

CEMENT MORTAR PANEL WITH PRESTRESSED BIAXIAL REINFORCEMENT
AND PROCESS FOR THE PRODUCTION THEREOF

DESCRIPTION

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Object of the Invention

The present invention relates, as indicated in the title thereof, to a cement mortar panel with prestressed biaxial reinforcement, as well as to the manufacturing process thereof, which more precisely relates to a panel of the type prefabricated from cement mortar which, in the construction of buildings, is designed to close openings in the structure of a building, both the external openings, in which case the visible face thereof is textured to form the facade, and the internal openings, in which case no texture is needed on its visible face, which delimit the internal courtyards of the building.

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State of the Art

The present applicant is holder of patents ES 2 220 189, US 6,857,241, utility models ES 1 041 896, ES 1 045 543, ES 1 057 874 and ES 1 057 875 and of patent applications EP 1 203 850 and WO0104433.

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All the above mentioned patents and regional and international patent applications disclose the process and/or means for the manufacture of a lightweight panel made with cement mortar which is for closing the openings in the structure of a building to form the external and internal facades thereof. The panel is of reduced thickness in the range of 2 to 6 cms and has a prestressed biaxial reinforcement.

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The panel is provided inserted in the mass thereof and extending out from the hidden face thereof with shaped means for anchorage to the structure of the building. The means preferably are formed by lengths of straight omega section galvanized steel sections.

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The said omega type section lengths inserted in the mass of the panel have the drawback that, apart from the operation of insertion of the said omega shaped sections in the mortar and consequently the operation of

maintaining them stable therein until the time when the mass of mortar is sufficiently hard at the onset of setting of the mortar to be able to rely on the stability of said omega shaped lengths being delicate and rather laborious, the fact that said omega shaped lengths project out from the hidden face of the panel causes problems of space in transportation and storage, without excluding the risk of scratches that may be caused in such situations on the visible faces thereof.

Description of the Invention

In order to overcome the abovementioned drawback, the solution has been adopted of providing the panel itself with versatile operating means allowing versatile operations to be performed therewith, either for carrying out, in principle, handling and transportation operations of, finally, for installation and anchorage thereof in the building structure.

According to the first aspect of the present invention, there is provided a cement mortar panel with prestressed biaxial reinforcement, especially a panel of the type prefabricated with cement mortar which, in the construction of buildings, is for closing openings in a building structure, both the external openings, in which case the visible face thereof is textured to form the facade, and the internal openings, which delimit the patios of the building, wherein it is formed by a slab of cement mortar having a thickness ranging from 2 to 7 cms and including a prestressed biaxial reinforcement. The reinforcement is formed by two series of prestressed cables or rods. The cables or rods are parallel and equidistant within one same series and cross each other orthogonally without being attached to one another to form a grid. The cement mortar slab is provided with means for versatile operating on the panel assembly allowing it to be handled and/or attached to the structure of a building. The said versatile operating means are completely disposed within in the mass of the cement mortar, without extending from any of the surfaces thereof and are inserted in some of the spaces in the grid. At the same time they themselves form, on one part, means for retention thereof in the set mass of the cement mortar and, on the opposite part, fixation means both for panel handling members and members for fixation thereof to the building structure.

One feature of the invention consists of the fact that the means for versatile operating on the cement mortar panel are embodied by plugs which are

inserted in the cement mortar mass prior to its setting and are located in the inner space of the grid formed by the biaxial reinforcement, in such a way that the retaining means thereof are housed in said cement mortar mass under the prestressed reinforcement without extending to the visible face of the panel, while the anchoring means both for panel handling members and members for the fixation thereof to the building structure have the end portion thereof flush with the surface of the hidden face of the panel.

One alternative to the foregoing feature is constituted by the possibility that the means for versatile operating on the cement mortar panel are embodied by holes made in the cement mortar mass during or after the setting thereof and situated in the inner space of the reinforcement grid, in which appropriate versatile operating means are anchored or there are provided panel handling members and/or members for fixation to the building structure which are successively directly inserted in said holes.

Further features of the invention related to the implementation of the versatile operating means in the form of a plug inserted in the mass of the panel are established by the following facts:

a – the plug forming the panel versatile operating means consists of a short thick body having at one end the means for retaining it within the set mortar, while the rest forms the anchoring means.

b – the plug forming the versatile operating means is formed by a body made from a material selected from the group comprising metals, synthetic and man-made plastics, ceramic materials, cement mortars and hydraulic cements.

c – the retaining means provided in the plugs are formed by one or more shoulders extending radially from an end perimetrical portion with which the corresponding end of the plug body is limited, preferably in form of a flange.

d – the radially extending shoulder forming the retaining means is provided with arrangements of the group comprising slots and holes for the passage of at least one of the reinforcements.

e – the anchoring means provided in the plug are formed by a deep axial blind hole which is provided with internal reliefs and opens in a centre of a flat annular end surface which limits the correspond end of the plug body

and which is flush with the hidden face of the panel, the internal reliefs provided in said deep axial blind hole being formed by reliefs of the group comprising screw threads, bayonet fittings and barbed surfaces.

