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

(11) **EP 2 930 280 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.10.2015 Bulletin 2015/42

(51) Int Cl.:
E04B 1/00 *(2006.01)* ***E04B 5/14*** *(2006.01)*

(21) Application number: **15163331.0**

(22) Date of filing: **13.04.2015**

(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
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **11.04.2014 FI 20145351**

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(54) **REINFORCED CONCRETE SLAB AND PRODUCTION METHOD THEREOF**

(57) A supporting slab (1) comprising a concrete matrix structure having at least a planar surface forming the upper surface (2) of the slab and a lower surface (3) located opposite the upper surface (2). The planar surface is surrounded by a kerb (4, 16) extending from the lower surface (3) of the slab to a direction opposite the upper surface (2) and the lower surface (3) of the slab comprises cross-wise webs (7). The webs (7) extend in the lower surface (3) over the area defined by the kerb (4, 14) inside it and protruding outwards from the lower surface. The kerb (4, 16) and the webs (7) each comprise reinforcing steels. The indentations between the kerb (4, 16) and the webs (7, 17) are at least partly filled with filler material lighter than concrete.

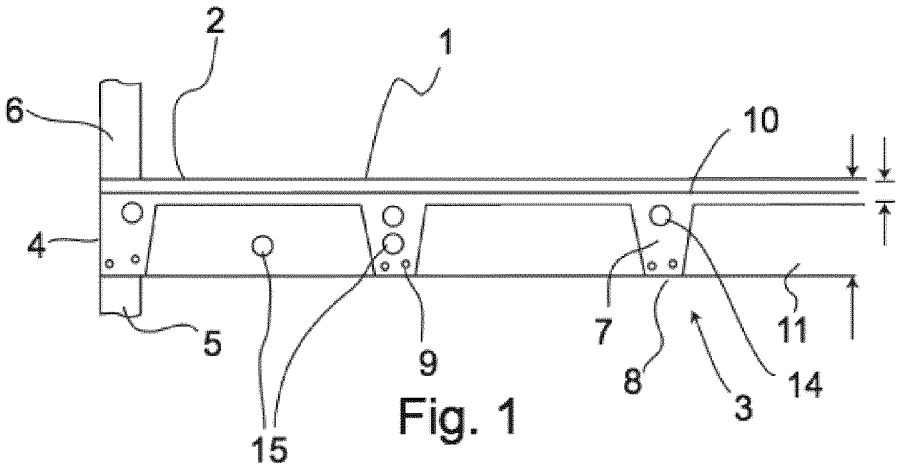

Fig. 1

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Description

Field of the invention

[0001] The present invention relates to a supporting slab of reinforced concrete for a floor, intermediate floor or a balcony.

[0002] The invention relates especially to a combined structure made of steel and concrete for forming the floor of a suspended balcony.

Background

[0003] Various concrete slab constructions can be used for forming floors, intermediate floors, balconies and other such structures where a structure extending over a certain span and carrying the necessary load is required. Usually, steel reinforcements are used in concrete slabs and the mass of the slabs can be reduced by using various cavities or rib and web constructions. Usually slabs are manufactured in element factories either into standard dimensions or, if needed, according to the customer's dimensions. Use of concrete slab structures is well known in building technology.

[0004] Suspended balconies are balconies suspended by tension bars from the frame of the building. The suspension can also be carried out by means of supporting walls from supporting intermediate walls.

[0005] The advantages of suspended balconies include e.g. that the balconies can be positioned more freely, even single balconies on a facade are possible. Balconies suspended by each floor do not cause positive forces caused by thermal movements, either.

[0006] Suspended balcony systems are also available as fiber-reinforced concrete solutions in which the use of fiber-reinforced concrete has allowed a reduction of the weight of the balcony.

[0007] The suspension bar can be located either inside or outside the balcony. The use of external tension bars is mainly limited by factors of municipal appearance. Stainless steel bars should be used as tension bars so as to allow achieving sufficient fire resistance without additional fireproofing. Ready-made tension bar systems or solutions related to standard balcony systems are usually used as tension bar solutions.

[0008] The tension bars are fastened to e.g. a steel profile (such as a square tube) in the slab with tension bar fastening parts already provided. The tension bar is anchored to the supporting frame of the building (either supporting intermediate wall, supporting inner shell of the outer shell or intermediate floor) or separately to the supporting outer shell.

[0009] The rear edge of the balcony slab is supported by the frame of the building or the supporting outer shell via steel components. The most simple solution for a concrete balcony slab is a steel profile at the rear edge, the profile being supported by the intermediate floor. When using supporting side walls for suspension they should be supported by suspending from the supporting intermediate floors by steel components. The steel components passing through the heat insulation should be made of stainless steel.

Short description of the invention

[0010] Conventional slab structures made of reinforced steel are quite massive. Thus their manufacture requires a large amount of raw materials, they are expensive to transport and powerful transport devices are needed for moving and installing the slabs in building sites. The support and suspension structures of the massive and heavy slabs must also be large. These features are emphasized in protruding structures, such as balconies.

[0011] Due to the reasons above it would be advantageous to provide a slab solution that is lighter than the previous ones.

[0012] The invention relates to a steel-reinforced concrete slab that can be used e.g. as a floor slab, intermediate floor slab and floor slab for suspended balconies and other corresponding structures for forming a supporting platform.

[0013] The invention especially relates to a slab for forming a suspended balcony.

[0014] Other features and embodiments of the invention provide a slab into which an air heating duct system or other heating system can be integrated.

[0015] According to one feature of the invention a method for forming a steel-reinforced concrete slab is provided, the slab having an insulation integrated thereto and forming the shape of the bottom side of the slab.

[0016] According to one feature of the invention a built-in combined slab consisting of steel profiles, steel reinforcement and concrete is provided, by means of which is it possible to form a suspended balcony having a light structure or the like protruding structure forming a supporting platform.

[0017] The invention is based on the fact that the slab is made of concrete and it comprises at least a planar surface forming the upper surface of the slab, a lower surface on the side opposite the upper surface and a kerb surrounding the planar surface and extending from the lower

[0018] surface of the slab to a direction opposite to the upper surface. The lower surface of the slab comprises at least two intercrossing webs extending in the lower surface over the area defined by the kerb and extending outwards from the lower surface. The kerb and the webs each include at least one reinforcing steel. The indentations between the kerbs and the webs are filled at least partly by a filler material lighter than concrete, especially with a heat and fire insulation.

[0019] According to one embodiment of the invention the reinforcing steels of the slab are stainless steel and a reinforcing profile made of stainless steel encircles the slab.

[0020] According to one embodiment of the invention the slab comprises at least two fastenings for the tension bars used for suspending the slab.

[0021] According to one embodiment of the invention the indentations between the kerb and the webs are filled by standard-sized insulation blocks for which the kerbs and web are formed during casting.

