure of one balcony slab according to the invention and the moulds used to make its surface and underside.

Figure 13 shows alternative moulds for making the underside.

Detailed description of the invention

[0034] Within the scope of the present invention, the term stainless steel refers to steel alloys that are stainless according to the standards.

[0035] Within the scope of the present invention, the term profile refers to a shaped profile, the cross-section of which differs from a solid bar, such as a flat bar, a

square bar, or a circular bar.

[0036] Figures 1 and 3 show a balcony slab 1, in which there is a flat upper surface 2 to form a floor level, and an under surface 3. The outer circumference of the slab 1 is surrounded by a C-profile frame 2, in which the opening of the profile's C points inwards, i.e. towards the centre of the slab. The flanges of the profile 2 form the upper and under surfaces of the edge of the balcony slab 1. Attachments for handrail posts 4 or other balcony equipment are formed in the upper flange of the C-profile frame 2. In addition, in the balcony slab 1 there are tension-rod lugs 5 for the balcony's tension rods 6 and wall attachments 7 for attachment to the wall. The loop of the tension rod 6 is placed in the tension-rod lug 5 and it is ensured that the loop remains in place using a nut. In the wall attachment 7 is a slot 10, which is installed in the counter piece of a bracket anchored in the wall of the building.

[0037] Figure 2 shows the steel structure of the balcony slab. This figure shows the reinforcement (Figure 5) of the balcony slab and part of the C-profile frame 2. There are openings 9 at regular intervals in the profile steel 8 of the C-profile frame 2 to be installed towards the wall of the building. The purpose of these openings is to permit concrete to be fed during casting into the C-profile frame enclosed in moulds. The number or shape of the openings 9 is not otherwise limited, as long as their surface area and location in the profile steel 8 to be installed against the wall is such that the concrete mass can be fed into the C-profile frame enclosed by moulds. The openings 9 are preferably oriented towards the wall for reasons of appearance. It can also be seen from the figure that the C-profile is partly closed, i.e. the profile's flanges turn from their edges towards the centre line of the profile.

[0038] The reinforcement is formed of two reinforcement frames 10, 11 on top of each other formed from straight steel, and transverse reinforcement 12 extending across the reinforcement frames 10, 11. Transverse reinforcements 13 are located in the webs of the balcony slab. The distance between the webs is preferably so dimensioned that a fire hatch or other necessary feed-through fits between them. In addition, in the reinforcement there is a reinforcement grid 14 fitted between the suspension points of the balcony slab. In this embodiment, the reinforcement grid is formed of two reinforcement bars 15 is the lower edge of the grid, an upper edge bar 16, and transverse supports 17 joining them. Tension-rod lugs 5 are attached to the lower edge reinforcing rods 15 at the ends of the reinforcement grid 14. Threaded sleeves 18 are attached at the desired intervals to both reinforcing frames 11, 12. The threaded sleeves 18 are fitted next to holes formed in the flanges of the C-profile frame, so that they form attachment points for attaching handrail posts or other equipment. By altering the length of the threaded sleeves 18, the distance of the upper surface and under surface of the reinforcing grid from the upper surfaces of the flanges of the C-profile frame, and thus also from the surfaces of the casting

filling the frame, can be adjusted. The wall bracket 7 is attached to the reinforcement and to the profile steel 8 coming against the wall.

[0039] Figure 3 shows the C-profile frame 2 installed around the reinforcing grid and Figure 4 shows the steel structure of the balcony slab in its entirety. A reinforcing mesh 19 is placed in the upper surface of the balcony slab to create the necessary strength in the upper surface of the slab. Figures 3 and 4 show the suspension points of the balcony slab, i.e. the locations of the tension-rod lugs 5 and the wall brackets 7 and their fitting with the C-profile frame 2.

[0040] In the steel structure of the balcony slab there is a lattice beam on the attachment line of the tension rods 6, a reinforcement grid 14, to which the tension rods' 6 lugs 5 are welded. In the upper and lower edge of the structure are rectangular reinforcement frames 11, 12, to which threaded sleeves 18 are welded, which can be, for example, internally threaded sleeves (e.g., M12-M16). The rest of the reinforcement is welded to these reinforcement frames 11, 12. The lower surface's transverse reinforcement is installed according to the lower surface of the webs. The upper surface's reinforcement (parallel to the attachment line of the tension rods 6) is installed according to the fall of the balcony's floor. The wall-bracket plates are welded between the aforementioned reinforcement frames 11, 12.

[0041] In the C-profile frame 2 there are holes/openings at the tension-rod 6 lugs 5, the wall brackets 7, and the casting openings 9. The steel structure installed inside the C-profile frame 2 is attached through the said holes to the threaded sleeves 18 by bolts. This ensures that the structure will remain precisely in place even during casting. The C-profile frame 2 acts as a frame when the reinforcement, the balcony slab's wall brackets 7, and the handrail posts' threaded sleeves 18 are installed precisely in place prior to their welding. The C-profile frame 2 acts as a mould producing a finished surface in vertical casting and, in the product, as a decorative and load-bearing element that withstands environmental stresses. In addition, the C-profile frame's 2 stainless steel (1.4301, 14310 or similar) improves the fire resistance of the structure. In the wall-side C-profile steel 8 there are openings 9 (typically 60 - 110 mm in diameter), through which, with the aid of which mould formed by the C-profile frame 2 is filled with concrete or other casting material suitable for the purpose.

[0042] The steel components of the balcony slab are assembled, according to one embodiment, by joining together the reinforcement mesh 19 (e.g., B600KX or similar), the balcony's attachments (tension-rod lug 5 and wall bracket 7), and the threaded sleeves 18 for the attachment of handrail posts and glazing. The threaded sleeves 18 are attached by bolts to the positions reserved for them in the C-profile frame and secured by welding to the reinforcement and to the upper and lower reinforcement frames 11, 12. A welded lattice beam is made on the tension-rods' 6 attachment line, a reinforcing lat-

tice 14, to the ends of which are welded tension-rod lugs 5 for attaching tension rods 6 or supporting pillars. Instead of the lattice-structure reinforcement profile, for instance a lightened I beam, or other profile or structure can be used, which gives sufficient stiffness with a low own mass.

[0043] The wall brackets 7 are attached to the reinforcing bars (reinforcement frames 11, 12) inside the C-profile on the edge in question. The wall brackets 7 are so designed that the tension rods 6 on a lower storey can be joined to the same bracket anchored in the building's wall, or to a separate support structure installed outside the wall. A steel mesh (e.g., B600KX 5#150) reinforcing the balcony's floor is installed and secured on top of the reinforcement on the inside of the C-profile frame on the upper surface of the reinforcement, according to the desired fall of the floor. On the tension-rods' 6 attachment line is a reinforcing lattice 14, in which there are two reinforcing rods 15 according to the dimensioning on the lower edge and between them is welded a steel bar forming transverse supports 17 and bent into a zigzag shape, to which the upper edge's reinforcing bar 16 is welded. The tension rods' 6 tension-rod lugs 5 are welded to the aforementioned reinforcing lattice 14. The tension-rod lugs 5 are dimensioned according to the loading demands.