5 A further feature of the invention is constituted by the fact that the anchoring means of the plug are temporally complemented by handling members which are insertable, preferably threadedly, in the deep axial blind hole thereof and which, in their inserted position project beyond the surface of the flat annular end surface limiting the corresponding end of the plug body, with a threaded end portion.

10 A further feature of the invention lies in the fact that the handling member temporally engageable in the deep axial blind hole of the plug anchoring means consists of a holding rod which is provided at one end thereof with a portion complementary to the anchoring means and which is preferably threaded and, at the other end comprises a gripping portion which is
15 complementary to an automatic gripping device which allows for handling of the panel.

A further feature of the invention resides in the fact that the member for final fixation of the panel in the building structure, while remaining operable, has one end inserted in the deep axial blind hole of the plug anchoring
20 means and another end, opposite the former, forming a threaded portion which extends from the hidden face of the panel and passes through a polygonal plate. This plate forms, on one of its sides, the seat thereof in a cradle of the building structure, at the same time as it is associated with positioning means thereof on said threaded portion allowing it to be firmly
25 located at any point along said threaded portion to adjust the distance of the panel from the building structure.

A further feature of the invention, directly associated with the foregoing one, lies in the fact that the building structure, in which the cement mortar panel with prestressed biaxial reinforcement is installed, comprises cross member
30 sections which, horizontally fixedly attached to uprights at one of their sides, have the opposite end to the fixed one overhanging and forming an upwardly open channeled cradle, which forms a seat for the polygonal plate

incorporated in the fixation members inserted in the anchoring means of the versatile operating means.

Further features of the invention, which are associated with the foregoing two, consist of the means for positioning the polygonal plate on the threaded portion of the fixation member may be formed by arrangements of the group comprising a threaded sleeve which, being fixedly attached to the polygonal plate, rotates along said threaded portion of the fixation member or a through hole in the polygonal plate for said threaded portion in cooperation with two nuts, one on each side of the polygonal plate which rotate along said threaded portion in the sense of positioning and fixing it at a point at a set distance from the building structure.

Yet another feature of the invention is constituted by the fact that the polygonal plate forming the positioning means is seated at one of its edges on the lower side of a C-shaped section horizontally installed in the structure, at the same time as the threaded portion of the fixation member, which extends from the panel and is attached to said polygonal plate, crosses through the open space formed lengthwise between the two flanges of the said C-shaped section. In this case, the dimension of the C-shaped section is narrower than the vertical dimension of the polygonal plate in its seated position therein, while having at its upper side on the upper flange, opposite to the side on which the polygonal plate is seated, passage gaps dimensioned for the vertical insertion of the polygonal plates mounted in the panels. The purpose of this is that in the final installed position of the panel the polygonal plates are situated at points of the C-shaped section where there are no passage gaps.

A further alternative feature of the foregoing lies in the fact that the member for final fixation of the panel in the building structure, while remaining operable, consists of a screw which, retained in the building structure, may be screwed into a screw thread provided in the deep axial blind hole of the anchoring means of the plug inserted in the panel.

A further feature of the invention, associated with the handling members, consists of the fact that the said handling members formed by the support rods, at the same time as they are fixed in the axial blind holes of the plug

bodies forming the anchoring means, retain a closure plate which with its Teflon-coated active surface engages the flat annular end surfaces of the plug bodies and the mortar surface forming the hidden face of the panel, encapsulating the mold.

A further feature of the invention is constituted by the fact that each of the automatic gripping devices consists of a mechanism which is of the type driven by means selected from the group formed by electric, pneumatic and hydraulic means and is provided with gripping means which are complementary to the gripping portion of the handling members. A plurality of these automatic gripping devices is incorporated in a horizontal frame which is provided with vertical movement and spacers which limit its seating on the mold while they are located in the frame in accordance with the positioning contemplated for the insertion of the plugs in the fresh mass of the cement mortar which will form the panel.

A further feature of the invention lies in the fact that the surface of the mold on which the cement mortar mass for forming the visible face of the panel rests comprises a bottom wall which is formed by a Teflon-coated sheet which may be provided with a defined pattern on its surface and side walls against which the said mortar mass must be applied to form the edges of the panel and which are formed by Teflon-coated plates having no defined pattern.