[0022] According to one embodiment of the invention the slab comprises at least one channel inside the web for heating air.

[0023] According to one embodiment of the invention the slab comprises at least one channel for heating air inside at least one insulation block and traversing at least one web.

[0024] According to one embodiment of the invention the slab comprises at least one provision for cabling, hydronic floor heating or other supplies.

[0025] Considerable advantages are achieved by means of the invention.

[0026] One of the most important advantages is the lightness achieved by means of the cross-wise web structure and the kerb in relation to the load capacity of the slab. It is easy to manufacture the slab by forming the structure of its lower surface by means of standard-sized insulation blocks while simultaneously producing a smooth lower surface for the slab. The lower surface can be coated, painted or covered as desired and it can also be provided with texturing for making the surface more attractive. This produces a ready surface that doesn't necessarily require any processing on the building site.

[0027] One feature of the invention is a standardized casting form block made of insulation material (heat, sound or fire insulation, such as cell-structured polymer-based EPS, XPS or rock wool, glass wool). When the invention is applied for a balcony, the dimensions of the block can be optimized according to the most common balcony dimensions. This allows producing a sturdy but light structure into which e.g. a fire hatch can be installed with accurate dimensioning between the ribs. A light fire-resistant structure is achieved by using stainless steel for both the concrete reinforcing as well as for other structures. Stainless steel does not require a thick protection layer of concrete, thereby allowing for a thin deck and narrow webs and kerb for the slab, but it can withstand much more heat without losing its strength than a construction reinforced by structural steels. In tension bar balconies a widened and strengthened rib is provided along the fastening line of the tension bars for supporting an essential part of the load of the platform. Other ribs can also be strengthened if necessary according to the strength and load calculations made for the structure. By means of optimized strength calculations and the shown grid-like ribbing as well as by using reinforcing made of stainless steel the strength and good fire resistance of the concrete structure is combined with the lightness of steel structure in the shown balcony solution. The insulation block ensures a dimensionally accurate casting to the desired shape and dimensions. Additionally it also functions as a desired kind of insulation that does not essentially increase the weight while providing a smooth lower surface that can be processed or coated as desired, by means of e.g. plastering.

[0028] In floor and intermediate floor applications the dimensions of the insulation block can be optimized so that their webs form a grid with such dimensions that a pipe work for air circulation floor heating can be installed. In these solutions weight and fire resistance aren't as central as requirements as in a balcony and for this reason the reinforcing is normal concrete steel. The dimensioning and reinforcing are planned according to the load and the span. The webs into which the heating pipes are installed are located at a center to center distance of about 400 to 800 mm to the lower surface of the deck slab. This ensures an even heat distribution to the floor. The webs are dimensioned so that if necessary, the heating air transfer pipe can also be installed in the web. In thin floor structures (about 200 mm) the heating air transfer pipes can be arranged in grooves formed in the insulation blocks parallel with the ribs. The necessary electric ducts, lighting fixture bases and other fittings can also be installed in the insulation blocks. If necessary, the insulation block used in the floor does not comprise a kerb located under the web, whereas the slabs manufactured for intermediate floors do comprise it as well as the insulation slabs manufactured for balconies. Both the floor and the intermediate floor are cast on the building site using the said insulation blocks. The lower side of the intermediate floor can be pre-coated in the concrete factory or at the building site and finished at the building site, if necessary.

[0029] The shown solution allows manufacture of floors and intermediate floors the temperature of which can be quickly adjusted by air heating as well (thin slab, low mass). Air heating and electric installations can be built as part of the floor elements manufactured at the factory. The insulated heating air transfer pipe allows transferring heat to the desired part of the building from the technical room having a dedicated blower for each space or area. This allows individual heating adjustment and service as well as maintenance for each area in the technical room.

[0030] Other aims and features of the invention are disclosed in the following detailed description by means of reference to the appended drawings. It is to be understood that the purpose of the drawings is only to describe the invention, not to limit it. For defining the invention we refer to the appended claims.

Description of the figures

[0031]

Figure 1 illustrates one slab according to the invention as a cross-section

Figures 2a and 2b illustrate embodiments of the insulation blocks used in the invention.

Figure 3 is a schematic view of an embodiment of the invention.

Figure 4 illustrates in cross-section a second embodiment of the invention.

Figure 5 is another cross-section of the slab of figure 4.

Figures 6 to 11 illustrate some details of the invention.

Figure 12 illustrates a third embodiment of the invention.

Figure 13 illustrates a fourth embodiment of the invention.

Figure 14 illustrates a fifth embodiment of the invention.

Detailed description of the invention

[0032] In this application the term stainless steel refers to steel alloys that are rust-free as defined by the standard.

[0033] In this application the term profile means a shaped profile the cross-section of which differs from a solid bar, such as a flat bar, square bar or round bar.

[0034] Figures 1 and 3 illustrate a floor slab 1 having a planar upper surface 2 for forming a floor level and a lower surface 3. A kerb 4 surrounds the periphery of the slab 1, extending outwards from the lower surface 3 to a direction opposite to the upper surface. The kerb 4 surrounds the whole circumference of the plane formed by the upper surface 2 forming a stiffener to the edge of the slab 1. As can be seen in figure 1, the kerb 4 is arranged on top of the foundation 5 or a wall element on a building and the next wall element 6 or other wall structure is placed on the kerb at the edge of the upper surface 2 on the place of the kerb 4. Thus the vertical loads of the frame of the building run via the kerb 4 of the slab 1. The aim of the invention was to accomplish a light slab having a good load capacity. This has been achieved by using webs 7 extending outwards from the lower surface of the slab in addition to the kerb. The webs 7 are arranged to run across each other on the lower surface of the slab. In this example the webs 7 are at right angles in relation to each other. Such a structure is easy to produce, but the invention allows the use of e.g. curved webs 7 or a diamond-shaped grid structure, f necessary. A web arrangement differing form straight angles could be used e.g. when at least one edge of the slab is curved, such as a semi circle-shaped slab.

[0035] In the lower edge of the kerb 4 and the webs 7 of the slab 1, i.e. in the surface distal from the upper surface 8 of the slab there is at least one embedded reinforcing steel 9. In the example of figures 1 and 3 each of these comprise two rebars 9 arranged, in a manner known from concrete casting technology, near the lower surface supporting the tension load of the structure so as to achieve the designed load capacity. Instead of rebars, it is conceivable to use wire or other reinforcing steel, possibly even pretensioned. However, as far as manufacturing is concerned, a rebar located inside the casting is the easiest solution. The reinforcing steels 9 are located in each web 7 and kerb 4. Additionally the upper surface of the 10 comprises a rebar net for ensuring the strength of the upper surface. The dimensioning and amount of reinforcing steels depends on the stresses exerted on the slab and they are calculated with normal strength calculation methods, preferably optimizing the mass of the slab, whereby an optimal result of the invention can be achieved. The slab according to the invention is especially suitable for applications in which the total thickness of the slab from the upper surface to the tops of the webs is about 100 to 400mm and the thickness of the actual deck slab between the webs is 30 to 80mm.

