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(54) **Title**: MODULAR HIGH STRENGTH CONCRETE SANDWICH PANEL

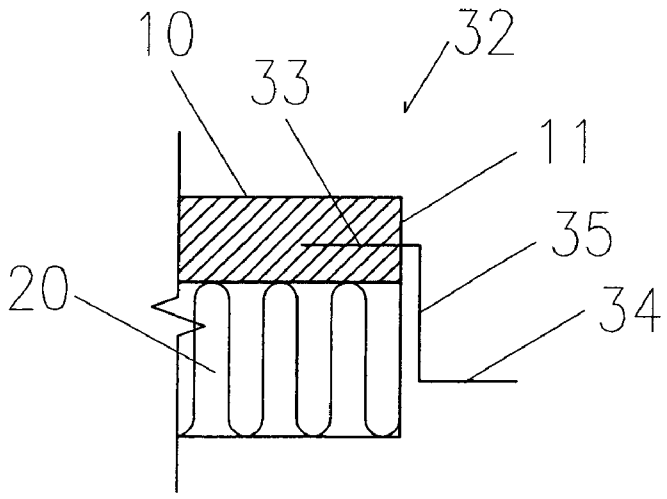


FIG.3

(57) **Abstract**: Modular high strength concrete sandwich panel (1), for use as facade, wall and/or ceiling panel, wherein the panel comprises a high strength concrete part (10), said concrete part (10) having a front face and a rear face opposite said front face, defining a con- crete material thickness there between, and that side edges delimit the high strength concrete part, and an insulating part (20), where said insulating part (20) is partly embedded in the rear face of said high strength concrete part (10), where the material thickness between said front and rear faces is between 5 and 25 mm, and that a rigid profile (30, 32, 37) is embedded in or adjacent the side edges, and protruding from said side edges and the periphery of said concrete sandwich panel (1), where means(31,36) are provided in said profile (30, 32, 37) for fastening of the sandwich panel (1) to a construction, behind the sandwich panel (1).

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Modular high strength concrete sandwich panel

Field of the Invention

The present invention relates to a modular high strength concrete sandwich panel as well as a method for mounting a modular high strength concrete sandwich panel.

Background of the Invention

In the art a number of different systems for providing façade, wall, floor or ceiling panel are known where the panels are attached to a construction which construction, for example when the panels are façade panels, will be attached to the load carrying structure behind the exterior façade.

The exterior façade serves as exterior protection against the environment, i.e. wind, rain etc. When the panels are used for ceilings they are mainly used for decorative purposes, but may also have a noise reducing property and a fire retardant function.

In one particular field there is special emphasis on the properties of the façade panels, namely in the field of renovation where typically older buildings are provided with a new outer skin comprising added insulation and a new weather and impact resistant façade. In these instances it is interesting to have as shallow a constructions depth as possible, to have a relatively high insulation value and at the same time provide a system which is extremely durable and substantially maintenance free. For these purposes various systems including metal and in particular aluminium or steel cladding have been developed. However, these systems usually change the appearance of the building radically, and as such are not always desirable.

The existing natural stone and tile solutions mostly have complex mounting systems with a separate installed insulation layer affecting a lot of on site work and high costs, There is presently no standardised systems offering a high performance concrete surface with or without insulation pre-mounted.

Object of the Invention

It is therefore an object of the present invention to provide a building panel, especially for façade, wall and ceiling panels, which addresses the disadvantages in the prior art.

Description of the Invention

The invention addresses this by providing a modular high strength concrete sandwich panel for use as facade, wall and/or ceiling panel, characterised in that he panel comprises a high strength concrete part, said concrete part having a front face and a rear face opposite said front face, defining a concrete material thickness there between, and that side edges delimit the high strength concrete part, and an insulating part, where said insulating part is partly embedded in the rear face of said high strength concrete part, where the material thickness between said front and rear faces is between 5 and 35 mm, and that a rigid profile is embedded in or adjacent at least two of the side edges, and protruding from said side edges and the periphery of said concrete sandwich panel, where means are provided in said profile for fastening of the sandwich panel to a construction, behind, below or beside the sandwich panel.

This panel construction is provided with a very thin concrete shell which provides a very durable, stiff and maintenance free surface which due to the compactness of the high strength concrete is substantially waterproof and as such will not allow any rain hitting for example a façade to penetrate even the thin concrete layer and gain access in that way to the insulation arranged behind the concrete layer. As high strength concrete with a compressive strength of more than 80 MPa is extremely strong, even a 5 mm material thickness layer will be sufficient in order to provide the rigidity and stiffness of the façade panel. In this context high strength concrete has strengths between 65 to 350 MPa. Within the scope of the invention tests using ultra high strength concrete has also proven successful. These types of concrete, i.e. high and ultra high strength concrete, in addition to the exceptional strength characteristics, also exhibit a high density, making panels made from these concretes substantially impermeable, and with very dense surfaces.

The rigid profile embedded in or adjacent the side edges and projecting past the side edges makes it possible to assemble two adjacent concrete sandwich panels next to

each other only leaving a very narrow space corresponding to the tool necessary in order to tighten or fasten the fastening means arranged behind the concrete sandwich panel. In this manner it is possible to fasten the concrete panels along all side edges, such that a very firm and reliable fastening of the panels is achieved. In applications where the concrete sandwich panels are used for ceiling panels, the joints between adjacent panels do not need any further work in that the rigid profile ensures that the assembly is carried out behind the exposed surface and thereby will be hidden in the joint between adjacent panels.

A further function of the rigid profile is the profiles ability to maintain the concrete part substantially flat. As cement hydrates during the curing process a certain creep occurs. This creep is countered or controlled by providing the profiles at least along two side edges. The resulting panel therefore is substantially plane, which is a distinct advantage as a large number of panels are used in making up a façade.

In a still further advantageous embodiment the rigid profile has a generally Z-shaped cross-section, comprising a first flange suitable to be embedded in concrete, a second flange comprising means suitable for being fastened to an underlying construction, where said first and second flanges are substantially parallel, and where said flanges are connected by a body, arranged substantially perpendicular to said flanges.

This rigid profile shape is especially useful in applications where the profile is embedded directly in a side edge perpendicular to the front surface or where the rigid profile is embedded in the rear face of the concrete panel whereby a substantially large contact area is provided between the high strength concrete and the rigid profile. Furthermore the profile provides stability to the concrete panel, and thereby assures the planeness of the panel.

In some embodiments the profile may advantageously be cast with the concrete panel, and be made from the same high strength concrete as the panel itself. It is clear that high strength concrete is an extremely rigid material, and by arranging the non-corrosive reinforcement appropriately in the side edge zones, the cast profiles will provide all the advantages comparable to other profiles.