According to the second aspect of the present invention, there is provided a process for the manufacture of a panel with prestressed biaxial reinforcement, precisely one molded preferably from a cement mortar, wherein, having metal molds which, being substantially flat, are constituted by a bottom wall and side molding walls and a closure cover, comprises the following process steps:

- a. providing in each of the molds a biaxially stressed reinforcement formed by two series of steel cables or rods, in each of which the cables or rods are coplanar, parallel and equidistant with one another, with the orthogonal superpositioning thereof forming a grid.
- b. pouring a mass of cement mortar in the mold and leveling its thickness.

- c. inserting in spaces of the grid a plurality of plugs, as the versatile operating means which, after the mortar has set, are provided with panel handling and/or fixation members.
- d. closing the upper surface of the mold with a mold encapsulating cover.
- e. transferring the closed mold to a modular tunnel kiln in which the mortar is pre-cured.
- f. progressively removing the molds from the tunnel kiln and stripping the pre-cured panel from each of them.
- g. post-curing the pre-cured panels, and
- h. quality control and trimming the external portions of the reinforcements.

Further features of the process of the invention consist of the following conditions:

- i. the pre-curing step in the modular tunnel kiln is effected by maintaining the mold with the mortar, the reinforcement and the versatile plugs at a temperature of 50°C for 7 hours.
- ii. the post-curing step in modular tunnel kiln is effected by maintaining the pre-cured panel at a temperature of 50°C and humidity of 95% for 48 hours.
- iii. The bottom wall, the side walls and the mold closure cover are coated with a layer of Teflon on their surfaces which contact with the cement mortar mass.

Brief description of the drawings

To facilitate the understanding of the foregoing ideas, there are described hereinbelow some preferred embodiments of the object of the invention, wherein there are brought together the manufacturing process and the product thereby produced, consisting of a cement mortar panel with prestressed biaxial reinforcement, with reference to the accompanying drawings which, in view of their merely illustrative nature, do not affect the scope of the invention. In the drawings:

Figure 1 is a cross sectional view of a portion of a cement mortar panel with prestressed biaxial reinforcement, showing one of the versatile operating means of the invention.

Figure 2 is a schematic view of the distribution of the versatile operating means in a cement mortar panel with prestressed biaxial reinforcement relative to said prestressed biaxial reinforcement.

Figure 3 is partly sectional elevation view of a plug forming one
5 embodiment of the versatile operating means which, according to the invention, have been adopted for the handling and attachment of a cement mortar panel with prestressed biaxial reinforcement to a building structure.

Figure 4 is a side elevation view of an embodiment of a handling member
10 for the cement mortar panel with prestressed biaxial reinforcement which, in engagement with the versatile operating means, allows the handling and installation of said mortar panel with prestressed biaxial reinforcement during its manufacture and attachment to the resistant structure of a building.

Figure 5 is a partly sectional elevation view of the plug according to the
15 embodiment of the versatile operating means shown in Figure 3 after it has been occluded in a cement mortar panel with prestressed biaxial reinforcement and the embodiment of the handling member shown in Figure 4 has been engaged therewith.

Figure 6 is a sectional view of an anchoring point of a cement mortar panel
20 with prestressed biaxial reinforcement in a metal section of a resistant structure of a building.

Figure 7 is a partly sectional elevation view of an embodiment of a member
25 for final fixation of a panel to the building structure which is formed by a polygonal plate and includes positioning means therefor constituted by two nuts.

Figure 8 is a partly sectional elevation view of a detail of another
embodiment of a member for final fixation of a panel to the building structure which is formed by a polygonal plate and includes positioning means therefor constituted by a threaded sleeve.

30 Figure 9 is a schematic view of a group of members allowing for handling of the cement mortar panel with prestressed biaxial reinforcement both in its preparation and molding process and in the removal thereof from the mold.

Figure 10, similarly to the previous figure, shows the group of members accompanied by certain details situated in functional parts of some of them.

Figure 11 is a top plan view of the arrangement of the members of Figures 10 and 11 in an operative frame.

5 Figure 12 shows, like the cases of Figures 10 and 11, a specific embodiment of an automatic gripping device which allows action to be taken on the versatile operating means in the handling of the cement mortar panel with prestressed biaxial reinforcement.

Figure 13 is a partly sectional view of a detail of the assembly of a panel in
10 a C-shaped section of the structure of a building by way of fixation means formed by a polygonal plate which is associated with a plug having an open passage for one of the biaxial reinforcement members.

Figure 14 shows, like the previous case, the members included in Figure 13, with the exception that the plug has an enclosed passage for one of the
15 biaxial reinforcement members.

Figure 15 is a perspective view of a detail of a building structure in which the horizontal support section for the panels is formed by a C-shaped section having gaps for vertical insertion of the polygonal plates of the fixation means.

20 Figure 16 is a top elevation view of a C-shaped section having gaps in which; at the left hand side, a panel has been installed while at the right hand side a panel is shown in the process of insertion of the polygonal plates.