[0044] The C-profile forming the C-profile frame has a height typically of 200 - 300 mm, a width of 40 - 80 mm, and wall thickness of 1.5 - 4.0 mm. According to an exemplary embodiment, the reinforcement is installed inside the C-profile frame and secured to the reinforcement by bolts to the welded threaded sleeves 18 through holes made at corresponding points in the C-profile 18. Alternatively, the threaded sleeves are attached first to the C-profile frame by bolts and the rest of the reinforcement is welded to their threaded sleeves. There are wall-bracket and tension-rod lugs ready in the steel structure of the finished balcony. The other attachment points are dimensioned for the lifting and installation of the balconies, and the attachment of the handrail posts, glazing, and tension rods. By this solution, only the angle weldings of the C-profiles need finishing. The other weldings and their thermal effect remain inside the casting.

[0045] The details described above of the steel structure of the balcony slab are shown in Figures 5, 6, and 7.

[0046] Figure 8 shows the web structure of the underside of the balcony slab. The balcony slab is enclosed by an edge 20, which is formed of a C-profile frame 2 and the slab's filling casting. The filling casting is usually concrete, but other structural substances that can be cast and are sufficiently strong can be used. The edge 20 encircles the frame of the level formed by the entire balcony slab to form stiffening at the edge of the slab. With the aid of the invention it has been sought to create a light balcony slab, which has a good load-bearing capacity. This has been achieved by using, in addition to the edge 20, webs 21 protruding outwards in the lower surface of the slab. The webs 21 are arranged to run cross-

wise in the lower surface of the slab. In this example, the webs 21 are at right angles to each other. Such a structure is easily implemented, but with the aid of the invention it is possible, if necessary, to use, for instance, curved webs 7 diagonal-grid structure. A web arrangement deviating from a rectangular structure can be used, for example, if one or more edge of the slab is curved, for instance in a semi-circular slab.

[0047] A grid structure like that described above permits a cost-effective and dimensionally precise implementation of necessary surface forms (emergency exit, water grooves, falls, drains, etc.). The grid structure is dimensioned in such a way that emergency exists (typically 620 mm x 620 mm) are easy to install between the webs 21.

[0048] At least one reinforcement is embedded in the lower edge of the edge 20 and webs 21 of the balcony slab, i.e. in the surface farther from the upper surface of the slab. In the example of Figures 9 and 10, the lower reinforcements of the edge 20 form a lower reinforcement frame 12. The reinforcement frame 12 is located, in a manner known from concrete casting technology, close to the lower surface carrying the tensile load of the structure, in such a way that the dimensioned load-bearing capacity is obtained. In the upper edge of the edge 20 the reinforcement is formed by the upper reinforcement frame 11, and at the webs 21, reinforcement is formed of transverse reinforcement 13. Reinforcements are in every web 21 and edge 20. In addition, there is a ribbed-bar grid 19 to ensure the strength of the upper surface.

[0049] The suspension points of the balcony slab are located at a distance from the wall of the building (from the wall brackets of the balcony slab) and this distance is defined in the strength calculation. The most advantageous place is in the front edge of the slab, seen from the direction of the wall. In the examples of Figures 9 and 10 the first transverse web 21 from the front edge towards the wall brackets is located at the point thus defined and the transverse reinforcing profile joining the suspension points is within this web. In the exemplary embodiments, the reinforcing profile is the grid structure 14 described above. The tension-rod lugs 5 form the suspension points and the tension-rod lugs 5 are attached to the grid structure 14, which thus carries, for its part, the load acting on the suspension points.

[0050] The dimensioning and amount of reinforcement depends on the strains acting on the slab and are calculated using normal strength-calculation methods, preferably optimizing the slab's mass, so that the most advantageous result is achieved in terms of the invention.

[0051] The shape of the under surface of the slab, with its edge 20 and web 21 is formed by using filler divisions in the slab's mould or by forming the necessary shape in the mould of the under surface of the balcony slab.

[0052] In the embodiment of Figure 9, the space between the webs 21 is open. In the embodiment of Figure 10, the spaces are filled with a filler material 22, which can preferably be a thermally insulating material, so that

the slab has a good thermal insulation capacity. The insulating material can insulate not only heat, but also sound and fire, or even be just a filler. Suitable materials can be, for example, cellular polymer-based EPS (expanded polystyrene), XPS (extruded polystyrene), or rock wool and glass wool.

[0053] Figure 11 shows an example of the placing of handrail posts 4 and a floor drain 23.

[0054] Figure 12 is a schematic diagram of the structural elements and moulds for making one balcony slab according to the invention. In the middle is a steel structure installed inside a C-profile frame 2, on the right is mould 23 for the under surface, which can also be an integrated component left in the product. On the left is the mould 24 producing the shapes of the upper surface. The aforementioned components form the casting mould. In this embodiment, the upper-surface mould 24 is wedge-shaped, in order to create a suitable fall for the floor level of the balcony, and in the under-surface mould 25 there are grooves 26 to form the webs 21 of the under surface. When making the balcony slab, the corresponding plate-like mould 24 is placed on the side of the upper surface and the grooved under-surface mould 25 producing a grid structure is placed on the side of the under surface. The mould 25 used on the side of the under surface can be made from, for example, EPS, XPS, or fire-resistant rock wool. The under-surface mould 25 can be designed to be left in the structure and heating-duct grooves 27 can be made in its upper surface for air-heating ducts (the cross-section of the ducts can be a rectangle, a square, or circular, with a dimension of 30 - 80 mm, depending on the structure's total thickness) (Figure 13). A cover can be installed in the under surface, the under-surface's grid mould is not left in the product.

[0055] For casting, the balcony-slab units according to Figure 12 are placed in a vertical position, with the edges to be attached to the building against each other, and are pressed together so that their C-profile frames 2 form a tight frame for a casting unit formed of several balcony-slab units. Holes 9 are made in the structural steel 8 of the C-profile frame of the edge of the balcony coming against the wall of the building, in order to permit the filling of the mould. After casting and the hardening of the concrete, the moulds are removed and lifting lugs are attached to the balcony slab's aforementioned attachment points, the threaded sleeves 18. The upper surface of the balcony is finished, for example, by water washing, grinding, brushing, or surfacing. The under surface is finished by surfacing if the mould remains in the product, or by a surfacing, for example a plate, attached inside the C-profile (this stage can also be carried out in the pre-installation stage on site). Handrail posts and handrails (possibly also handrail glazing) are pre-installed on site in the balcony slabs, before they are lifted to their installation locations.

[0056] In production, it is advantageous to set several of these casting moulds against each other and press them together. It is then possible with a single casting to

fill several moulds simultaneously from the upper edge.

[0057] One advantageous feature of the invention is the ease of arranging various equipment. Air ducts can be formed in the balcony slab for heating, according to Figure 13. The air ducts in the balcony slab permit it to be heated or cooled by blowing air through the ducts formed, thus replacing, for example, separately installed IR heaters. The construction shown permits, for example, a solar heater acting as a handrail to collect heat for transfer to the floor slab. Because the slab's mass can be kept small, reaction to changes in temperature is rapid.

[0058] Similarly, pipes can be laid in the slab for other equipment too and, for example, it is easy to make ready places in the insulation for attaching lights, either at the prefabricated-unit factory or on site.

[0059] Stainless steel is used for the balcony slab's reinforcement and equipment, so that sufficient fire resistance is achieved and the reinforcements can be placed near to the surface of the concrete structure, without having to worry about the corrosion-protection distance.