In embodiments where the rigid profile is fastened to the profile this may be done by any suitable means such as mechanical fastening, adhesives etc.

In a further advantageous embodiment the rigid profile has a generally L-shaped cross section comprising a first flange suitable to be embedded in concrete and a second flange comprising means suitable for being fastened to an underlying construction.

This rigid profile is especially useful where the profile is embedded in the rear face adjacent the side edge.

The term rigid profile covers any materials which are suitable to be cast in the concrete and which either due to appropriate coatings or to the materials themselves are non-corrosive. For example plastic profiles have been used successfully in that in addition to being non-corrosive they also provide enough rigidity to the construction as such, so that a firm and stable mounting of the panels on façades is achieved. The same is true for stainless steel and aluminium profiles, but the aluminium profiles need to be coated in order for the cement content of the high strength concrete not to react with the aluminium as such.

Tests have also been carried out with composite material profiles, for example GRC or carbon-reinforced epoxy or polyester profiles which were also stable enough. The stability is both with respect to the physical forces which need to be transferred from the panel to the underlying construction in use such as for example impact from wind, gravity, rain etc., but also and especially from variations in temperature where the embedded rigid profile needs to have approximately a thermo-expansion coefficient substantially corresponding to that of the concrete. Alternatively profiles selected from materials not being influenced by the concrete's movement may be selected. Such materials are flexible and does not give rise to crack formation, chipping or the like. With high strength concrete, movements caused by variation in moisture are negligible, and as such tests have indicated that it is not necessary to take this into account, and furthermore the natural shrinkage arising from the hardening of cement is also negligible.

In a still further advantageous embodiment of the invention the insulating part comprises a relatively rigid part, selected from PUR, PIR, polystyrene based polymer foams, and a relatively soft insulating part selected from rockwool, mineralwool, where the rigid foam part is embedded in the concrete, and the soft insulating part is arranged opposite the concrete part.

This embodiment is particularly useful where the modular high strength concrete sandwich panel comes into contact with the surface on which it is mounted, be it an old ceiling or an old façade. The soft insulating part will be able to be deformed as it is lightly pressed against the surface and as such provides a built-in adjustment mechanism whereby it may be achieved that no airspace is provided between the high strength concrete sandwich panel and the underlying construction. This may be advantageous in that drafts or the like could diminish the insulating properties of the overall construction.

In a still further advantageous embodiment reinforcement is arranged in the concrete part where said reinforcement is selected from or combined from: non-corroding fibres, non-corroding netting, non-corroding strings or bars, where said reinforcement may be/is anchored to said rigid profile.

Especially when casting very thin-shelled concrete panels these will have a tendency to bend, buckle or even bend in two dimensions. However, by adding a thin reinforcement netting in the concrete shell, this problem is completely eradicated or at least carefully controlled, without any practical consequences for the resulting panel. Furthermore, the addition of fibres or reinforcement as such will provide an increased tensile property to the high strength concrete sandwich panel as well as improved ductility. The ductility is especially important for very thin-shelled concrete layers down to 5 mm, in that the concrete matrix as such is strong enough when exposed to compressive forces, but by the addition of for example fibres or reinforcement netting the ductility of the construction is greatly improved.

In a still further advantageous embodiment the rigid profile is provided with apertures and/or holes and/or cut-outs in the profiles' flanges.

These features are added in order to improve the connection between the rigid profile and the concrete matrix. By minimising the surface area of the embedded rigid profile the integrity of the concrete matrix is improved and thereby the likelihood of cracks being formed is minimized. The shape of the aperture's holes or cut-outs may be chosen freely as it is not the shape that usually provides the advantages but the fact that there are apertures in the rigid profile. Furthermore, where the profiles are made from a metal or plastic material, it may be possible to stamp out lugs and turn these slightly out of the plane of the flange in order to improve the grip.

In some embodiments the apertures extends outside the concrete part in the finished panels ort may be a separate array of apertures alltogether. When the panels are mounted as façade elements the steam pressure inside the building cannot escape the concrete part. The high strength concrete is so dense that vapour cannot penetrate freely enough in order for the building to be able to breathe. Therefore by providing ventilation openings in the shape of (small) apertures in the profiles it is foreseen that the vapour generated inside the building can escape.

In a further advantageous embodiment the rigid profile is provided along the entire free side edges of the panel.

In some embodiments it may be necessary only to have the rigid profile provided in sections along the side edges, but for other purposes it is desirable to have the rigid profile along the entire side edge. One of the advantages of having the rigid profile along the entire free side edges of the panel is the fact that once it comes to waterproofing a façade it is easier to install a weather strip between two overlying rigid profiles as will be explained below with reference to the method of mounting modular high strength concrete sandwich panels.

In a still further advantageous embodiment the invention foresees that along two side edges the sandwich panel is provided with a profile according to claim 2 and along two other side edges is provided with a profile according to claim 3. This embodiment is particularly useful in applications where the high strength concrete sandwich panels are used in façade applications and especially where the corners of four elements meet in a

cross such that the overlap of the rigid profiles is slightly offset making room for a proper connection without the façade bulging out in this position.

In a further advantageous embodiment side edges not provided with embedded profiles is provided with a recess into the side edge where said recess has a depth and a width and an extend along the side edge ranging from a minor part to the entire side edge and where said recess optionally may be provided with a profile defining said recess.

The recesses serve to accommodate a profile covering the gap between two adjacent panels. The profile may typically be a resilient V-shaped profile where the distal ends of the to free ends of the V are provided with a bent portion, such that the bent portions can be inserted in the recesses, and the resiliency maintain the profile in engagement with the recesses of both adjacent panels.

By further providing a resilient profile defining said recess, i.e. a rubber profile various advantages are achieved, such as tighter (both with respect to moisture and wind) joint between panels, stiffening of panel side edge. This is further improved in embodiments, as will be explained below, where a rigid profile, including a recess are arranged along the side edge. In addition to providing improved tightness, the profile further provides increased stiffness. This is also true, during manufacture and hardening of the panels, where the cementious reactions in the panel material (high strength concrete) will cause creep (typically between 0,5 – 1,5 %), which in turn may cause the panels to bend. The side edge profiles counters this and assures that the panels stay flat.

In a further advantageous embodiment the sandwich panel is provided with one or more reinforcement ribs, provided on and integral with the front or rear concrete face of the panel.

This embodiment is especially advantageous for large panels, where a higher degree of stability is required. Usually the reinforcement ribs are made from high strength concrete, but also composite materials, metals may be used. In this connection it is important that the expansion properties of the ribs are substantially identical to those of the concrete from which the panel is made, in order not to induce tension etc.