[0036] The shape of the lower surface of the slab with its kerb 4 and webs 7 is formed by using filler blocks in the casting mould of the slab, examples of the filler blocks being shown in figures 2a and 2b. Preferably the blocks 11 and 12 are made of heat insulation material, whereby the slab can be provided with a good heat insulation capability. In addition to heat, the insulation material can be sound insulation or fire resistant material or even just filler material. E.g. cell-structured polymer-based EPS (expanded polystyrene) and XPS (extruded polystyrene) or rock wool and glass wool can be mentioned as suitable materials. A casting mould block is most preferably made of insulation material, but it can possibly also be made of filler material. The dimensions of the block can be optimized for a suitable web distance and web height to fit the slab or the most common balcony dimensions. This allows producing a sturdy but light structure into which e.g. a fire hatch can be installed with accurate dimensioning between the webs. Figure 2a shows in more detail the insulation block 11 used in the slab of figure 1. The block is a truncated pyramid in shape and its footprint is a square. The sides of the square can be dimensioned so that distance between the webs 7 i.e. their dimension form center to center is from 400 to 800mm. The thickness of the webs 7 is defined according to strength calculation depending on whether pipe works are to installed inside the webs and how much space they take up. The block is pyramid-like in shape in order to provide a slightly wedge-like shape to the webs and the inside of the kerb 4. The wedge shape if better for distributing tensions than a straight T-shape. As can be seen from figure 1, in the slab of the example the surface of the bottom is flat and it is formed by the tops of the webs and the surface of the insulation block 11 between them. The tops of the webs remain visible. If it is desired to cover the tops with insulation material, it is possible to use the insulation block of figure 2b having protrusions 13 on the side of the largest cross-section of the pyramid shape. These protrusions 13 are dimensioned so that the protrusions of two adjacent insulation blocks together cover the web between them. This produces a smooth surface covered by insulation material, which can be, depending on the material, ready ceiling surface or it can function as a substrate for surface treatment or attaching surface material.

[0037] One advantageous feature of the invention is the facility to arrange various fittings. Figures 1 and 2 illustrate the arrangement of air-circulation floor heating in a slab according to the invention. For the heating air channels 14 are provided in the webs 7 and, if necessary, in the kerb 4 on the side of the upper surface 2 of the slab. These air channels can be arranged to run as shown in figure 3 along the longer side of the slab so that the cross-wise movement to the return circulation takes place in the ends of the slab either inside the kerb or in a transverse web. Air channels 14 can be formed by means of a suitable sufficiently heat-permeable tube installed in the casting mould before casting or by suitable filler material that is removed from the casting. These tubes are not insulated so as not to prevent heat transfer. The air channel 14 are arranged onto the surface of the slab just below the rebar net in order to ensure good heat transfer and the diameter of the channels can typically be from 40 to 80mm. The locations of the webs define the locations of the channels so a dense distribution of webs allows a more even heat distribution, if necessary. If desired, the air channels 14 can run in each web and form a network crossing each other. As the mass of the slab can be kept low, reactions to temperature changes are fast.

[0038] The heating air transfer tubes 15 can be arranged into holes formed in insulation blocks 11, or if the web thckiness is sufficient, also inside the webs. These channels can be insulated for reducing energy consumption and their inside diameter is typically from 40 to 100mm and the outside diameter exceeds the I/D by the thickness of the insulation. Holes must be arranged in transverse webs for these transfer tubes. Tubing can similarly be provided in the slab for other fittings as well and for e.g. fastening lighting fixtures it is easy to provide holes in the insulation either at the element factory or at the building site.

[0039] Figures 4 to 11 illustrate an especial embodiment of the invention for forming a suspended balcony and various alternative construction details. In a balcony slab the kerb of the slab 1 is formed by steel profile 16, thereby producing a construction much lighter than a slab having a concrete kerb. Stainless steel is used for reinforcing and fitting the balcony slab, thereby achieving sufficient fire resistance and the reinforcing can be placed near the surface of the concrete structure without worrying about corrosion prevention distances. 15 to 25mm will be a sufficient thickness of the concrete covering. The concrete part of the balcony slab is formed by a thin deck slab and cross-wise webs 7 according to a previously described example. A stainless steel net is placed in the deck slab and two stainless reinforcing bars 18, 19 are placed at each web in both longitudinal and transverse direction, the lower 19 of which comes near the top of the web and the higher 18 of which comes near the surface of the slab so that it supports the stainless steel net of the surface of the slab. Thus the slab is provided with a double superimposed reinforcing grid structure. The thicknesses of the reinforcing bars can vary according to the dimensioning, especially the lower bars can be thicker. In this example the edge of the slab is surrounded by a C-profile kerb 16 in which the edge moulding 20 of the opening has been turned inwards towards the centerline of the profile. Instead of a C-profile it is possible to use other open profiles as well, such as a £ profile or C-profiles turned in different ways at their edges. The opening of an open profile is facing outwards whereby its inside does not have to be filled with concrete and the planar surface of the profile provides a good support against the concrete structure. Thus the profile can also act as a part of the cast mould. The C-profile comprises two superimposed holes 21 at each web of the slab, the ends of the reinforcing bars being arranged into the holes and then welded to the C-profile. The C-profiles are also welded together in the corners of the slab so that a solid circumferential structure is formed around the slab. The reinforcing bars 18, 19 stiffen the C-profile especially in rotation direction forming two fulcrums at a distance from each other.

[0040] The shape of the bottom of the slab is produced by means of insulation blocks 12. In this case blocks with edge protrusions as described in figures 8 and 8a are used, the edge protrusions extending over the top of the web 7 and forming a smooth outer surface. When the blocks 12 are placed next to each other, the protrusion edges 13 abut each other and the lower surface becomes smooth. A downwards narrowing gap is formed in the middle of the blocks forming a mould for the webs of the slab. If desired, the shape and cross-section of the webs 7 can be varied by changing the edge shape of the blocks. Because the slab is intended to be used as a bottom slab of a suspended balcony, it must have separate fastenings for the tension bars used for suspending. For the fastening one web 22 is formed to be a bit wider than others. The widening can be made by arranging at the wide web 22, between the edge protrusions 13 of the insulation blocks, an insulation plate 23 made preferably of the same material, thereby widening the gap between the blocks. Fastening part 24 according to figure 7, for example, is fitted at this web 22. The fastening part 24 is formed by a stainless steel plate 25 with reinforcing bars welded into its holes, typically 4, with the bars being similar to bars 18 and 19 or alternatively rebars 26 having a length of about one meter. A bracket eyelet 27 made of the square profile of the balcony is welded to the stainless steel plate 25. The C-profile is provided with holes at web 22 for the rebars of the fastener 24. The fastener 24 can be welded to the profile for ensuring fastening. The location of the fastener 24 on the slab can be seen in figure 5. The fastener shown here is only one preferable alternative, and it is possible to use others,

[0041] already known fastening methods in connection with the invention.