Figure 17 is a schematic view of the layout of the manufacturing means for
25 the cement mortar panels of the invention according to their location in a hypothetical industrial plant for their preparation.

Description of an embodiment of the invention.

Figure 1 shows a small fragment of a panel 1 of cement mortar with
30 prestressed biaxial reinforcement 2 incorporating versatile operating means therefor in a building structure which means are formed, in a preferred embodiment, by a plug 3 which is located in said panel 1 as shown in

Figure 2, where the arrangement thereof in the grid formed by the prestressed biaxial reinforcements 2 is shown.

Figure 3 shows in detail a preferred embodiment of the versatile operating means of the panel 1 which are formed by said plug 3. This consists of a short, thick body portion 4 having at one end retaining means 5 for retaining it in the hardened mortar of the panel 1. The retaining means 5 are formed by an outwardly extending polygonal shoulder of star or other shape and, in the present case having the form of a flange, while in the rest of the body portion 4 there are the anchoring means 6 formed by a deep axial blind hole 7, having internal reliefs 8 and which opens out axially and centrally of a flat annular end surface 9 which limits the corresponding end of the body portion 4 of the plug 3 and lies flush with the hidden face of the panel 1, without projecting therefrom, as shown in Figure 1.

With regard to the above mentioned versatile operating means for the panel 1, the retaining means 5, as shown in Figure 5, are housed in the mortar mass before it hardens and within the grid formed by the prestressed biaxial reinforcements 2, under said reinforcements and without reaching the visible face 10 of the panel 1, while the anchoring means 6 to a building structure have a portion thereof formed by the flat annular end surface 9 which lies flush with the hidden face 11 of the panel 1.

The internal reliefs 8 provided in the deep axial blind hole 7 of the plugs 3 forming the anchoring means 6 are of the group comprising screw threads such as those shown in Figure 3, bayonet fittings and barbed surfaces, not shown in the drawings.

As shown in Figures 4 and 5, the anchoring means of the plugs 3 are complemented by handling members 12 which may be engaged with the deep axial blind hole 7 thereof and project outwardly in the fixed position thereof from the surface of the flat annular end surface 9 limiting the corresponding end of the body portion 4 of the plug 3.

One possible embodiment of the said handling member 12 consists of an anchoring rod 13 which is provided at one end thereof with an anchoring portion 14 which is complementary to the anchoring means 6 of the plug 3,

and at the other end it comprises a gripping arrangement 15 with which an automatic gripping device 16 may engage as shown in Figure 9.

According to a first stage of use of the versatile operating means embodied by the plug 3, the handling member 12 may be screwed in the screw thread 8 of the deep axial blind hole 7 of said plug 3 and consists of a support rod 13 which, as shown
5 in Figures 4 and 5, has at one end a fixation portion 14, which in this case is threaded and complementary to the said screw thread 8 of the plug 3 and at the other end it comprises a gripping arrangement 15, formed by a throat 17 and a chamfer 18, with which the automatic gripping device 16 may engage.

10 In a second, and normally definitive, stage of use of the said versatile operating means embodied by the plug 3, as shown in Figure 6, the handling member 12 engageable with the deep axial blind hole 7 of a plug 3 is replaced by a fixation member which is of a type capable of being screwed into the screw thread 8 of said plug 3 and consists of a screw 19 for fixation of the panel 1 to a section 20 of
15 the building structure. The screw 19 may be accompanied by retaining washers or other security means.

In Figure 7 there is shown a preferred embodiment of a final fixation member 21 for the panel 1 to the structure of the building which, while remaining removable, has one end 23 inserted in the deep axial blind hole 7 of the anchoring means 6 of the
20 plug 3 and the other end 24, opposite to the former, forming a threaded portion which projects from the hidden face 11 of the panel 1 and passes through a polygonal plate 25 which forms the seat therefor in the building structure.

The building structure is formed mainly by transverse sections 26 which are fixedly attached horizontally to uprights 27 by one of their edges 28f while at their opposite
25 edge they form an upwardly open channel-shaped cradle 29. Such cradle 29 forms a seat for one edge 30 of the polygonal plate 25 which is attached to the final fixation members 21 inserted in the anchoring means 6 of the versatile operating means formed by the plug 3.

The polygonal plate 25 is seated by the edge 30 of one of its sides in the cradle 29,
30 at the same time as it is associated with positioning means

therefor on said threaded portion of the end 24 allowing it to be fixedly located at any point along said threaded portion to adjust the distance from the panel 1 to the building structure 22 and thereby assure that the visible faces 10 of the facade panels are coplanar.