When the ribs are provided on or in the front face, the extra concrete does not influence the thermal insulation properties as no new thermal bridge is created.

The invention is also directed to a method for mounting modular high strength concrete sandwich panels which is particular in that it comprises the following steps:

a) a plurality of rigid projecting members are arranged projecting from the surface onto which the high strength concrete panels are to be mounted, where the rigid members are arranged in rows, where the distance between each row at least corresponds to the modular dimensions of the high strength concrete panels, and such that at least two rigid members are provided for each panel;

b) a washer is fixed on each rigid member at a predetermined distance from the surface onto which the high strength concrete panels are to be mounted;

c) the high strength concrete panels are positioned such that holes provided in the rigid profile are superposed the rigid projecting members, and in contact with the washer, where said washer has a diameter larger than the diameter of the hole in the rigid profile;

d) fixing means are applied to the rigid projecting member fixing the rigid profile relative to the rigid projecting member.

Further advantageous methods, particularly relating to the water tightness of the finished construction, are set out in the dependent sub-claims.

Description of the Drawing

The invention will now be described with reference to the accompanying drawings wherein:

Figure 1	illustrates a simple cross-section through a high strength concrete panel according to the invention
Figure 2	illustrates a plane view of a high strength concrete modular panel
Figure 3 and 4	illustrate two examples of cross sections of a concrete panel

edge

Figure 5 illustrates

Figure 6 illustrates perspective view of the rigid profile

Figure 7 illustrates part of a wall comprising a number of high strength modular concrete panels

Figure 8 illustrates a cross section through an exterior wall of an existing building provided with modular concrete panels according to the invention

Figure 9 illustrates details of how to install the high strength concrete panels

Figure 10 illustrates an alternative mounting arrangement where the high strength concrete panels are provided with rigid profiles

Figures 11 and 12 illustrate a system of how to waterproof the connections in the joints between adjacent panels

Detailed Description of the Invention

In figure 1 is illustrated a simple cross-section through a high strength concrete panel according to the invention. The high strength concrete panel 1 comprises a front section 10 made from high strength concrete. The thickness of the layer 10 will typically be between 5 and 25 mm and furthermore reinforcement netting will be embedded in the concrete in order to provide ductility and in order to keep the panel plane.

Tests indicate that in high strength concrete panels without the reinforcement netting the high strength concrete front section 10 tended to bend and buckle, but by adding even a very thin reinforcement netting the high strength concrete section even over very long time and exposed to varying moisture and temperature remained absolutely plane.

On the rear side of the high strength concrete section 10 is arranged an insulation 20. Any type of suitable insulation may be used with the present invention. The insulation 20 is embedded in the rear side of the high strength concrete in that it has been found

that the insulation may advantageously be forced down into the wet concrete while still in the mould whereby a very good connection/bond between the high strength concrete section 10 and the insulation 20 is achieved. In other embodiments the insulation 20 has been added after the high strength concrete section has hardened, where an adhesive has been used in order to attach the insulation 20.

Turning to figure 2 a plane view of a high strength concrete modular panel 1 is illustrated. Along the side edges 11 of the high strength concrete section 10 are provided rigid profiles 30 which profiles are embedded in the concrete section 10 and project outside the periphery, i.e. the side edges 11 of the concrete section 10. As illustrated the rigid profiles are provided with apertures or lugs 31 such that it is possible to assemble and mount the panels as will be explained below.

In figures 3 and 4 are illustrated two examples of cross sections of a concrete panel edge. In figure 3 a Z-shaped rigid profile 32 is embedded in a side section 11 of the concrete section 10.

The rigid profile 32 comprises a first flange 33, a second flange 34 which flanges 33, 34 are substantially parallel and connected by a body 35 such that the flanges 33, 34 are offset relative to each other. The flanges 33, 34 are as indicated in figure 5 provided with means for fastening either the rigid profile to the concrete section 10 or to the underlying construction, see below.

The means may be in the shape of apertures 31 or cut-outs 36.

In figure 4 is illustrated an alternative to the rigid profile in figure 3. In this embodiment the rigid profile has en L-shape comprising two flanges 33, 34 arranged at an angle. The flange 33 is again adapted and suitable to be embedded in the concrete 10, whereas the other flange 34 is provided with means for being fastened to the underlying construction as explained above with reference to the flange 34 of figure 3.

A perspective view of the rigid profile 37 is illustrated in figure 6.

In figure 7 is depicted part of a wall comprising a number of high strength modular concrete panels 10. The panels will typically have a modular size of 600 mm high and 1,500 mm wide. Naturally, other sizes are also contemplated within the scope of the invention, but at these sizes the panels have a weight of less that 20 kilos and as such can be handled manually without the use of lifting equipment.

Between each panel a joint 40 is present which will be explained with reference to the following figures.

In figure 8 is illustrated a cross section through an exterior wall of an existing building provided with modular concrete panels according to the invention.

In the existing façade 50 are provided a number of rows of projecting rods 51. The rods are typically provided with a thread in the end away from the façade 50 in order to be able to adjust a washer or scrim 52 at a fixed distance such that the washers or scrim 52 on all the rods on the façade on which the high strength concrete panels are to be mounted will be arranged in the same plane irrespective of the orientation of the façade 50. In this manner the high strength concrete panels will be arranged in a substantially even façade plane irrespective of the old façade being not completely in the same plane or even buckling.

In order to support the rigid profiles 30 embedded in the high strength concrete panels 10 a guide rail 53 is arranged in this embodiment. It should be noted, however, that this guide rail is not necessary in that the rigid profiles will be able to provide the guidance and support, but tests indicate that a much firmer and more reliable façade structure is obtained using these guide rails 53. After this the high strength concrete panels 10 are mounted such that the apertures 31, 36, see figures 5 and 6, are superposed the projecting rod 51 and such that the rigid profiles are overlapping each other. Finally, fastening means, such as for example a nut, is applied to the end of the rod tightening the profiles against the guide rail thereby fixing the high strength concrete panels in their position. This leaves a joint 40 between two adjacent high strength concrete panels 10.

The high strength concrete panels are in this embodiment provided with two types of insulation 20, 21. The first type of insulation 20 may be relatively rigid, whereas the second type 21 may be relatively soft such that the insulation is able to deform as the insulation comes into contact with the façade 50 of the building onto which the high strength concrete panels 10 are to be mounted. In this manner it is achieved that no air pockets or the like arise between the high strength concrete panels 10 and the façade 50.