[0042] The balcony slab according to the invention is produced so that the steel structure of the slab is first assembled by welding together a circular steel profile 16

with its related reinforcing bars 18, 19 and the fastener of tensioning bars. The bottom mould is formed by placing side by side the necessary amount of insulation blocks for forming e.g. a slab of 2500 x 4000 - 5000 mm. If necessary, the block 34 at the edge is sawn narrower and a provision for the web 17 surrounding the edge of the slab is cut thereto. In this slab the edge of the slab is surrounded by a concrete kerb formed by the outermost webs, but its purpose is to act as a support surface for the steel kerb 16 actually carrying the load at the edge of the slab. The blocks are located on a horizontal level and the steel frame of the slab is arranged in connection with the blocks so that the steel profile kerb 16 surrounds the placed blocks and the reinforcing bars 18, 19 are located in the grooves between the blocks. The steel net reinforcing the deck of the slab can be readily welded to the steel frame or it can be lowered over the frame arranged over the blocks to be supported by the upper reinforcing rods 18. The necessary inclination for the floor surface is achieved by arranging the bottom mould to be level and by setting the steel frame to the desired inclination, such as the 1:80 inclination commonly used in balconies. When the insulation blocks and the steel frame are arranged in their places in a support mould or jig, the mould can be cast full, whereby the structure is joined into a combined structure formed by concrete, insulation and steel as the concrete sets. In this structure the concrete acts as the matrix material, the steel is the reinforcing material and insulation the filler.

[0043] The previously described floor slab is manufactured by a nearly corresponding method, but it requires an edge mould for forming a concrete kerb and the reinforcing must be supported on their suitable places in the mould with methods known from concrete casting techniques.

[0044] The upper surface of the balcony slab can be treated with mortar screed or it can be provided with another ready or semi-ready floor surface. The lower surface can be thinrendered after being lifted from the mould or it can be treated for producing another suitable surface.

[0045] The front edge of the slab can be provided with a water groove made of stainless steel plate by bolting or welding it to the C-profile. Alternatively the water drainage can be carried out by means of the following method illustrated in figure 9 and 10.

[0046] A 30x40 water groove 28 is made on the inside of the C-profile 16 at the outside edge of the balcony. The desired L-moulding, e.g. a 30x30x2, is welded to the C-profile, onto which the stainless reinforcing net of the surface of the slab is also welded. The L-moulding is typically welded from 60 to 80mm below the upper edge of the C-profile. If necessary, a stainless steel bar 30 can be welded to the C-profile of the outer edge for stiffening the profile when the other steel bars 18, 19 are also welded. The floor level 2 is set so that on the wall side it is 20mm below the upper surface of the C-profile 16 and it descends 20mm to the outer edge (inclination 1:80), where there is a 40mm deep groove 28 allowing an inclination of about 1:100 by means of a wedge placed at the bottom of the inclination. The groove 28 is horizontal and therefore a direction can be selected for both the groove descending right and left by means of a wedge-like filling, being about 40mm high at the start end and 0mm at the water drainage end. At the drainage end a hole is made into the beam of the end C for draining the water. The bottom of the beam of end C is also provided with a wedge-like filling having a high edge at the opening side of the C beam. A water drainage pipe is welded on the wall side and attached to the drain located beside the wall. This solution creates an inclination away from the wall and water is transferred into the drain located beside the wall, if necessary. For this, the stainless C-profile of the edge of the balcony is utilized for water drainage. The inclination is achieved by means of a wedge-like filling having an edge partially filling the opening of the C-profile, because the edge of the C-profile is too low to act as a water trough. This solution also allows easy cleaning of the trough, when necessary.

[0047] Two examples of fastening the fences of the balcony are showed here. In the solution of figure 6 holes are made in the C-profile and bolts 33 are arranged in them with the threaded part facing outwards. This way the heads of the bolts stay in the casting and the fence parts can be fastened to the threads of the bolts. In the solution of figure 11 the fastening of the fence posts is made by means of bolts arranged to the holes in the edge moulding of the C-profile. It is obvious that there are a number of options for attaching the fence.

[0048] The opening of the C-profile or other open profile can be covered by a trim board or filler material. Varying the colour and surface texture of these allows having an effect on the looks and mood of the balcony and the whole building.

[0049] Figure 12 illustrates one embodiment of the invention. This balcony or patio slab is a so-called wedge slab, in which a concrete deck slab is mainly placed at the edge of the slab, over the surrounding C-profile 15 so that the top surface 2 of the slab remains above the edge of the frame formed by the C-profile 16. The steel net 10 used as a reinforcing for the upper surface of the slab is here welded to the upper edge of the frame formed by the C-profile so that in the fence side of the slab, i.e. on the outer side, the net 10 is level with the upper surface of the profile and in the opposite side of the net 10, facing the wall, there is a fold 35 raising the reinforcing net 10 slightly above the upper surface of the C-profile 16. The thickness of the upper surface of the slab is larger on the wall side than on the side of the fence 32 to create a sufficient inclination towards the side of the fence 32 for removing water. A fold 35 of the reinforcing net 10 allows the reinforcing net 10 to be located in a wedge-like slab at the same distance from the surface 2 of the slab along the whole area of the slab. As the inclination of the slab is towards the side of the fence, a water groove 28 is required at this side. The water groove 28 can be formed as described previously or it can be formed by means of

a groove cast or otherwise formed at the outer surface 2 of the slab. One method of forming the water groove is shown in figures 13 and 14.

[0050] In the slab of figure 13 at least the edge on the fence side, i.e. the side opposite to the wall in an installed balcony is formed of a profile, the other flange 36 of which is formed of a folded Z shape. First the flange turns in an acute angle towards the centerline 16 of the profile as the first fold 37, after which it turns away from the centerline of the profile into a second fold, parallel with the web 40, and finally at a right angle away from the web 40. In a slab according to the invention the Z-shaped flange is arranged on the side of the upper surface of the slab so that the first fold 37 turns downwards from the surface of the slab and the second fold turns towards the upper surface 2 of the slab. Now, when the profile side of the upper surface 2 of the slab is cast so that the edge is located over the first fold 37, a water groove 28 is formed, defined by the first 37 and the second 38 fold and the upper surface 2 of the slab. In this embodiment the fence of the balcony is fastened to the lower inwards-facing C-eyelet of the profile and to the outer surface of the second fold 38 by bolts 33. A provision must be cut into the third fold 39 of the profile for the fence post 32.