5 As shown in Figures 7 and 8, the positioning means for the polygonal plate 25 on the threaded portion of the end 24 of the final fixation member 21 are formed, as shown in Figure 7, by arrangements of the group comprising that of a through hole 31 in the polygonal plate 25 for the passage of said threaded portion of the end 24 in cooperation with two nuts 32 and 33, one
10 on each side of the polygonal plate 25 and which are rotatably moved along said threaded portion of the end 24 in the sense of locating and fixing the plate in a point at a certain distance from the building structure 22, while in Figure 8, the said positioning means are formed by a threaded sleeve 34 which is integral with the polygonal plate 25 and is rotatably moved along
15 said threaded portion of the end 24 of the final fixation member 21.

In Figure 9 there is shown the positioning of the automatic gripping device 16 relative to: a mobile support frame 35; the handling members 12, formed by the support rods 13 after being fixed in the axial blind holes 7 of the body portions 4 of the plugs 3; the panel 1, with the prestressed biaxial reinforcement 2; a Teflon-coated base plate 36 of the mold which, having a
20 visible texture appropriate for a facade forms the visible face 10 of the panel 1, with the mold holder 37; and the fact that it retains together with the said body portions 4 of the plugs 3 a closure plate 38 whose contact surface with the said body portions 4 of the plugs 3 and with the mortar of
25 the hidden face 11 of the panel 1 is Teflon-coated.

As shown in Figure 10, walls 39 or surfaces of the sides of the mold against which the mortar mass for forming the edges of the panel 1 must be applied, like the Teflon-coated bottom wall 36 and closure 38 plates, are formed by Teflon-coated plates through which the prestressed biaxial
30 reinforcements pass. The latter are stressed by hydraulic devices 40 mounted on the mold holder 37 which, in turn, is located on rotary rollers 41.

In Figure 11 there is shown a possible embodiment of support for the horizontal mobile frame 35 capable of vertical movement and provided with a plurality of automatic gripping devices 16 which are situated in accordance with the positioning contemplated for the plugs 3 in the panel 1.

5 Figure 12, which is substantially similar to Figures 9 and 10, shows that the mobile support frame 35 for the automatic gripping devices 16 is provided with spacers 41 which limit its seating on the mold, at the same time as it shows one possibility of operation of one embodiment of an automatic gripping device 16 which is provided with an automatic gripping device 42
10 driven by the rod 43 of a piston 44 sliding in a fluid-operated cylinder 45.

In Figure 13 there is shown, on the one hand, a panel 1 with its biaxial reinforcements 2 and a plug 3, arranged relative to one another in such a way that one of the members 2A of the biaxial reinforcements 2 extends in a slot 46 provided in the head formed by the retaining means 5 of the plug
15 3 in the panel 1, while on the other hand it shows the assembly of a polygonal plate 25 to the final fixation member 21 and the seating thereof by its edge 30 in a C-shaped section 47 which is horizontally attached to an upright 27. The said C-shaped section has a base wall 48, a lower side 49 followed by a lower flange 50 and an upper side 51 followed by an upper
20 flange 52, there being between the lower flange 50 and the upper flange 52 an open longitudinal space 53 through which said fixation member 21 extends.

In Figure 14 there is shown the same members as in Figure 13, although the member 2A of the biaxial reinforcements 2 extends through a hole 54
25 diametrically formed in the head forming the retaining means 5 of the plug 3 in the panel 1. It will be seen in both figures that a member 2B of the biaxial reinforcements 2 perpendicular to the member 2A extends in the vicinity of said head without engaging it. Nevertheless, it is contemplated that said member 2B also may engage said head, either along a slot perpendicular
30 to the slot 46 provided for the member 2A, or through a hole perpendicular to the hole 54 for the member 2A.

In Figure 15 there is to be seen an upright 27 and a C-shaped section 47 horizontally attached to the upright 27. The C-shaped section 47 has

passage gaps 54 which affect portions adjoining the upper side 51 and the upper flange 52 and which are dimensioned to allow the vertical insertion of the polygonal plates 25A and 25D for final fixation of the panels 1. These polygonal plates 25A and 25B have been shown in the drawings as independent from the panels to facilitate the understanding of said passage gaps 54.

In the foregoing figure it is to be noted that the polygonal plate 25A is capable of being inserted vertically in the C-shaped section 47 thanks to the passage gap 54 to reach the position shown in phantom line of the polygonal plate 25C, after which this polygonal plate 25C is moved to the left of the drawing to reach the position of the polygonal plate 25A. In this position the polygonal plate 25A can no longer move vertically, thereby ensuring the positioning of the panel 1.

In Figure 16 there is shown the final positioning of a panel 1A, in which its polygonal plates 25A are blocked in the C-shaped section 47 and spaced from the passage gaps 54, while the panel 1B is being inserted in the C-shaped section 47, prior to being moved to abut panel 1A.