Various types of insulation material is suitable with the present invention. In addition to traditional insulation types such as mineral- and glasswool, PUR, PIR, polystyrene etc., also more exotic materials are feasible. Even though they may be more expensive the overall cost of the entire modular high strength concrete panel remains feasible, due to the inherent advantages with the panels according to the invention.

Of exotic insulation materials VIP and aerogels have provided particularly good results.

A Vacuum insulated panel (VIP) consists of a gas-tight enclosure and a rigid core from which the air has been evacuated.

By removing air from fiber, powder, or foam core materials VIPs achieve high thermal performance at a fraction of the thickness of cut-to-fit insulation materials. VIP products are made-to-fit architectural details, with specified service lives for floor, wall, and roof constructions. Quality control of component manufacture is important.

A VIP uses the insulating effects of a vacuum to produce much higher thermal resistance than conventional insulation. Conventional insulation produces an R-value of eight or less per inch (fibreglass being towards the lower end and foam panels towards the higher end). VIPs are commonly as high as R-30 per inch, and have achieved commercially viable levels of R-50 per inch.

VIPs consist of:

- Membrane walls, used to prevent air from getting into the vacuum area
- Core material, used to hold the vacuum inside the membrane while preventing the membrane walls from collapsing (e.g. aerogel)
- Chemicals to collect gases leaked through the membrane or offgassed from the membrane materials.

The near-vacuum inside VIP's greatly reduces conduction and convection of heat. This is similar to the way in which a vacuum flask works, but without the reflective metal coatings.

VIPs offer very high R-value by thickness (30-50R value per inch compared with 5-8R/in for various foams and a lower 2-3.54R/in for common fiberglass batting), but by cost and lifespan it is less competitive. Compared to more conventional insulating materials VIPs have a high cost/r-value ratio. Unlike fiberglass (although foam insulation does age), VIPs age as it is impossible to completely keep air from filling the vacuum. As air leaks in and pressure of the panel normalizes with its surrounding air its R-value deteriorates.

Although their higher cost compared with fiberglass and foam generally keep them out of traditional housing situations, their spectacular R/in values make them useful in situation where high insulation requirements or space constraints make traditional insulation impractical. (Foam sheets are used over fiberglass often for the same goal of higher R/in, despite higher cost for the same R value).

Aerogels are good thermal insulators because they almost nullify the three methods of heat transfer (convection, conduction, and radiation). They are good conductive insulators because they are composed almost entirely from a gas, and gases are very poor heat conductors. Silica aerogel is especially good because silica is also a poor conductor of heat (a metallic aerogel, on the other hand, would be less effective). They

are good convective inhibitors because air cannot circulate through the lattice. Carbon aerogel is a good radiative insulator because carbon absorbs the infrared radiation that transfers heat at standard temperatures.

In figure 9 are illustrated details of how to install the high strength concrete panels 10 to a façade adjacent a window or door opening. In this embodiment the projecting rod is replaced by a fastening angle 60 fastened to the façade 50. The high strength concrete panel is provided with an end wall 12, i.e. the side edge is bent around, and a straight rigid profile 39 is embedded in the side edge 11 of the high strength concrete panel 10. The rigid profile 39 is fastened to the angle 60 such that a rigid connection is provided between the high strength concrete panel 10 and the façade 50. The rigid profile extends from the end wall 12 a distance whereby a joint 41 is provided. This joint 41 is very important in that it breaks an otherwise thermal bridge between the façade 50 and the high strength concrete panel section 10.

After having arranged the high strength concrete panel relative to the façade 50 the frame 70 of the door or window may be built into the structure in a known manner.

In other embodiments window frames have been arranged in the mould prior to casting the panel, such that the window frame is cast integral with the panel. On site the window was thereafter mounted in the frame.

In figure 10 is illustrated an alternative mounting arrangement where the high strength concrete panels 10 again are provided with rigid profiles 30 arranged such that when the high strength concrete panels are place adjacent to each other apertures in the profiles will overlap whereby it becomes possible to insert a screw, bolt or the like 41 in order to connect the rigid profiles 30 to a mounting bracket 80. The mounting bracket comprises two parts 81, 82, each being L-shaped having substantially perpendicular flanges. By overlapping a flange on each of the L-shaped profiles 81, 82 it is possible to adjust the distance between the two other flanges such that the mounting of the profiles to the mounting profile 80 will have the correct distance from the rear construction 50. By tightening the bolts 83 connecting the two L-shaped profiles 81, 82 a fixed

mounting bracket 80 is provided where the mounting flange 84 is at a correct distance from the wall 50.

Turning to figures 11 and 12 a system of how to waterproof the connections in the joints between adjacent panels is illustrated. In figure 11 the construction is seen from behind, i.e. the front face of the high strength concrete panel is not visible, but the rear side of the insulation is visible.

Overlapping rigid profiles 30 in the illustration in figure 11 meet where four high strength concrete panels 10', 10'', 10''', 10'''' meet. In the intersection a cross-shaped member 80 made from U-shaped profiles is superposed the overlapping rigid profiles 30. The cross shape member 80 is fastened to the rigid profiles, for example by means of screws 81. In order to safeguard the watertightness, resilient weather strips or the like are arranged between each layer, i.e. the cross-shaped member 80 and the rigid profiles 30. In the embodiment illustrated in figure 11 the rigid profiles are terminated such that they are even with the octagonal side edge such that the centre 90, illustrated in phantom lines is free from profiles.

In figure 12 a cross-section A-A is depicted in order to illustrate the cross-shaped member's 80 position relative to the rigid profiles 30.

In fig. 13a to fig 13 is illustrated the side edges of adjacent panels 10. Between the panels is provided a joint 40. The adjacent side edges are provided with recesses 81,81' on the faces 82,82' of the side edges facing each other in the joint 40.
In the joint 40, in order to render the joint watertight (or avoid water access to the interior of the construction) a resilient profile 83 is arranged. The profile is biased such that the free ends of the profile is urged into the recesses, thereby locking the profile 83 in place.
In fig 13a the recess 81,81' is made in the concrete, whereas fig 13b to 13e illustrates more advanced recess constructions.

In fig 13b and 13c a resilient member 84, for example made from rubber is cast into the concrete adjacent the recess. The member 84' depicted in fig 13c is provided with lips

85 closing the recess' opening, and arresting the profile 83 in the recess 81,81'. The lips 85 provide a firmer grip on the profile 83, and at the same time closes the recess such that foreign matter cannot be assembled in the recess.

In fig 13d the resilient profile 83 is provided with a resilient/soft profile 86. The advantages of this arrangement are equivalent to the other embodiments described above, however with the extra feature that it is easier to replace the profile 86 should it deteriorate or be damaged.