[0051] The embodiment of figure 14 uses profiles slightly modified from the previous profiles. In this alternative the profile on the wall side and possibly the side profiles are C-profiles in which the outer edges 41 of the flanges are folded away (outwards) from the centerline of the profile to be parallel with the web of the profile. Thus the outer edge of the flange forms a protective kerb surrounding the edge of the concrete slab 1. This forms simultaneously an even fastening surface for fences or other desired fittings of the slab formed by the outer edges of the flanges at the outer edge of the slab. This profile can also be used for fastening the slab to the wall of the building.

[0052] In the embodiment of figure 14 the fastening of the fence posts of the outer edge has been made by bolting the fence posts 32 to the third fold 33 of the profile of the outer edge.

[0053] As is obvious from the above examples, the slab meant for forming a patio or balcony comprises two basic embodiments; a trough-shaped, in which the concrete slab 1 remains inside the steel frame, and a wedge-like, in which the upper surface of the slab 1 is above the upper edge of the steel frame. In a trough-shaped slab the reinforcing net of the upper surface of the slab is fastened to the frame formed by the C-profile or the like and the concrete cast also remains within the frame and the beam forms the edges of the trough. In a wedge-like slab the concrete deck is located on the frame formed by the steel profile 16 and the reinforcing net is welded on the beam. The fence posts can be installed over the profile or at its side. In a wedge slab the water grooves can be formed as grooves from 15 to 20mm in depth and they can be connected to a drain pass-through as in the usual wedge slab production method.

[0054] Generally speaking, the slab structure according to the invention is formed by a thin, solid planar slab and a web structure supporting it. The height and reinforcing of the webs are defined by the dimensioning of the structure based on the span and load of the slab.

[0055] The slab element according to the invention can be produced by casting so that when the reinforcing and any pipe works for air heating and any tubing for the electrical cabling are installed in a mould having ready shapes for the insulation blocks or the insulation blocks embedded in the ready slab, the concrete is cast in the mould for forming the combined structure. This can also be accomplished at the building site as casting in situ. Casting in situ is especially suitable for production of floors and intermediate floors. If made at the factory, the mould is turned after the casting has set, and in case the cast does not utilize insulation blocks remaining in the cast, the space reserved for them is filled by e.g. spraying polymer-based insulation or insulation made from mineral wool and bonding agent.

[0056] On top of this a coating can be made over the lower surface by e.g. plastering. In the production alternative suitable for use at the concrete factory the upper surface of the slab to be the floor plane is cast against the mould. Hereby the stepwise casting process in which first the deck casting is made, then the installation of insulation blocks and finally the casting of the webs is made, allows ensuring the quality and evenness of the surface of the slab as well any shapes to be cast, such as water grooves, while also minimizing the post-treatment at the site. This also makes it possible to produce the coating covering the lower surface at the concrete factory immediately subsequent to the previous process steps. The desired floor coating can be made at the factory to the surface that will be the floor plane.

[0057] Various products can be produced by means of the invention.

[0058] In balcony structures the invention can be utilized in e.g. structures for constructing a new type of balcony. Unlike previous solutions, it uses stainless steel for reinforcing and edge beams. The reinforcing of the webs and the reinforcing net to be arranged on the deck as well as the fastenings for the tension bars are welded to the edge profile. The unit, forming the reinforcing of the balcony and the reinforcing of the beam arranged at the outer edge as well as the webs, is installed in the mould for casting, The advantages of stainless steel are demonstrated in meeting of the fire and corrosion resistance requirements more easily than with construction steel structures. These advantages allow a thinner concrete protective layer, whereby the total weight of the structure can be considerably reduced. The disclosed solutions achieve the robustness of the concrete slab, good weather resistance and an important advantage for a balcony fastened with tension bars, lightness.

[0059] For floors, the first production alternative described above is suitable for casting on the construction site using insulation blocks. Considered as a part of con-

struction work, this is nearly the normal floor production process. it is preferable to make the intermediate floor at the concrete factory by using a standard mould, optimized reinforcing and pipe works to avoid the mould work otherwise required at the construction site. The use of insulation blocks simplifies the structure of the mould, the mould is only needed as a support structure under the insulation blocks, whereby also casting in situ at the construction site can well be accomplished. The wall fastenings required for balconies to be suspended by tension bars can be fastened to the slab at the factory or during the casting phase. The edge reinforcing of the floor or intermediate floor slab must be at least partly cast at the construction site, whereby the insulation block located inside and the wall insulation located outside act as the mould. This allows ensuring the fastening of the slab to the reinforcing of the underlying wall as well as ensuring the fastening reinforcing of the wall arranged above.

[0060] In the above examples the slab has been rectangular and the webs have been arranged cross-wise to each other at right angles. It is, of course, possible to vary the shape of the slab so that at least one of its edges is curved, polygonal or other suitable form. Especially a semi-circular shape could be easy to accomplish. Thereby the webs could also be curved or inclined in relation to each other. Various slab shapes allow extra possibilities for planning the buildings.

Claims

1. A supporting slab (1) comprising a concrete matrix structure having at least a planar surface forming the upper surface (2) of the slab and a lower surface (3) located opposite the upper surface (2), **characterized**

   - **by** a kerb (4, 16) surrounding the planar surface and extending from the lower surface (3) of the slab to a direction opposite to the upper surface (2),
   - by at least two cross-wise webs (7) at the lower surface (3) of the slab (1), the webs (7) protruding in the lower surface (3) over the area defined by the kerb (4, 14) inside it and extending outwards from the lower surface,
   - by at least one reinforcing steel (9, 18, 19) in the kerb (4, 16) and each web (7), and
   - by filler material lighter than concrete with which the indentations between the kerb (4, 16) and the webs (7, 17) are at least partly filled.

2. A slab according to claim 1 for forming a suspended balcony, **characterized in that** the reinforcing steels (18, 19) of the slab are stainless steel and that the kerb surrounding the slab is formed by a profile made of stainless steel, the cross-section of which differs from a solid bar.

3. A slab according to claim 2, **characterized in that** the kerb (16) surrounding the slab (16) is formed by an open steel profile the opening of which points away from the edge of the slab.

4. A slab according to claim 2, **characterized in that** the stainless steel kerb (16) surrounding the slab (1) is fastened to the concrete matrix of the slab via reinforcing steels (18, 19).

5. A slab (1) according to any of the preceding claims, **characterized in that** at least one of the webs (22) extending over the area defined by the kerb (4, 14) inside it is wider than the others and at least two fasteners (24) have been attached thereto for the tension bars used for suspending the slab (1).