[0060] Overall, the slab structure according to the invention is formed of a thin, uniform, flat slab and a supporting web structure. The depth and reinforcement of the webs are defined by structural dimensioning made according to the slab's span and loading.

[0061] With the aid of the invention, various kinds of product can be created.

[0062] In balcony structures, the invention can be utilized to build a new type of balcony. In it, and differing from earlier structures, stainless steel is used as reinforcement and as the edge beam. The reinforcement of the webs and the reinforcement grid used as the cover, as well as the tension-rod attachments are welded to the edge profile. This totality, which forms the balcony's reinforcement and the reinforcement of the beam and web used in the outer edge, is installed between the moulds forming the upper and under surfaces, for casting. The advantages of stainless steel appear as meeting the balcony's requirements of fire and corrosion resistance more easily than when using structural-steel structures. These advantages permit a thinner concrete protection layer, so that the total weight of the structure can be lightened significantly. The concrete slab's sturdiness, good weather resistance, and, the important advantage of a balcony attached by tension rods, lightness, are achieved by means of the solutions described.

[0063] With the aid of at least one embodiment, for example the slab according to the invention shown in Figures 1 - 4, it is possible to implement a suspended balcony even in such buildings, in which the structure of the building's frame, such as the wall and floor, does not permit the use of conventional tension-rod attachments. The attachment of the balcony can then be made in such a way that load-carrying grids protruding outwardly from the wall are made from steel, to the edge nearest the wall are attached a bracket on the wall side, and on the edge farthest from the wall an attachment, which is referred to

here as a tension-rod attachment. In other words, attachments anchored to the wall are replaced by a load-bearing grid protruding from the wall attached to the wall on both sides of the balcony, in which there are attachment points for the attachments of the balcony. This is an alternative for making a balcony in buildings in which the structure of the wall and floor does not permit the use of tension-rod attachments. With the aid of the solution, balconies can also be made in buildings, in which there have been no balconies, and the frame of the building has not been designed taking balconies into account. Thus, with the aid of the invention, alternatives can also be increased in renovation construction.

[0064] In the above examples, the slab has been rectangular and the webs arranged cross-wise to each other at right angles. The shape of the slab can, of course, vary, in such a way that at least one of its sides is curved, polygonal, or some other suitable shape. Particularly a semi-circular shape can be easily implemented. The webs too can then be curved or at an angle relative to each other. The use of different slab shapes can create additional possibilities in the design of buildings.

[0065] The grid-type structure is especially advantageous because fire hatches (size 600 - 800 mm x 600 - 800 mm) can be flexibly placed in the slab. With the aid of such a structure, the weight of the balcony can also be reduced. By correct placing of the webs and the use of stainless steel, weights of well under 200 kg/m² can be achieved, even with concrete deck balconies. This is extremely important from the point of view of attachments anchored in the wall. However, this requires quite precise design for present quality, fire-resistance, and cost requirements to be met.

[0066] Correctly used and handled, concrete is a durable, many-shaped, non-flammable, long-lived, care-free, and cost-effective solution for floors (both internal and external floors). The C-profile in the edge is both aesthetic, withstands environmental stresses, is fire-resistant, increases the structure's strength, simplifies the attachment of handrails, facilitates lifting during installation, and plays a role in reducing finishing on site. In various embodiment of the invention, a stainless-steel sheet in the order of 2.5-mm thick can be used, which permits the use of stainless steel though it is clearly more expensive than normal structural steel.

[0067] In the manufacturing method according to one embodiment, the C-profile frame also acts as a mould, when casting is performed with the upper surface downwards against the mould. The reinforcement described is installed inside the C-profile frame installed around the upper-surface mould, in the manner described above. The cost-effective and dimensionally precise implementation of the necessary surface shapes (fire hatches, water groove, falls, drains) then becomes possible. Reinforcement and lugs at the attachment points for the tension rods, handrails, and glazing can then be placed ready in the C-profile frame already at the factory. After casting of the unified deck slab, the mould sections are

placed and the casting of the webs formed between them is carried out immediately. The mould sections can be left in place or removed and reused. If mould sections made from fire-resistant rock wool or foamed glass are used, they can be left in place to improve fire resistance.

[0068] The air ducts described permit the heating of the balcony or similar slab by blowing warm air through the system of ducts. As glazing has become common in balconies they have become a "second living room" and IR heaters are often used in them. The structure described permits, for example, the heat collected by a solar heater installed in the handrail to be transferred to the floor slab. Being massive, it retains heat and makes the slab more pleasant as the evening cools (and is almost free of cost). Terrace panels and mats made of wood, for example, which are problematic in terms of fire, are not required.

Reference numbers:

[0069]

- | | |
|----|--------------------------------|
| 1 | balcony slab |
| 2 | C-profile frame |
| 3 | flange of C-profile |
| 4 | handrail post |
| 5 | tension-rod lug |
| 6 | tension rod |
| 7 | wall bracket |
| 8 | structural steel facing wall |
| 9 | opening |
| 10 | slot |
| 11 | upper reinforcement frame |
| 12 | lower reinforcement frame |
| 13 | transverse reinforcement frame |
| 14 | reinforcement grid |
| 15 | lower-edge reinforcing bar |
| 16 | upper-edge reinforcing bar |
| 17 | transverse support |
| 18 | threaded sleeve |
| 19 | reinforcing mesh |
| 20 | edge |
| 21 | web |
| 22 | filler material |
| 23 | floor drain |
| 24 | upper-surface mould |
| 25 | lower-surface mould |
| 26 | groove |

Claims

1. Balcony slab (1), for a suspended balcony, which comprises a matrix structure comprising a filler substance and reinforcing steel, in which there is at least a flat surface, which forms the upper surface of the slab, and a lower surface on the opposite side to the upper surface, and in which there are wall brackets

(7) for attachment to a wall, and, at a distance from these, suspension points, in which there are tension-rod lugs (5) for suspending the balcony slab, **characterized by**

- an edge (20) encircling the flat surface, which extends outwards from the lower surface of the slab,
 - at least two cross-wise webs (21) in the lower surface of the slab (1), which webs (21) extend over the area delimited inside the edge (20) in the lower surface and are oriented outwards,
 - a steel C-profile frame (2) encircling the edges of the balcony slab (1), in which the opening of the C of the profile is oriented towards the centre of the balcony slab (1), and which forms, together with the filler substance, the edge (20) of the balcony slab (1),
 - a reinforcing profile joining the tension-rod lugs (5) of the balcony slab (1), and
 - that the steel components of the balcony slab (1) are of stainless steel.
2. Balcony slab according to Claim 1 for forming a suspended balcony, **characterized by** a filler material lighter than concrete, with which the recesses between the edge (20) and the webs (21) are at least partly filled.
 3. Balcony slab according to Claim 1 or 2, **characterized in that** reinforcement is fitted inside the C-profile frame (2), in which there is reinforcing steel (11, 12) located in the area of at least one flange (8) of the C-profile.
 4. Balcony slab according to Claim 1, 2, or 3, **characterized in that** the C-profile frame (2) made from stainless steel and encircling the slab (1) is secured to the filler matrix of the slab by means of reinforcing steel (11, 12, 14).
 5. Balcony slab (1) according to any of the above Claims (1), **characterized in that**, in the reinforcing steel (11, 12) fitted in the area of the flange (8) of the C-profile, there is at least one attachment (18) and this attachment (18) is also joined to the C-profile in order to form an attachment point for a handrail post (4) or other balcony equipment.
 6. Balcony slab according to any of the above Claims, **characterized in that** the transverse reinforcement profile is a lattice structure (14).
 7. Balcony slab according to any of Claims 1 - 6, **characterized in that**, in at least one side of the C-profile frame (2) encircling the balcony slab (1), there are openings (9) for feeding filler inside the C-profile (2) frame through these openings (9).