In fig. 13e is illustrated an especially advantageous construction. In this embodiment reinforcing profiles 87 are provided along the side edges 82,82' of the panels 10. The profiles provide stiffness to the panels and at the same time provides protection against chipping or other damage to the panels which may occur during handling prior to installation. Typically the profiles are made from a non-corrosive material, such as stainless steel, aluminium, reinforced composites and the like. The other features relating to the resilient profile 83, has already been explained above.

CLAIMS

1. Modular high strength concrete sandwich panel, for use as facade, wall, floor and/or ceiling panel, characterised in that he panel comprises a high strength concrete part, said concrete part having a front face and a rear face opposite said front face, defining a concrete material thickness there between, and that side edges delimit the high strength concrete part, and an insulating part, where said insulating part is partly embedded in the rear face of said high strength concrete part, where the material thickness between said front and rear faces is between 5 and 25 mm, and that a rigid profile is embedded in or adjacent at least two of the side edges, and protruding from said side edges and the periphery of said concrete sandwich panel, where means are provided in said profile for fastening of the sandwich panel to a construction, behind or besides the sandwich panel.

2. Modular high strength concrete sandwich panel according to claim 1, characterised in that the rigid profile has a generally Z-shaped cross-section, comprising a first flange suitable to be embedded in concrete, a second flange comprising means suitable for being fastened to an underlying construction, where said first and second flanges are substantially parallel, and where said flanges are connected by a body, arranged substantially perpendicular to said flanges.

3. Modular high strength concrete sandwich panel according to claim 1, characterised in that the rigid profile has a generally L-shaped cross-section, comprising a first flange suitable to be embedded in concrete, and a second flange comprising means suitable for being fastened to an underlying construction.

4. Modular high strength concrete sandwich panel according to claim 1, 2 or 3, characterised in that the insulating part comprises a relatively rigid part, selected from PUR, PIR, polystyrene based polymer foams, and a relatively soft insulating part selected from rockwool, mineralwool, where the rigid foam part is embedded in the concrete, and the soft insulating part is arranged opposite to the concrete part or that the insulation part is a single insulating layer selected from or combined from PUR (polyurethane foam), PIR (polyisocyanurate foams) or polystyrene based foams, VIP (vacuum insu-

lated panel), aerogels, phenoalic foams, expanded clay, natural fibres, mineral and/or glasswool.

5. Modular high strength concrete sandwich panel according to any previous claim, characterised in that reinforcement is arranged in the concrete part, where said reinforcement is selected from or combined from: non-corroding fibres, non-corroding netting, non-corroding strings or bars, where said reinforcement may be/is anchored to said rigid profile.

6. Modular high strength concrete sandwich panel according to claim 2 or 3 characterised in that the rigid profile is provided with apertures and/or holes and/or cut-outs in the profiles' flanges.

7. Modular high strength concrete sandwich panel according to any preceding claim characterised in that the rigid profile is provided along parts of the at least two side edges or the entire free side edges of the at least two side edges of the panel.

8. Modular high strength concrete sandwich panel according to claim 2 and 3 characterised in that along two side edges the sandwich panel is provided with a profile according to claim 2 and along two other side edges is provided with a profile according to claim 3.

9. Modular high strength concrete sandwich panel according to claim 1, characterised in that side edges not provided with embedded profiles is provided with a recess into the side edge where said recess has a depth and a width and an extend along the side edge ranging from a minor part to the entire side edge, and where said recess optionally may be provided with a profile defining said recess.

10. Modular high strength concrete panel according to claim 1, characterised in that one or more reinforcement ribs are provided on and integral with the rear concrete face of the panel.

11. Method for mounting modular high strength concrete sandwich panels according to any of claims 1 to 10 comprising the following steps:

a) a plurality of rigid projecting members are arranged projecting from the surface onto which the high strength concrete panels are to be mounted, where the rigid members are arranged in rows, where the distance between each row at least corresponds to the modular dimensions of the high strength concrete panels, and such that at least two rigid members are provided for each panel;

b) a washer is fixed on each rigid member at a predetermined distance from the surface onto which the high strength concrete panels are to be mounted;

c) the high strength concrete panels are positioned such that holes provided in the rigid profile are superposed the rigid projecting members, and in contact with the washer, where said washer has a diameter larger than the diameter of the hole in the rigid profile;

d) fixing means are applied to the rigid projecting member fixing the rigid profile relative to the rigid projecting member.

12. Method according to claim 11 wherein before step c) a guiding profile is arranged spanning two or more rigid projecting members in a row, such that as the high strength concrete panel is mounted in step c) the rigid profiles of the concrete panels comes into contact with the guiding profile, before being fixed in step d).

13. Method according to claim 11 or 12 characterised in that a resilient strip is provided between overlapping profile flanges of adjacent modular high strength concrete sandwich panels, and optionally that a substantially cross-shaped member, made from U-shaped profiles is arranged behind the intersection.