The manufacturing process of the present cement mortar panel with prestressed biaxial reinforcement is achieved by molding of the cement mortar in metal molds which may be arranged with one of the major dimensions thereof in a vertical position or with the two major dimensions in a horizontal position. The horizontal position is preferably adopted for the manufacture of flat surfaced panels and the vertical position for the manufacture of panels having a curved, irregular or mixed surface.

The appropriate molds for the said molding operation are made from metallic materials, especially steel, and are formed by a lower base plate for making the visible face of the panel, side walls for forming the panel edges and a closure cover for encapsulating the mold to avoid evaporation of the water from the mortar in the setting stage.

The metal base plate may be smooth and support a sheet of synthetic or other material with an ornamental texture to embellish the visible face of the panel, or, this metal base plate may be directly provided with the said

ornamental texture. In all cases, it is highly desirable that the active surface of the plate is covered with a coating of Teflon.

In turn, the side walls and the closure cover have no type of texture, since the surfaces molded by them are hidden in the building, but it is desirable
5 that their active surfaces which contact the cement mortar or are facing it are covered with a layer of Teflon.

Complementarily, the molds will be mounted in mold holder frames which incorporate the prestressing means for the biaxial reinforcement which will be hidden in the cement mortar mass of the panel, forming an assembly
10 which is moved for insertion in the tunnels for pre-curing and post-curing the cement mortar and for stripping the panel from the mold after the mortar has set.

With the molds as succinctly described above, the steps of the process of the invention for the manufacture of the cement mortar panels with
15 prestressed biaxial reinforcement are as listed below and shown in Figure 17:

- a. – placing in each of the molds A a biaxially stressed reinforcement formed by two series of steel cables or rods, in each of which series the cables or rods are coplanar, parallel and equidistant one from another, with
20 the orthogonal overlaying of them forming a grid.
- b.– pouring a mass of cement mortar A1 in the mold and leveling the thickness.
- c. – inserting in spaces of the grid A2, as versatile operating means, a plurality of plugs which, once the cement mortar has set, are provided
25 either with handling members or panel fixation members.
- d. – closing the upper surface of the mold A3 with a mold encapsulating cover to avoid evaporation of the water from the cement mortar during the pre-curing and post-curing steps of the set mortar.
- e- transferring the closed mold to a modular tunnel kiln B in which the
30 cement mortar is pre-cured.
- f. – progressively removing the molds from the tunnel kiln B, mold stripping C of the panel pre-cured in each of them and cleaning D of the molds for reuse.

- g. – post-curing of the pre-cured panels in tunnel kilns E and
- h. – quality control F and trimming the external portions of the prestressed biaxial reinforcement.
- i. – drying in store G, surface H, cleaning I and painting J.

- 5 The pre-curing step in modular tunnel kiln is effected by holding the mold with the cement mortar, the reinforcement and the plugs of the versatile operating means at a temperature of 50°C for 7 hours, while the post-curing step in modular tunnel kiln is effected by holding the panel stripped from the mold at the end of pre-curing at a temperature of 50°C and 95% humidity
- 10 for 48 hours.

CLAIMS

- 1.- A cement mortar panel with prestressed biaxial reinforcement , especially a panel of the type prefabricated with cement mortar which, in the construction of buildings, is for closing openings in a building structure, both the external openings, in which case the visible face thereof is textured to form the facade, and the internal openings, which delimit the patios of the building, wherein it is formed by a slab of cement mortar which, having a thickness ranging from 2 to 7 cms, includes a prestressed biaxial reinforcement, which is formed by two series of prestressed cables or rods which are parallel and equidistant within one same series and cross each other orthogonally without being attached to one another to form a grid, wherein the cement mortar slab is provided with means for versatile operating on the panel assembly allowing it to be handled and/or attached to the structure of a building, which versatile operating means are completely disposed within in the mass of the cement mortar and are inserted in some of the spaces in the grid, at the same time as they themselves form, on one part, means for retention thereof in the set mass of the cement mortar and, on the opposite part, fixation means both for panel handling members and members for fixation thereof to the building structure.
- 2.- The cement mortar panel with prestressed biaxial reinforcement of claim 1, wherein the means for versatile operating on the cement mortar panel are embodied by plugs which are configured to be inserted in the mass of cement mortar before setting and are configured to be located in the inner space of the grid formed by the biaxial reinforcement in such a way that their retaining means are housed in said cement mortar mass below the prestressed reinforcement and without extending to the visible face of the panel, while the anchoring means for panel handling means and/or members for fixation of the panel to the structure of a building have the end portion thereof flush with the surface of the hidden face of the panel.