6. A slab according to any of the preceding claims, **characterized by** insulation blocks (11, 12), by means of which the indentations between the kerb (4, 16) and webs (7, 17) have at least partly been filled.

7. A slab according to claim 6, **characterized in that** the insulation blocks are of standard length and of identical size.

8. A slab (1) according to any of the preceding claims, **characterized in that** the slab (1) comprises a channel (14) inside at least one web (7) for heating air.

9. A slab (1) according to any of the preceding claims, **characterized in that** the slab (1) comprises a channel (15) for the heating air inside at least one insulation block (11) and across at least one web (7).

10. A slab (1) according to any of the preceding claims, **characterized in that** the slab has at least one provision for cabling, hydronic floor heating, lighting fixture or other fittings.

11. A slab (1) according to any of claims 2 to 10, **characterized in that** the upper surface (2) of the concrete cast of the slab is inside the kerb (4, 14).

12. A slab (1) according to any of claims 2 to 10, **characterized in that** the upper surface (2) of the concrete cast of the slab is above the kerb (4, 14).

13. A slab according to claim 12, **characterized in that** the upper surface (2) of the concrete cast of the slab extends at least partly over the kerb (4, 14).

14. A method of producing a supporting slab, in which method

- an edge mould (16) is formed for defining the outer edge of the slab,
- reinforcing steels (9, 18, 19) are arranged inside the edge mould, and
- concrete is cast into the mould for forming the slab (1),

characterized in that

- the inside of the edge mould is filled with mould blocks (11, 12) so that at least two grooves remain between the blocks and the edge mould, the grooves running cross-wise over the area defined by the edge mould as well as one groove between the edge mould and the mould blocks (11, 12) for forming the kerb (4, 17) of the slab (1) and at least two cross-wise webs, and
- arranging at least one reinforcing steel into each groove formed by the mould blocks (11, 12).

15. A method according to claim 14, **characterized in that**

- an edge mould is formed of a profile made of stainless steel (16),
- reinforcing steels (18, 19) are attached to the steel profile so that they run over the area defined by the steel profile (16) at the grooves of the mould blocks, and
- the edge mould formed of steel profile is arranged together with a bottom formed of mould blocks.