FIG.1

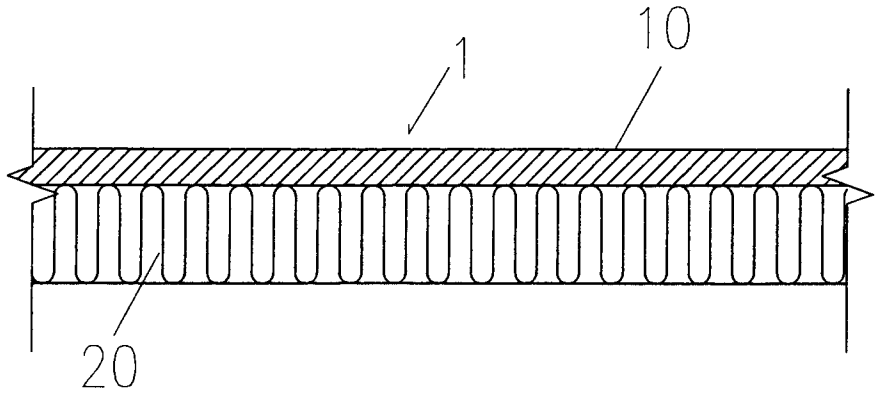


FIG.2

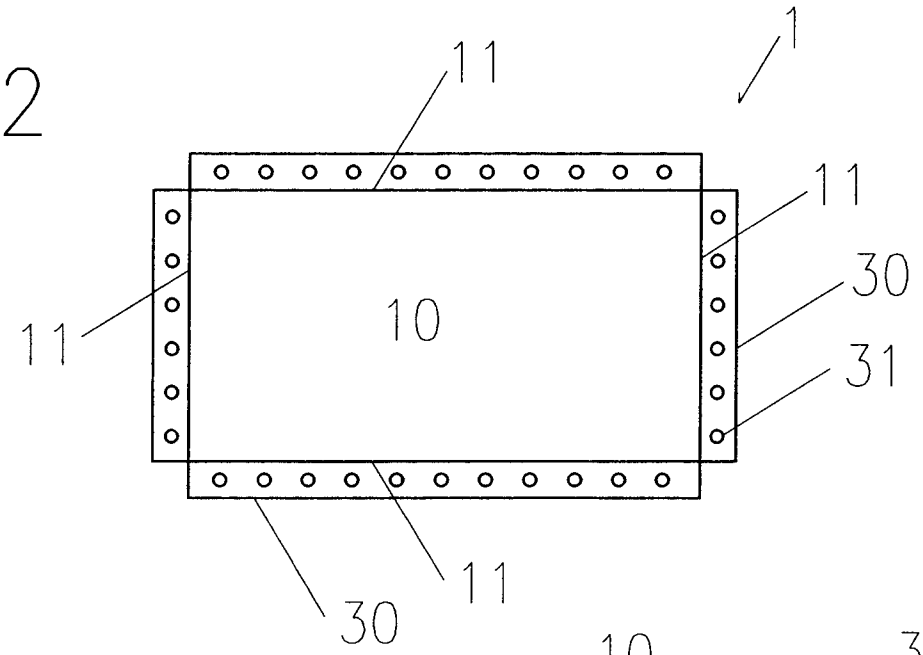


FIG.3

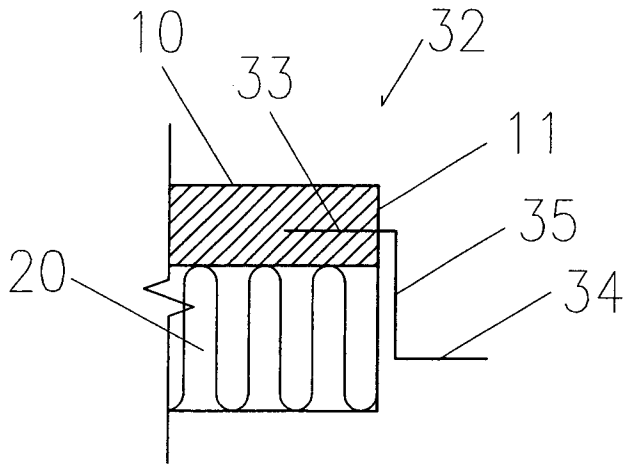


FIG.4

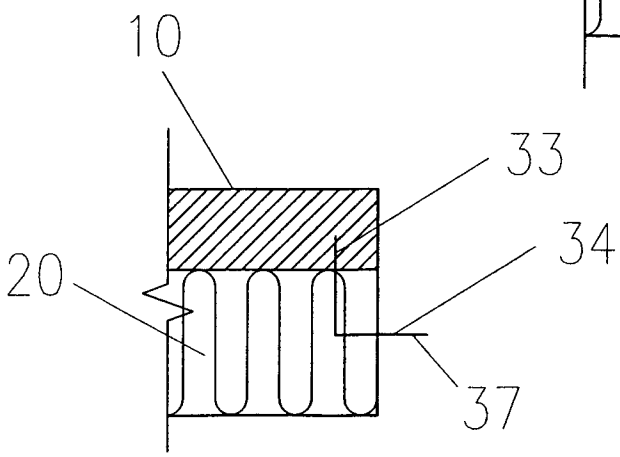


FIG.5

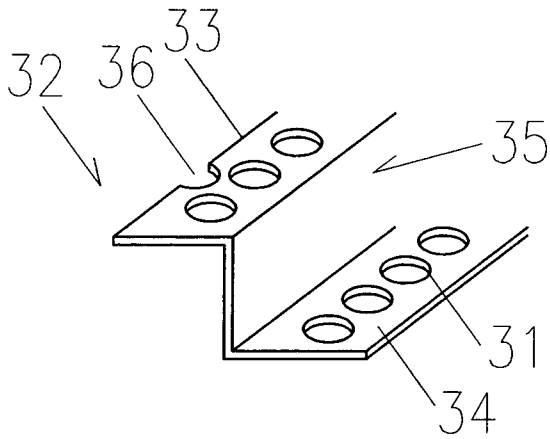


FIG.6

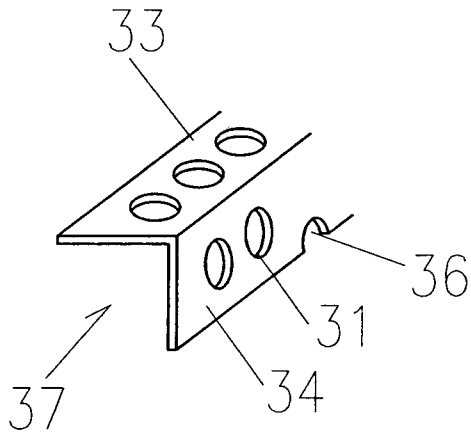


FIG.7

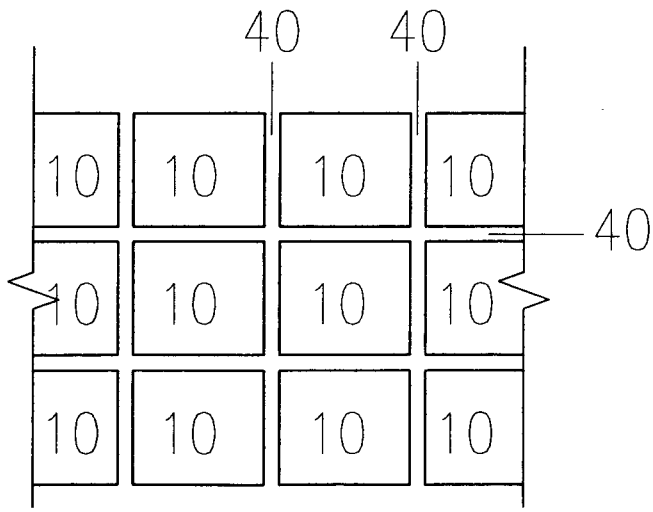


FIG.8

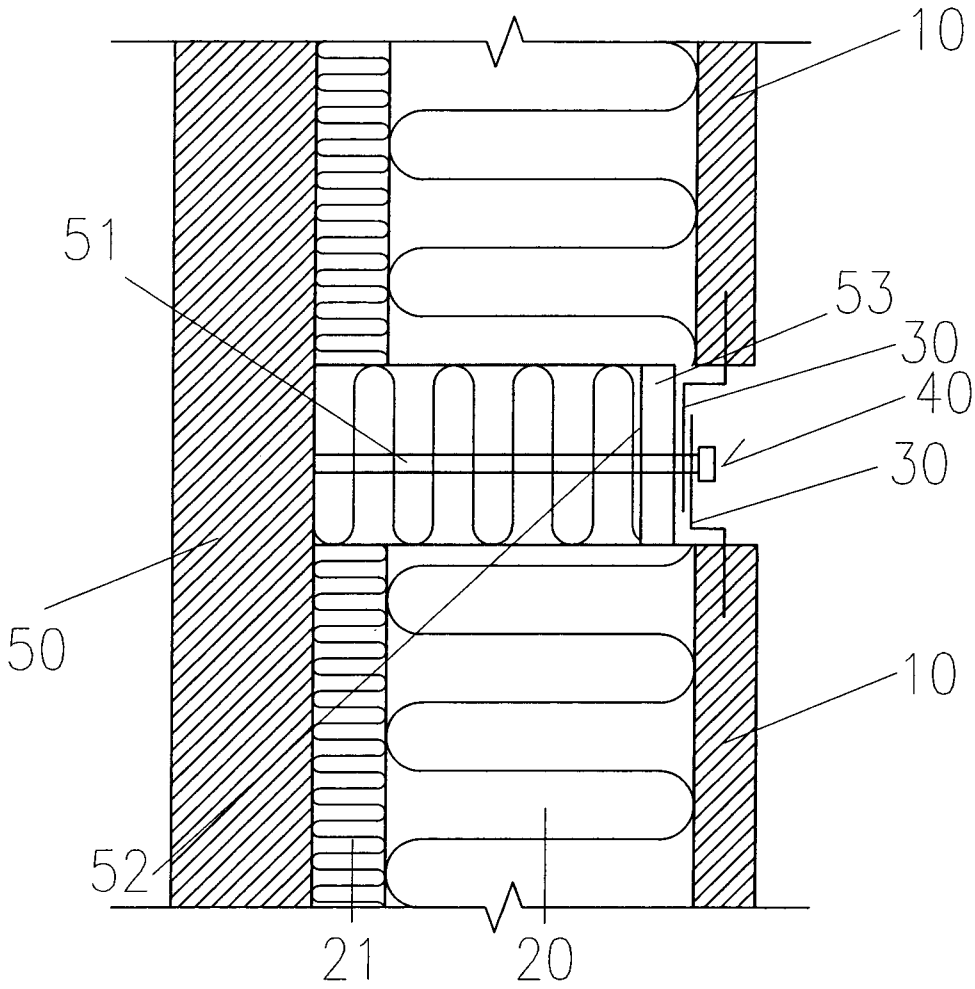


FIG.9

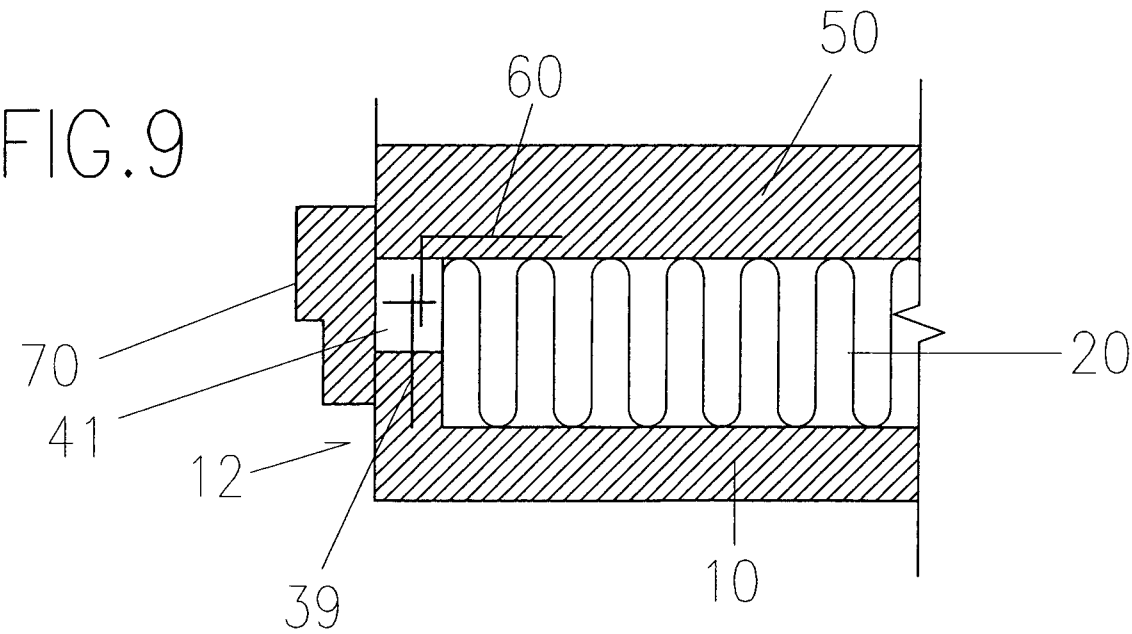


FIG.10

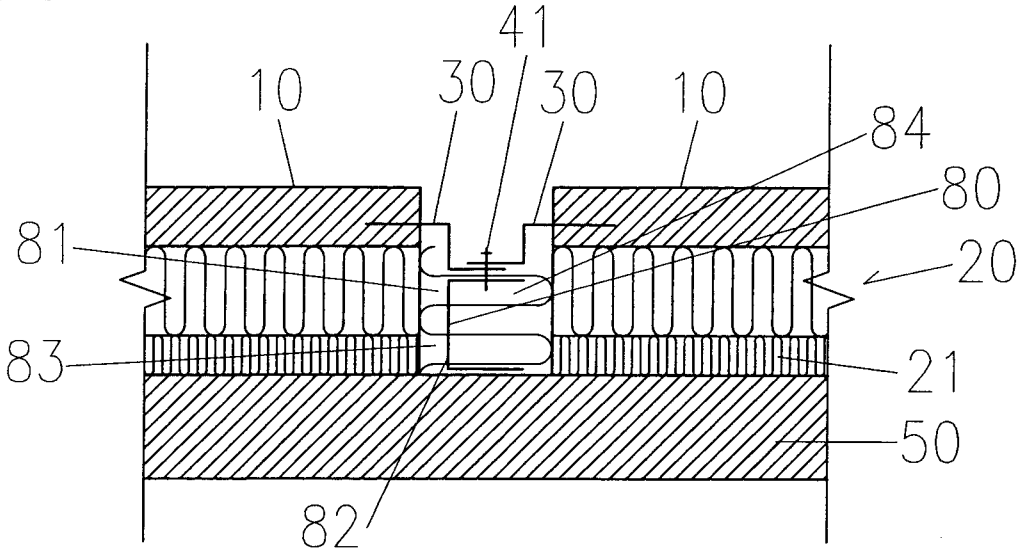


FIG.11

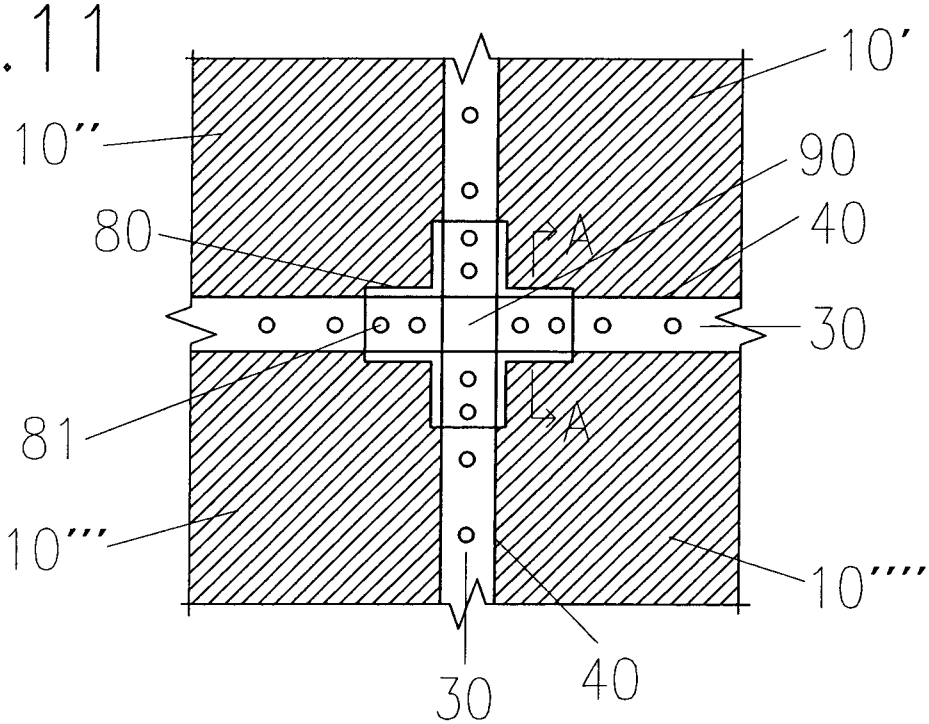


FIG.12

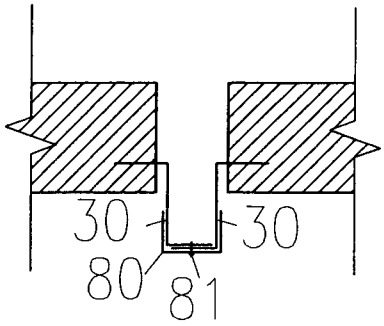


FIG.13a

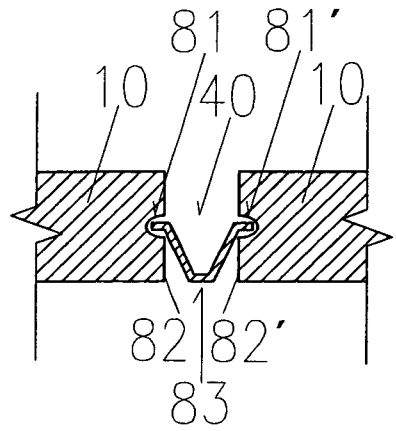


FIG.13b

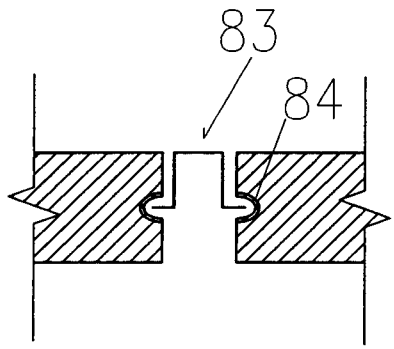