3.- The cement mortar panel with prestressed biaxial reinforcement of claim 1, wherein the means for versatile operating on the cement mortar panel are embodied by holes made in the cement mortar mass during or after the setting thereof and are configured to be situated in the inner space of the reinforcement
5 grid, in which panel handling members or members for fixation to the building structure are anchored.

4.- The cement mortar panel with prestressed biaxial reinforcement of claim 2, wherein the plug forming the means for versatile operating on the panel consists of a short thick body having at one end the means for retaining it in the set mortar,
10 while the rest forms the anchoring means.

5.- The cement mortar panel with prestressed biaxial reinforcement of claim 2, wherein the plug forming the versatile operating means is formed by a body made from a material of the group comprising metals, synthetic and man-made plastics, ceramics, cement mortars and hydraulic cements.

15 6.- The cement mortar panel with prestressed biaxial reinforcement of claim 2, wherein the retaining means provided in the plugs are formed by one or more shoulders extending radially outwards from a perimetrical end portion with which the corresponding end of the plug body is limited.

7.- The cement mortar panel with prestressed biaxial reinforcement of claim 2,
20 wherein the anchoring means provided in the plug are formed by a deep axial blind hole which is provided with internal reliefs and opens in a centre of a flat annular end surface which limits the corresponding end of the plug body and which is flush with the hidden face of the panel.

8.- The cement mortar panel with prestressed biaxial reinforcement of claim 2
25 wherein the plug retaining means are formed by a radially extending shoulder which is formed as a flange.

9.- The cement mortar panel with prestressed biaxial reinforcement of claim 8, wherein the radially extending shoulder forming the

retaining means is provided with arrangements for the passage of at least one of the reinforcements belonging to the group formed by slots and holes.

10.- The cement mortar panel with prestressed biaxial reinforcement of claim 7, wherein the anchoring means formed by the internal reliefs provided in the deep axial blind hole of the plug are reliefs of the group formed by screw threads, bayonet fittings and barbed surfaces.

11.- The cement mortar panel with prestressed biaxial reinforcement of claim 10, wherein the plug anchoring means are temporally complemented by handling members which are configured to be insertable in the deep axial blind hole thereof and which, in their inserted position, project beyond the surface of the flat annular end surface limiting the corresponding end of the plug body, with a threaded end portion.

12.- The cement mortar panel with prestressed biaxial reinforcement of claim 10, wherein the plug anchoring means are temporally complemented by handling members which are configured to be insertable in a screw thread provided in the deep axial blind hole and in their inserted position, project beyond the surface of the flat annular end surface limiting the corresponding end of the plug body, with a threaded end portion.

13.- The cement mortar panel with prestressed biaxial reinforcement of claim 11, wherein the handling member, which is configured to be temporally connectable to the deep axial blind hole of the plug anchoring means, consists of a retaining rod which is provided at one end thereof with a portion complementary to the anchoring means and, at the other end comprises a gripping portion which is complementary to an automatic gripping device.

14.- The cement mortar panel with prestressed biaxial reinforcement of claim 11, wherein the handling member is configured to be temporally insertable in the screw thread of the deep axial blind hole of the plug anchoring means and consists of a retaining rod which is provided at one end thereof with a threaded portion complementary to said screw thread and, at the other end comprises a gripping portion which is complementary to an automatic gripping device.

15.- The cement mortar panel with prestressed biaxial reinforcement of claim 2, wherein the member for final fixation of the panel in the building structure, while remaining operable, is configured to have one end inserted in the deep axial blind hole of the plug anchoring means and another end, opposite the former, which
5 forms a threaded portion which extends from the hidden face of the panel and passes through a polygonal plate which forms, on one side thereof, the seat thereof in a cradle of the building structure, at the same time as it is associated with positioning means thereof on said threaded portion allowing it to be firmly located at any point along said threaded portion to adjust the distance of the panel
10 from the building structure.

16.- The cement mortar panel with prestressed biaxial reinforcement of claim 15, wherein the positioning means of the polygonal plate on the threaded portion of the fixation member are formed by arrangements of the group comprising that of a threaded sleeve which, being integral with the polygonal plate, is moved by rotation
15 along said threaded portion of the fixation member and that of a through hole in the polygonal plate for said threaded portion in cooperation with two nuts, one on either side of the polygonal plate which are moved by rotation along said threaded portion in the sense of situating and fixing the plate at a point a certain distance from the building structure.

20 17.- The cement mortar panel with prestressed biaxial reinforcement of claim 15, wherein the polygonal plate forming the positioning means is seated on one of its edges on the lower side of a C-shaped section horizontally installed in the structure, at the same time as the threaded portion of the fixation member, which extends from the panel and is attached to said polygonal plate, passes through the
25 open space formed longitudinally between the two flanges of the said C-shaped section.

18.- The cement mortar panel with prestressed biaxial reinforcement of claim 17, wherein the C-shaped section has a width smaller than the vertical dimension of the polygonal plate in the seated position of the latter therein.