8. Slab (1) according to Claim 7, **characterized in that** the openings (9) in the C-profile frame (2) are in the edge of the balcony slab facing towards the wall of the building.

9. Slab (1) according to any of the above Claims, **characterized in that** the balcony slab's (1) wall brackets (7) of the building are attached to the reinforcing structure (11, 12) inside the C-profile.

10. Slab (1) according to any of the above Claims (1), **characterized in that** the filler is concrete.

11. Method for manufacturing a suspended balcony slab, **characterized in that**

- a C-profile frame (2) is manufactured, in which the opening in the C-profile is inwards in the frame and in which there are openings (9) on one side for feeding the concrete mass into the frame,
- steel reinforcement (11, 12, 13, 14) is prepared and fitted inside the C-profile frame (2),
- the open sides of the C-profile frame (2) are closed by a mould (24) on the upper surface of the balcony slab (1) (and by a mould (25) forming shaping from a web structure (21) from its opposite side, and the concrete or corresponding filler of the slab is poured from the openings (9) in the side of the C-profile frame to fill the moulds, and
- the mould structure (2, 24, 25) is dismantled once the filler has hardened.

12. Method according to Claim 11, **characterized in that** several mould structures (2, 24, 25) are placed against each other and the openings (9) of the C-profile are placed upwards and several moulds are filled at the same casting.

13. Method according to Claim 11 or 12, **characterized in that** grooves (27) are formed in the under-surface mould (25) for a system of ducts for air heating.

14. Method according to any of Claims 11 - 13, **characterized in that** the under-surface mould (25) is left at least partly to form a composite structure with the balcony slab.

15. Balcony structure, which comprises at least one balcony slab (1) according to any of Claims 1 - 11 and load-bearing grids situated on both sides it transversely to the wall of the building, which are attached to the wall and protrude outwards from the wall.