FIG.13c

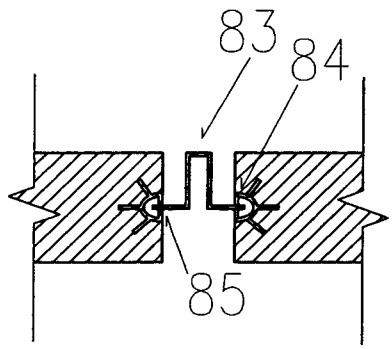


FIG.13d

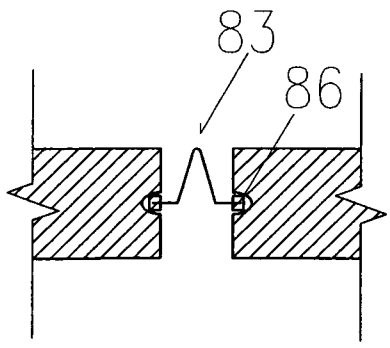
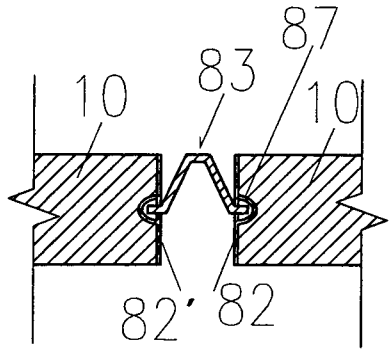


FIG.13e



INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2011/050372

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04C2/288 E04C2/38 E04B1/68
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04C E04B E04F

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2008/006034 A2 (OLDCASTLE PRECAST INC [US]; BUI THUAN [US]; MESSENGER HAROLD G [US]) 10 January 2008 (2008-01-10) page 19, line 5 - page 23, line 23; figures 7,8,8a,8b	1-13
Y	DE 299 20 485 U1 (SCHWOERER HAUS GMBH & CO [DE]) 27 January 2000 (2000-01-27) page 4, paragraph 5 - page 5, paragraph 5; figure 1	1-10
Y	WO 93/25778 A1 (BAECKMAN BYGG AB S [SE]; BAECKMAN STURE [SE]; ERIKSSON STURE [SE]; MIL) 23 December 1993 (1993-12-23) page 5, line 29 - page 6, line 7; claims 1, 3	1-13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 December 2011	02/01/2012

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

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2011/050372

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	EP 0 054 747 A1 (KOBER AG [CH]) 30 June 1982 (1982-06-30) abstract; figures 1-8	9
Y	FR 2 540 911 A1 (MORILLON CORVOL COURBOT ENTR [FR]) 17 August 1984 (1984-08-17) abstract; figures 1-4	9
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