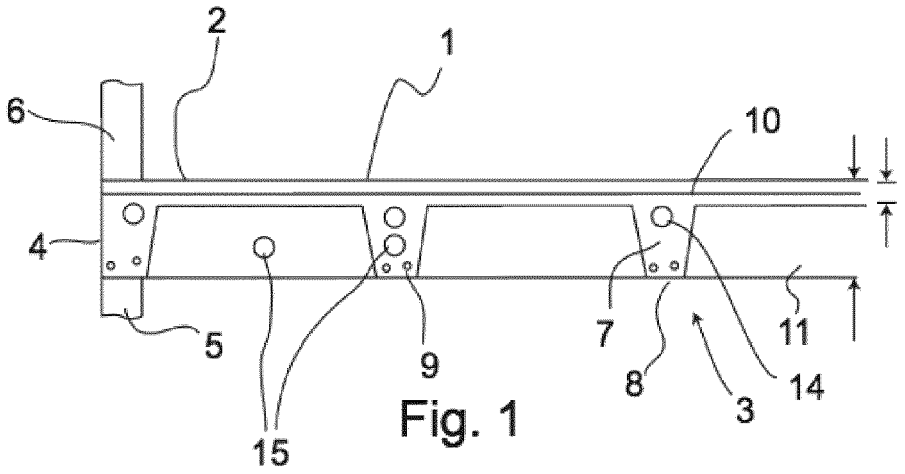


Fig. 1

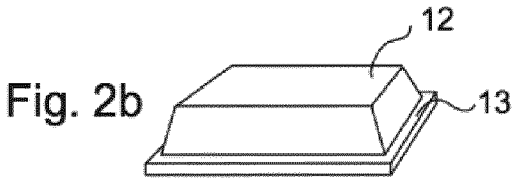


Fig. 2b

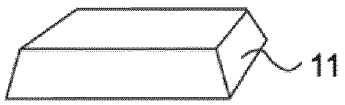


Fig. 2a

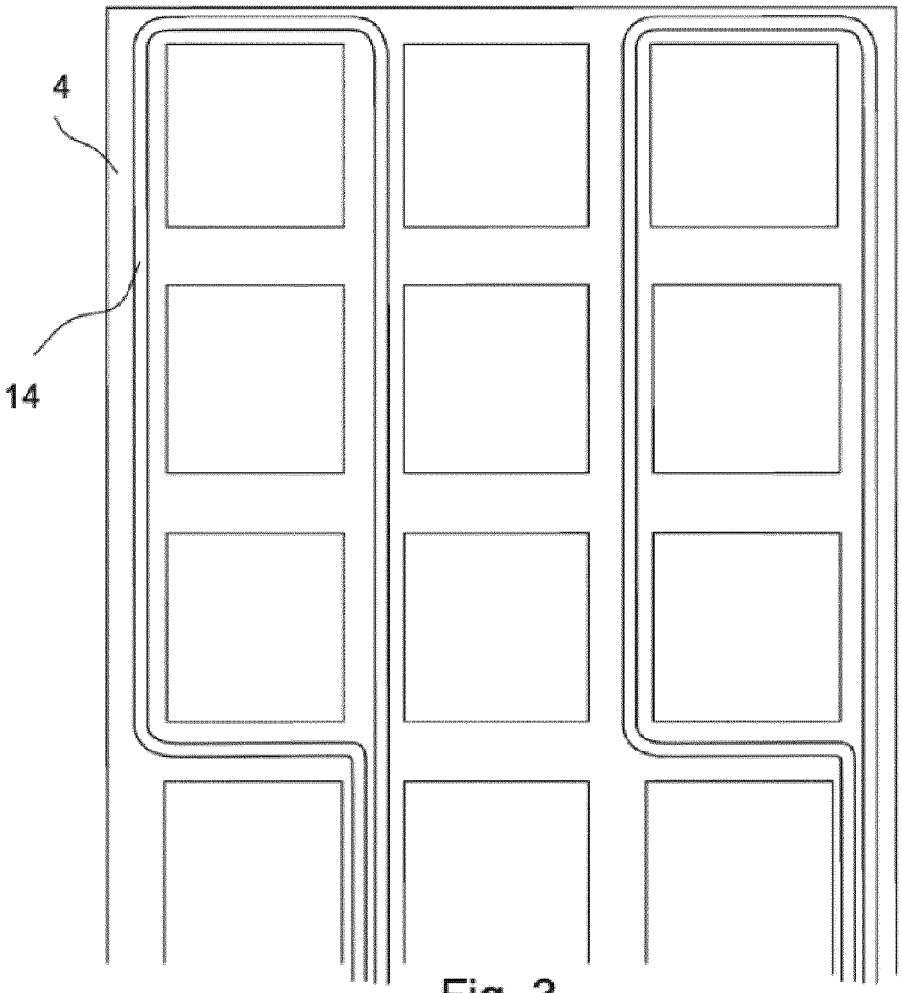


Fig. 3

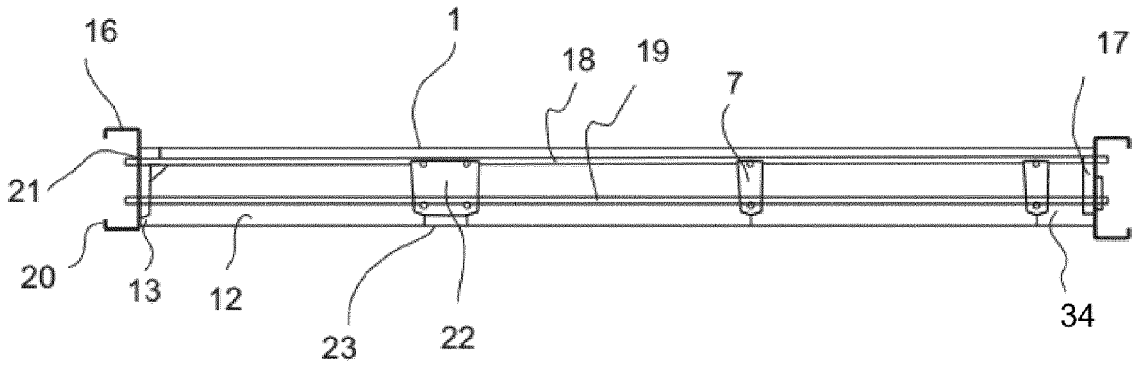


Fig. 4

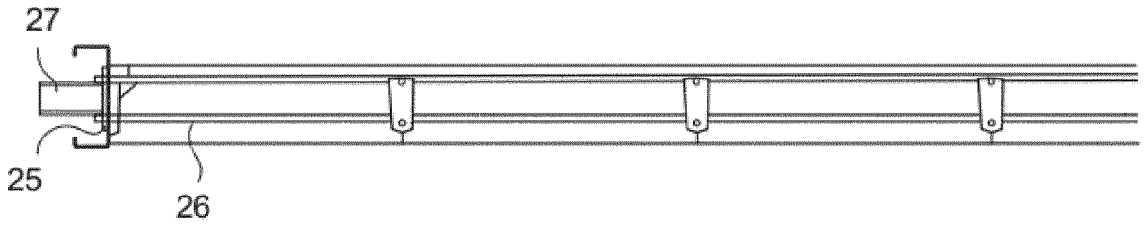


Fig. 5

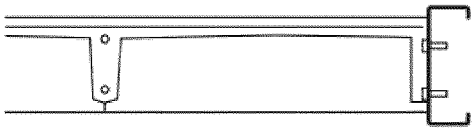


Fig. 6

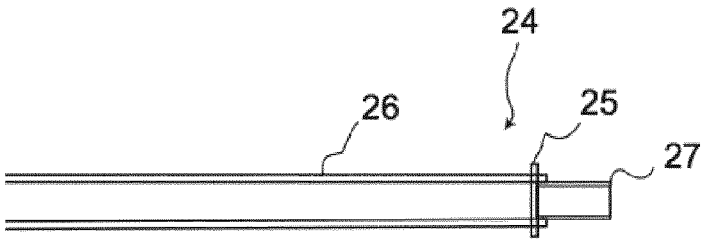


Fig. 7

Fig. 8a

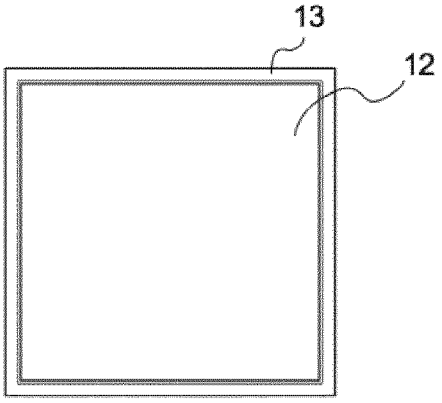
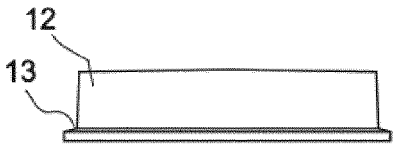