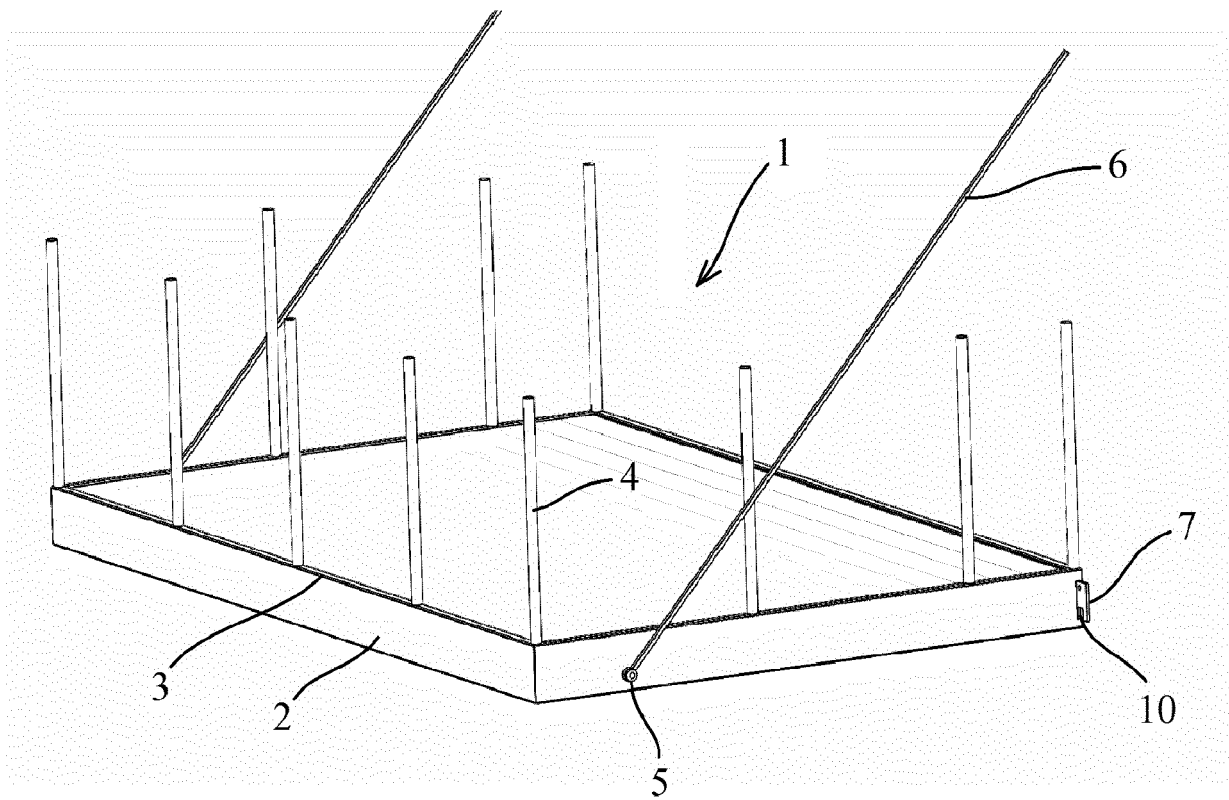


Fig. 1

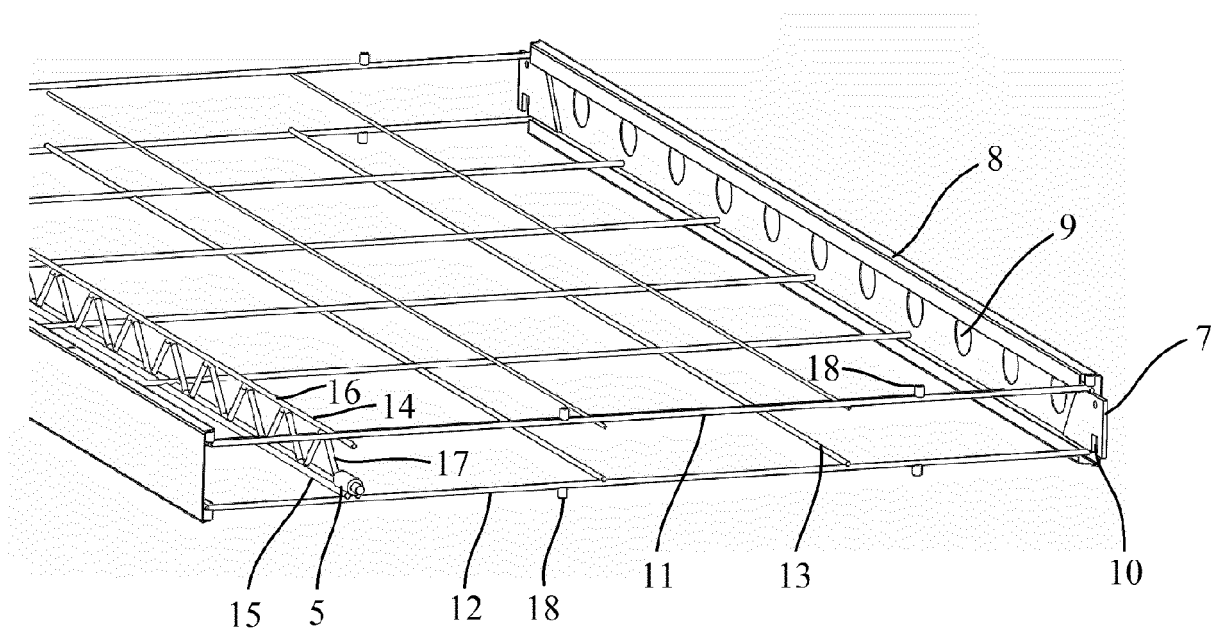


Fig. 2

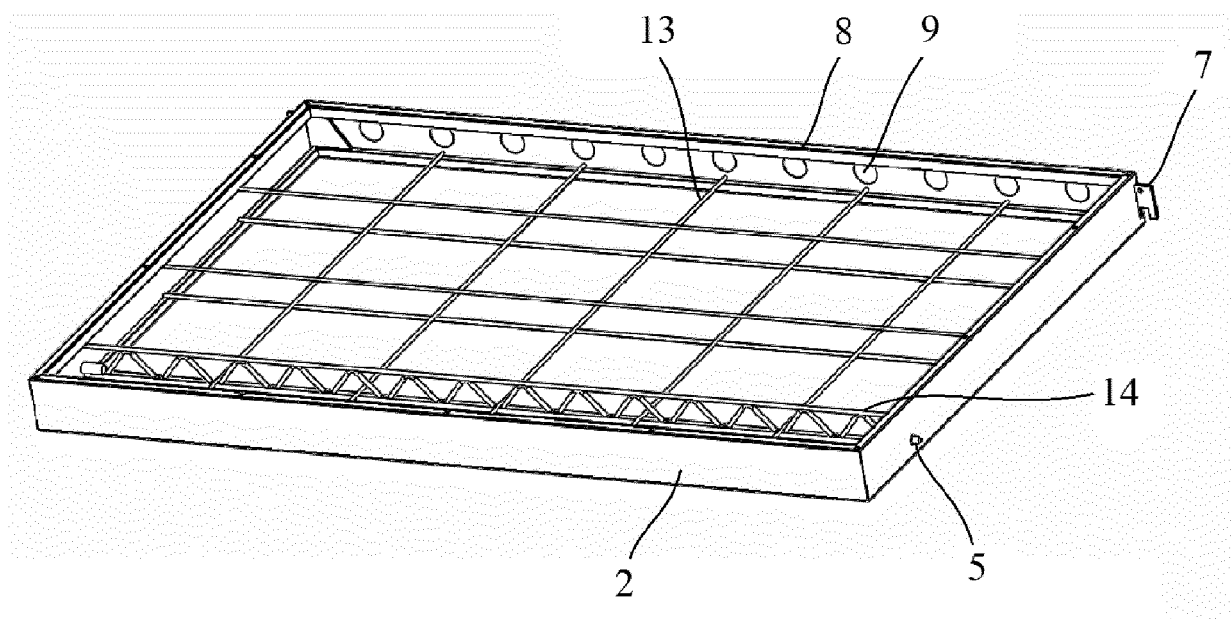


Fig. 3