- 19.- The cement mortar panel with prestressed biaxial reinforcement of claim 17, wherein the C-shaped section has on its upper side and on the upper flange, opposite to the polygonal plate seating side, passage gaps dimensioned for the vertical insertion of the polygonal plates mounted on the panels.
- 5 20.- The cement mortar panel with prestressed biaxial reinforcement of claim 19, wherein in the final installed position of the panel the polygonal plates are situated at points of the C-shaped section where no passage gap is open.
- 21.- The cement mortar panel with prestressed biaxial reinforcement of claim 12, wherein the member for final fixation of the panel to the building structure, while
10 remaining operable, consists of a screw which, retained in the building structure, is configured to be screwed in a screw thread provided in the deep axial blind hole of the anchoring means of the plug inserted in the panel.
- 22.- The cement mortar panel with prestressed biaxial reinforcement of claim 14, wherein the handling members formed by the support rods, at the same time
15 as they are fixed in the axial blind holes of the plug bodies forming the anchoring means, are configured to retain a closure plate having a Teflon-coated active surface with which it is configured to engage the flat annular end surfaces of the plug bodies and the surface of the mortar in the mold which is to form the hidden face of the panel, in order to encapsulate the mold.
- 20 23.- The cement mortar panel with prestressed biaxial reinforcement of claim 11, wherein each of the automatic gripping devices consists of a mechanism which, being one of the type driven by means of the group which comprises electric, pneumatic and hydraulic means, is provided with gripping means which are complementary to the gripping portion of the handling members.
- 25 24.- The cement mortar panel with prestressed biaxial reinforcement of claim 23, wherein a plurality of automatic gripping devices are incorporated in a horizontal frame which is provided with vertical movement and are located in it in accordance with the positioning contemplated for the

insertion of the plugs in the fresh mass of cement mortar which will form the panel.

25.- The cement mortar panel with prestressed biaxial reinforcement of claim 23, wherein the frame of the automatic gripping devices is provided with spacers configured for limiting its seating on the mold.

5 26.- The cement mortar panel with prestressed biaxial reinforcement of claim 15, wherein the building structure, in which the cement mortar panel with prestressed biaxial reinforcement is installed, comprises cross member sections which, horizontally fixedly attached to uprights at one of their sides, have the opposite side to the fixed one in cantilever and forming an upwardly open
10 channeled cradle, which forms a seat for the polygonal plate which is incorporated in the fixation members inserted in the anchoring means of the versatile operating means.

27.- The cement mortar panel with prestressed biaxial reinforcement of claim 2, wherein the visible face of the panel is configured to rest on the mold, the surface
15 of the mold comprising a bottom wall which is formed by a Teflon-coated sheet which may be provided with a defined pattern on its surface and side walls for forming the edges of the panel and which are formed by Teflon-coated plates.

28.- A process for the manufacture of a panel with prestressed biaxial reinforcement, precisely one molded preferably from a cement mortar, wherein,
20 having metal molds which, being substantially flat, are constituted by a bottom wall and side molding walls and a closure cover, comprises the following process steps:
a. providing in each of the molds a biaxially stressed reinforcement formed by two series of steel cables or rods, in each of which the cables or rods are coplanar, parallel and equidistant with one another, with the orthogonal superpositioning
25 thereof forming a grid.

b. pouring a mass of cement mortar in the mold and leveling its thickness.

c. inserting in spaces of the grid a plurality of plugs, as the versatile operating means which, after the mortar has set, are provided with panel handling and/or fixation members.

- d. closing the upper surface of the mold with a mold encapsulating cover.
 - e. transferring the closed mold to a modular tunnel kiln in which the mortar is pre-cured.
 - f. progressively removing the molds from the tunnel kiln and stripping the pre-cured
 - 5 panel from each of them.
 - g. post-curing the pre-cured panels and
 - h. quality control and trimming the external portions of the reinforcements.
- 29.- The process for the manufacture of a panel with prestressed biaxial reinforcement according to the previous claim, wherein the precuring step in
- 10 modular tunnel kiln is effected by maintaining the mold with the mortar, the reinforcement and the versatile plugs at a temperature of 50°C for 7 hours.
- 30.- The process for the manufacture of a panel with prestressed biaxial reinforcement of claim 28, wherein the post-curing step in modular tunnel kiln is effected by maintaining the pre-cured panel at a temperature of 50°C and humidity
- 15 of 95% for 48 hours.
- 31.- The process for the manufacture of a panel with prestressed biaxial reinforcement of claim 29, wherein the bottom wall, the side walls and the mold closure (encapsulating) cover are coated with a layer of Teflon on the surfaces thereof in contact with the cement mortar mass.