Fig. 8b



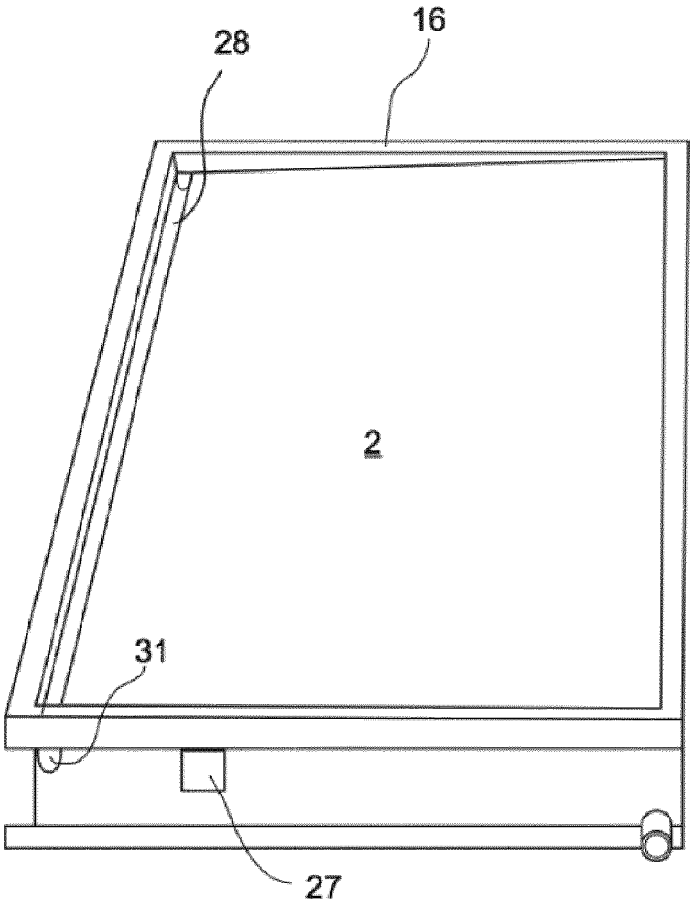


Fig. 9

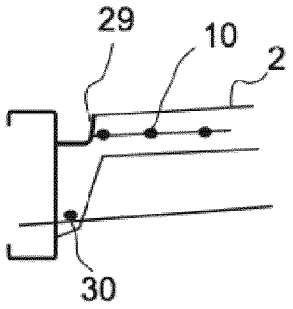


Fig. 10

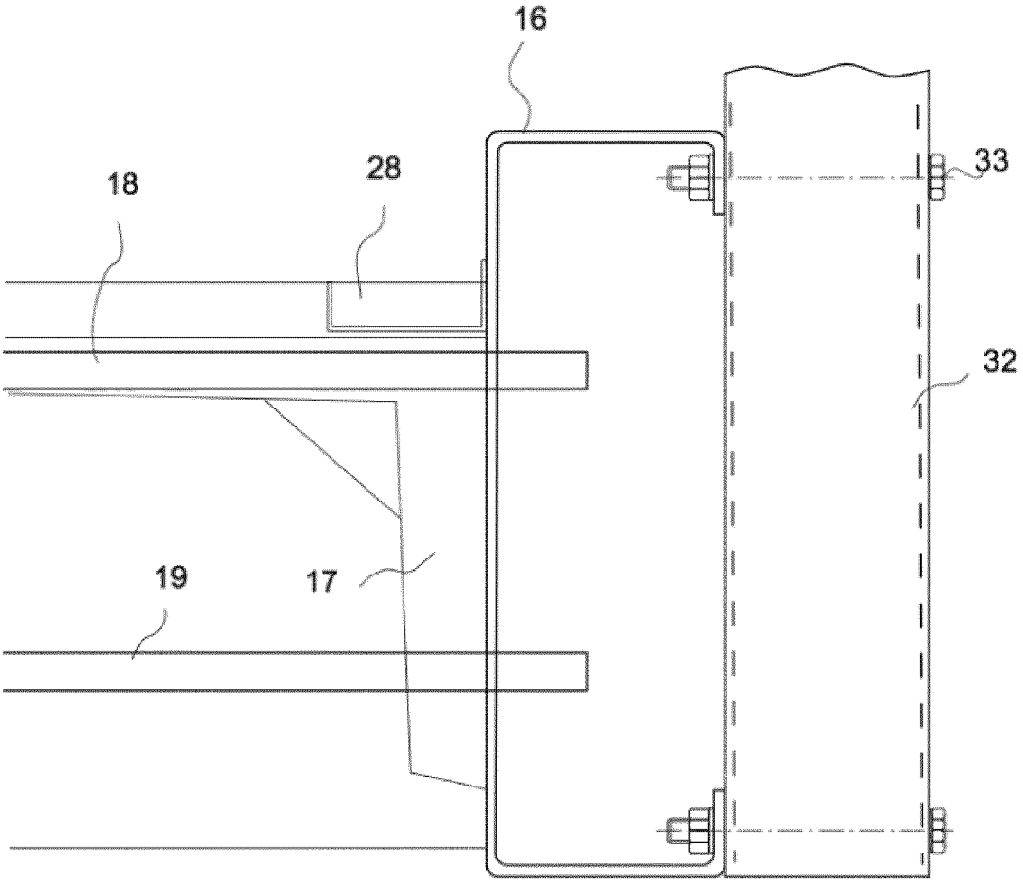


Fig. 11

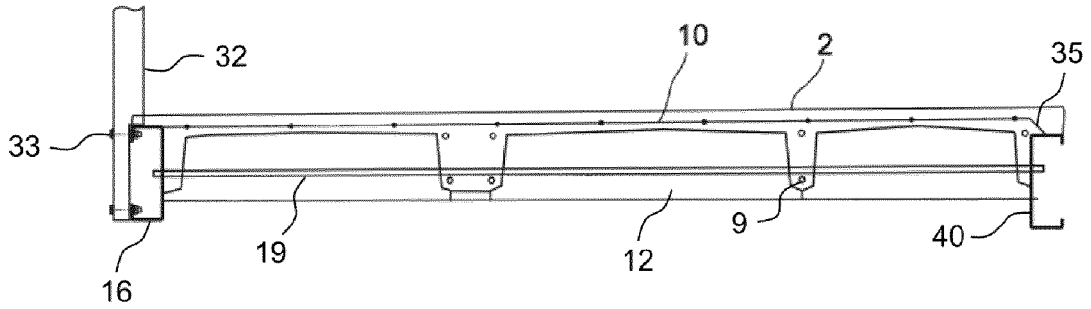


Fig. 12

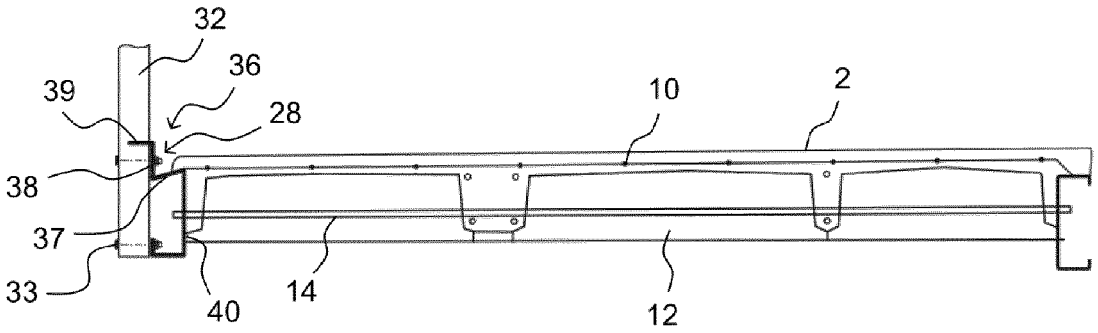


Fig. 13

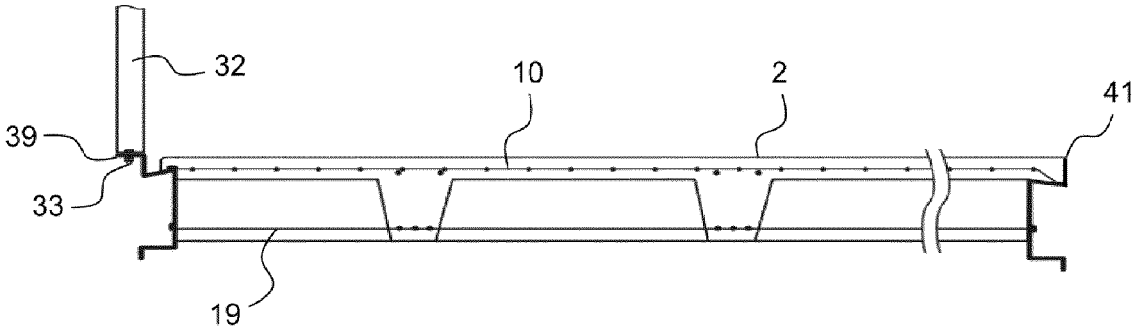


Fig. 14

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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 3331

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 August 2015	Petrinja, Etiel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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