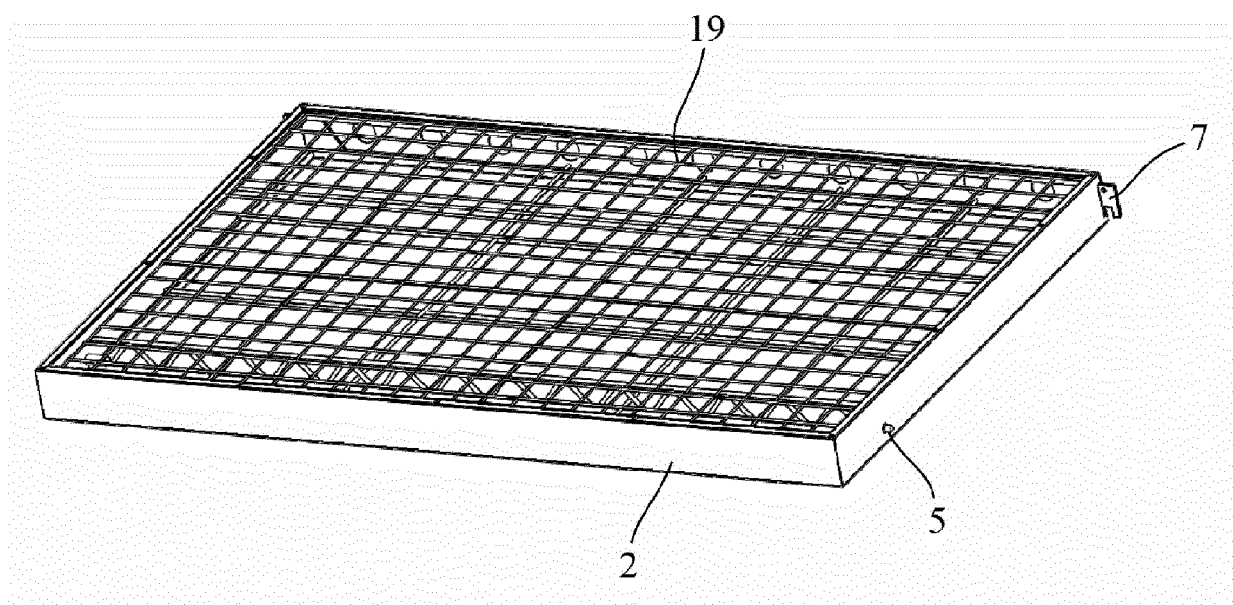


Fig. 4

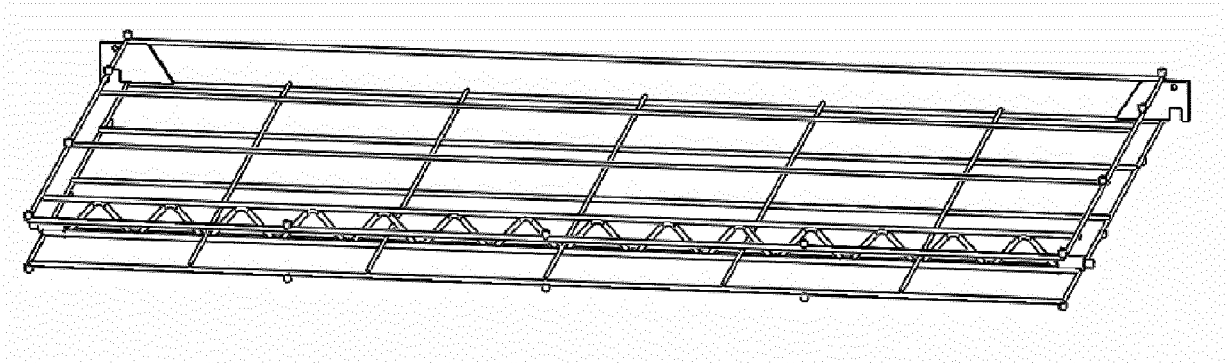


Fig. 5

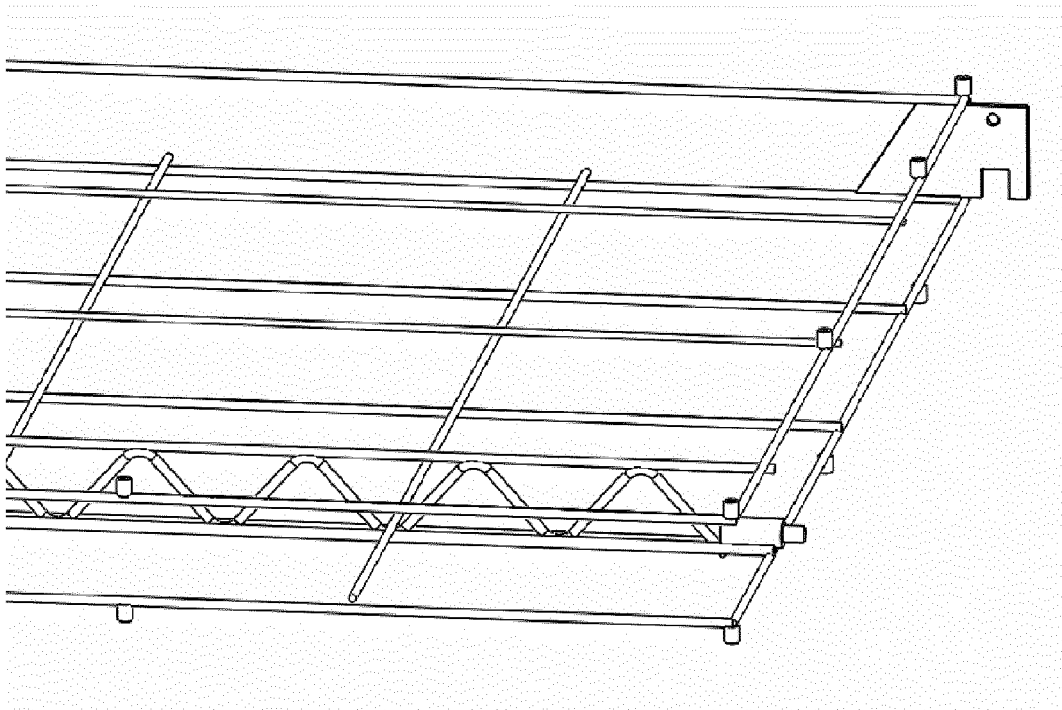


Fig. 6

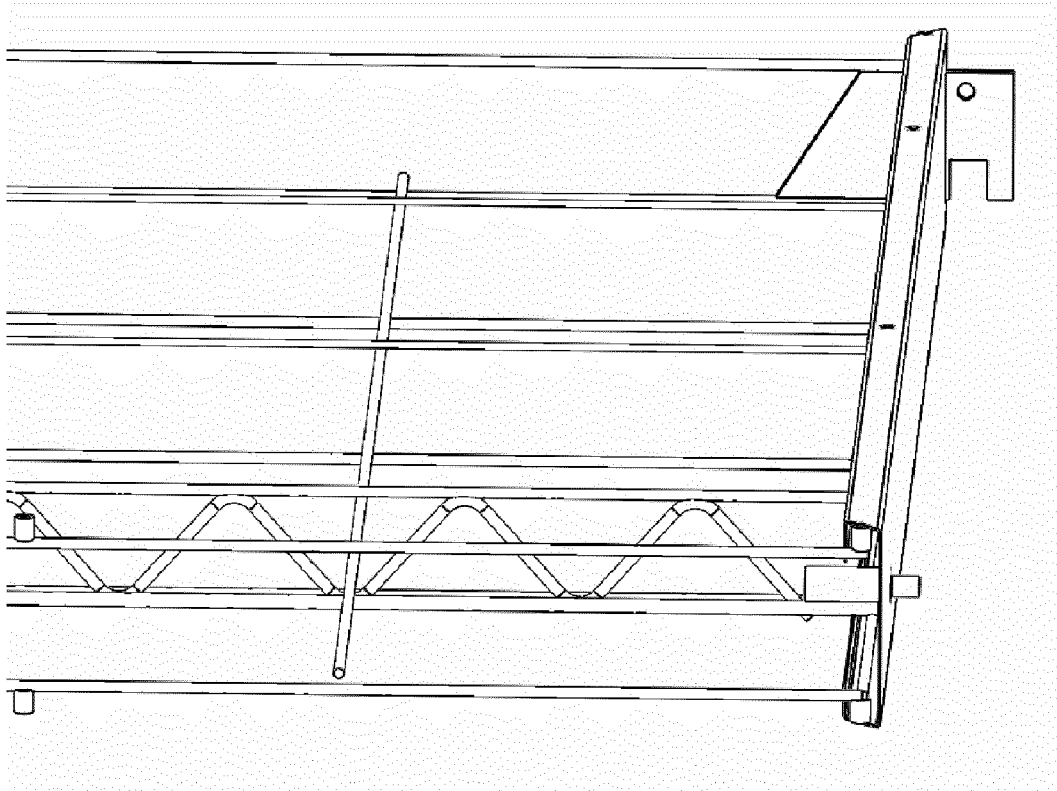


Fig. 7

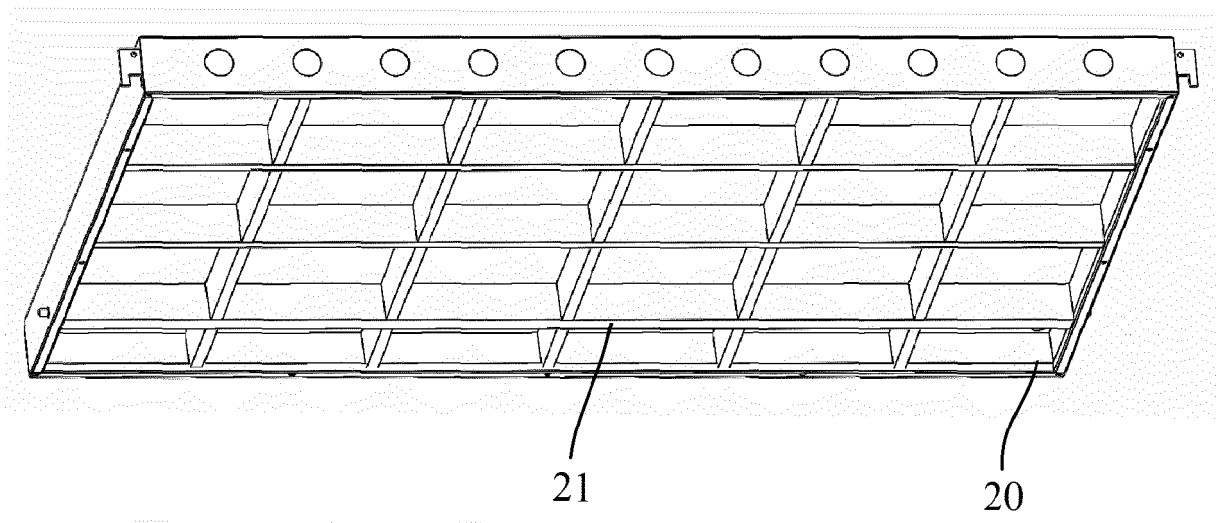


Fig. 8

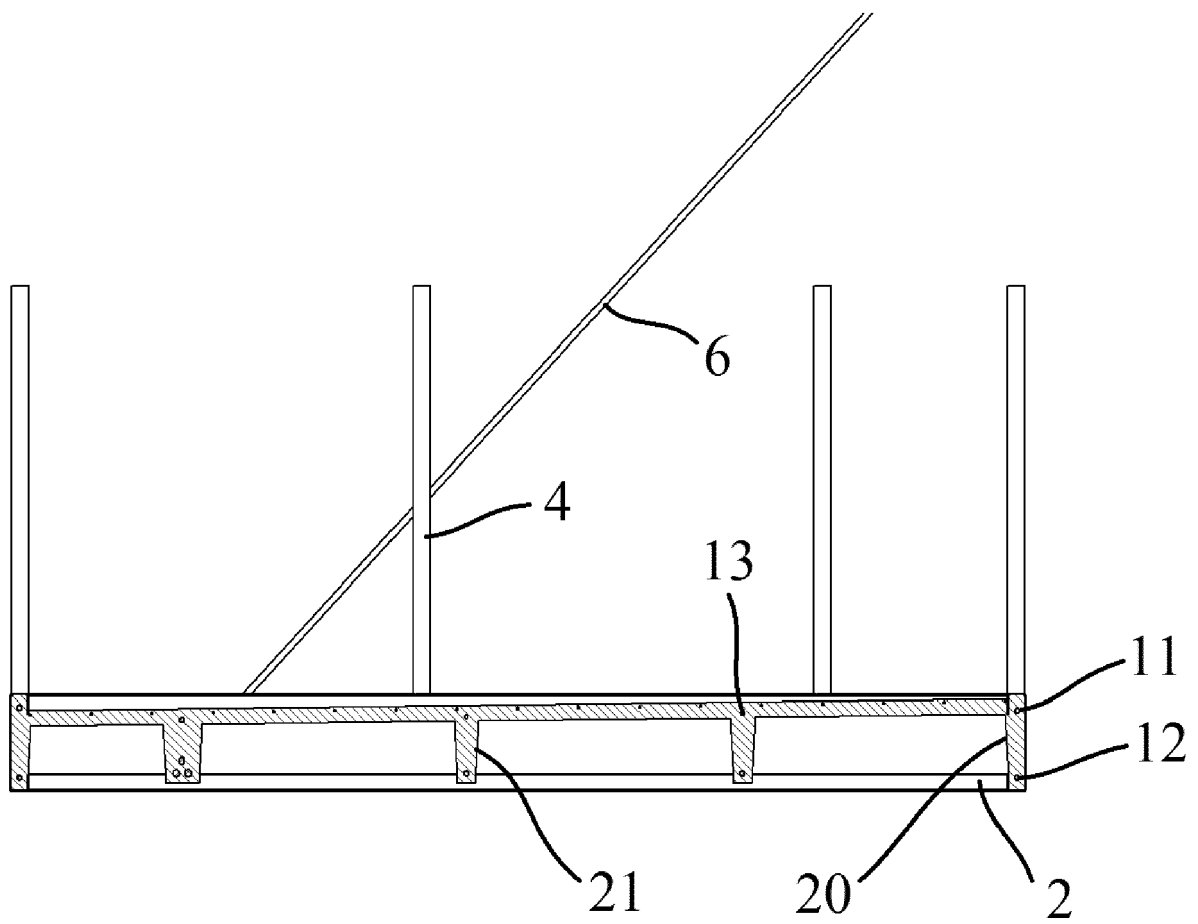
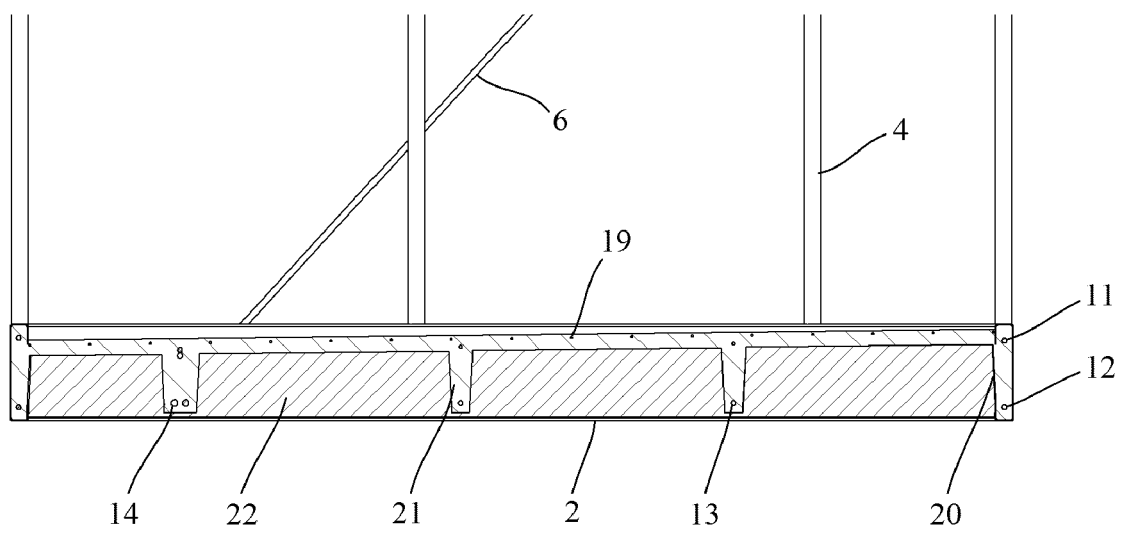


Fig. 9



SECTION B-B

Fig. 10

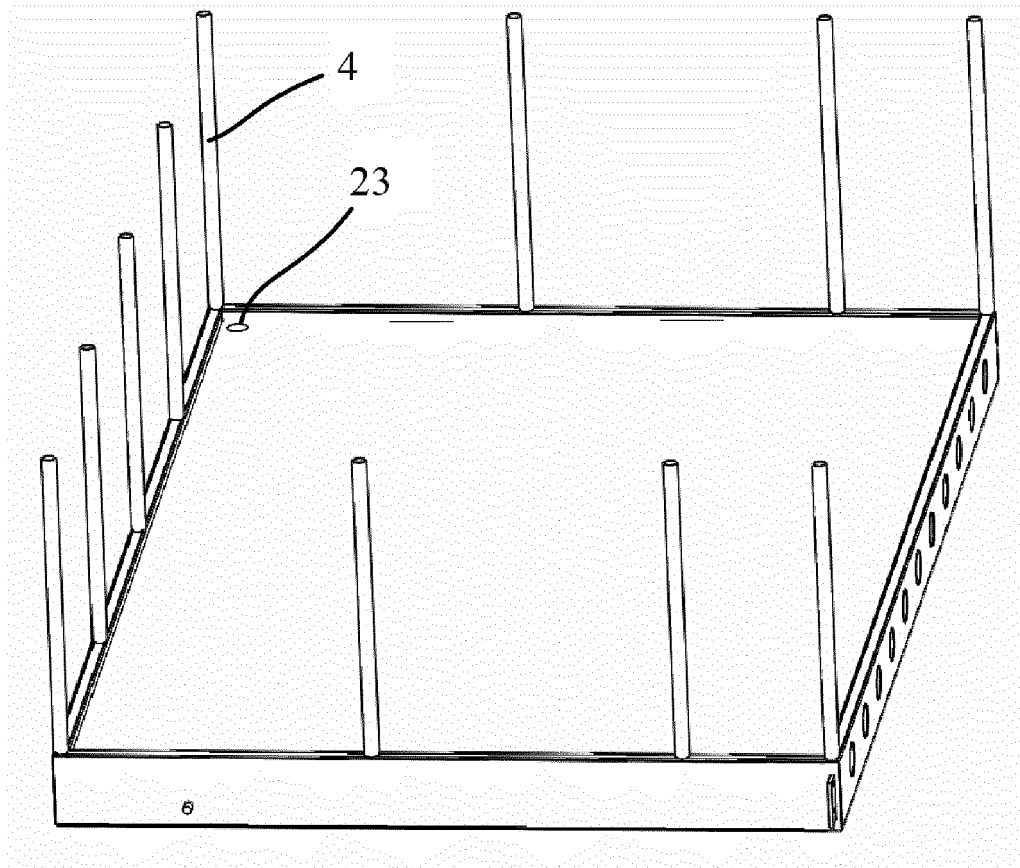


Fig. 11

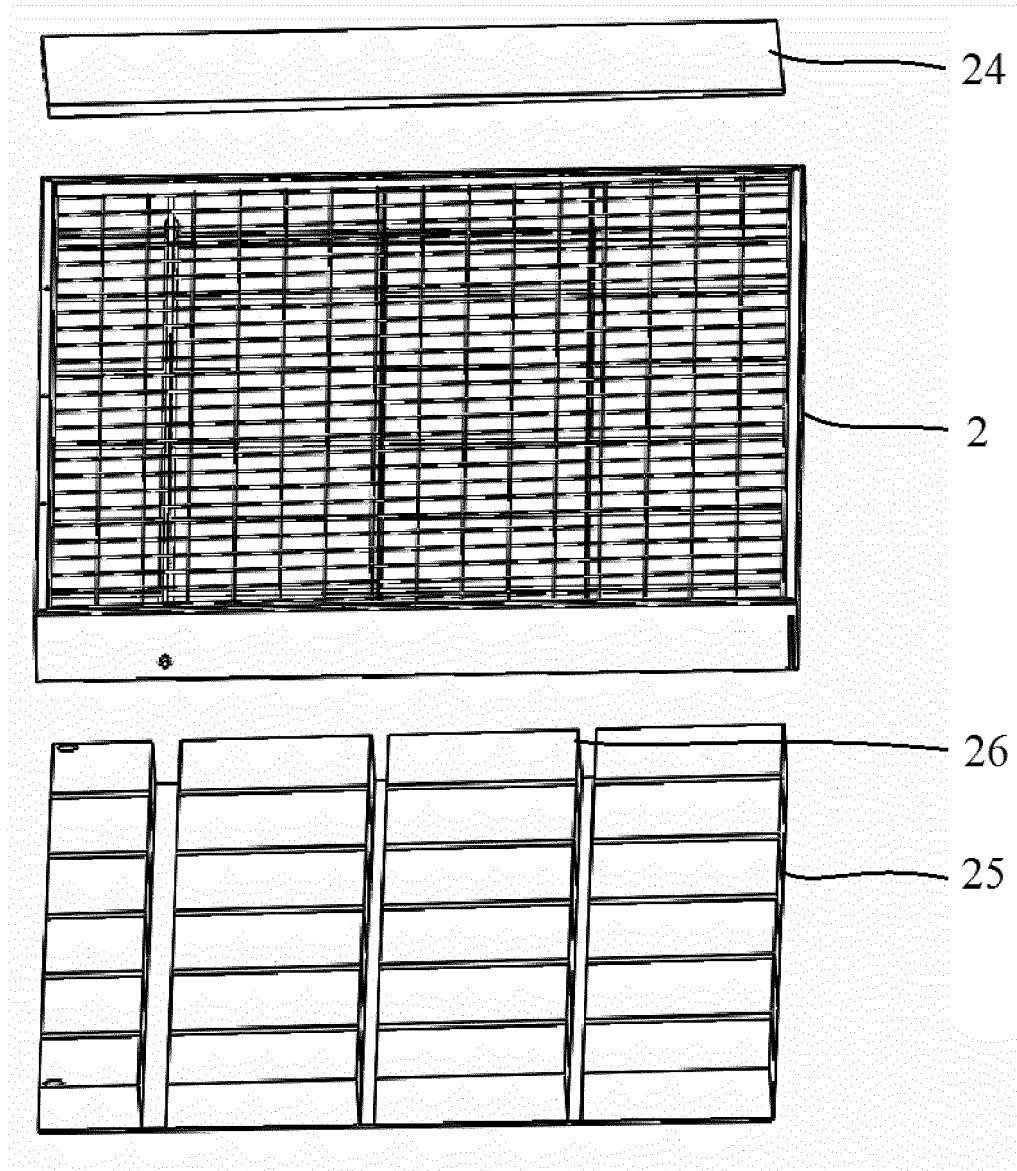


Fig. 12

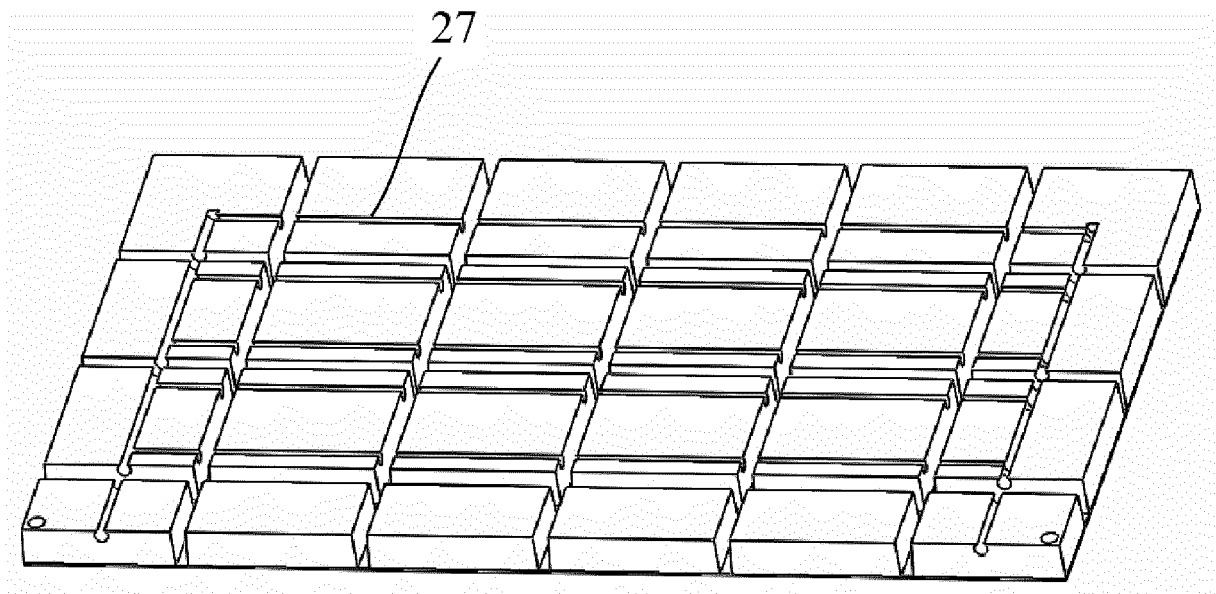


Fig. 13