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STRUCTURAL ELEMENTS OF COMPRESSED CONCRETE, AND APPARATUS
FOR MAKING THEM.

The invention relates to concrete structural elements having a very high permissible working load, say at least 50-100 MPa (megapascals).

EP-A-0129480 which is cited under the provisions of article 54-3 of the Munich Convention describes technics for manufacturing concrete structural elements having a permissible working load in the range of 50-100 MPa (megapascals) or greater, wherein the concrete is compressed axially before setting under a pressure in the range 50-150 MPa in a tube surrounded by a hoop made of crossed wires which constitute at least two helical windings around the tube, these two windings having winding directions opposite to each other and fixed ends.

The tube and the hoop remain fixed to the concrete element and therefore it is very important that their cost be as low as possible.

According to the present invention, one uses a hoop whose wires constitute a tubular braid made of bands which are woven together in order to constitute helicals whose winding directions are opposite and which are embedded into a cured synthetic resin.

Examples of embodiments according to the invention will be disclosed hereafter, with reference to the schematic figures of the attached drawing in which :

- Figure 1 is a longitudinal section through a device usable for manufacturing a concrete element ;

- Figure 2 is an enlarged view of a portion of a hoop according to the invention ;

- Figure 3 is an enlarged view of another embodiment of hoop ;

5 - Figure 4 is a view of the element manufactured by means of the device according to figure 1, and

- Figure 5 is a view of a concrete cable made of elements according to the invention.

10 The device shown in figure 1 comprises a tubular casing 1 to be filled up with concrete and means for axially compressing the concrete before the concrete sets. Compressing means includes, for instance, two pressure plates 2,2' at ends of the casing and means for pushing or drawing the plates one towards the other one. The last means are, for instance, one or two jacks 3,3'. In a simple embodiment, one of the pressure plates is
15 fixed and the other one is movable and drawn or pushed towards the fixed plate. It is convenient to use a cable for drawing the plates on towards the other one.

20 Preferably one or several longitudinal tubes 5 are provided in the concrete, for instance, for draining water from the concrete, for the passage of cable 4 or for other uses.

25 According to the invention, the casing 1 is made of crossed wire webs embedded into a cured synthetic resin. The resin is a means for blocking the wires of the webs. In figure 2 is shown schematically a portion of such an embodiment wherein the hoop is made of two webs 6,7 or more which are crossed at about 90° to each other and which are helical windings whose winding directions are opposite.

Such a casing is easy to manufacture, for instance by using known processes for manufacturing plastics tube for high pressure (see, for instance French Patent N° 2 373 386).

30 Preferably during the manufacture, the wall of the tube is provided with small holes 8 for draining the water from the concrete during its compression.

It is obvious that such a tube which constitutes both the molding casing and the hoop is by far less expensive and much more simple than the device disclosed in the above publications which comprises a tube surrounded by a first hoop spiral wire, which is itself surrounded by a second hoop spiral wire.

5 Moreover the resin acts for protecting the hoop.

It is known to pour concrete in reinforced plastics casing (DE-A-2 300 209) but this prior art does not teach the use of a tubular casing, nor the use of a hoop, and does not teach axially compressing the concrete.

10 In figure 3 is shown a portion of a cylindric hoop made of two bands 9,10 which are woven together in order to provide spirals whose winding directions are opposite and which are crossed at about 90° and to provide windows 8' between the bands.

The bands are blocked relative to each other, at least at the ends of the tube, by adhesive means.

15 Such a hoop provides a double advantage : the hoop constitutes itself the moulding tube and the windows constituted the draining holes. Thus, this embodiment appears to be still more advantageous than the embodiment with resin tube having webs included in the wall of the tube.

20 In a peculiar embodiment, each band is made of two superposed ribbons and, at each crossing of the two bands, one ribbon of a band passes between the two ribbons of the other band.

25 The invention is neither limited to a peculiar angle of crossing of the wires, nor to a peculiar means (adhesive means, anchoring means, welding means,...) for blocking the wires at the ends of the tube or elsewhere and is not limited to the embodiments disclosed above.

As wires for making the hoop, steel wires or carbon wires are used preferably, for instance, wires having a diameter of 0.1 to 0.5 mm, or glass fibers.

30 For example, for making the braid, one uses ribbons of carbon fibers having a width of about 5 mm and a thickness of about 0.1 mm knitted together for constituting spirals crossed at 90° providing between them windows having a size of about 4 x 4 mm and the intervall between two adjacent windows being about 15 mm along a spiral.

For manufacturing a concrete element according to the invention, the resin tube or the braid is filled up with liquid concrete and the concrete is submitted to an axial pressure of at least 50 MPa before setting. The hoops stretch under the effect of the pressure of the concrete caused by the axial pressure and, when the concrete has set, the hoops try to resume their initial dimension, thereby exercising a biaxial compressing effect transverse with respect to the axis of the tube.

Since the mould used for manufacturing the elements is a mould which remains incorporated to the moulded element, it is peculiarly important that the manufacturing cost of this mould be as low as possible, which is obtained by the present invention.

The products moulded are especially characterized by the fact that the concrete constitutes a block of compressed concrete surrounded by a hoop constituted by a tubular braid 1 of intercrossed wires, specially such as described above in reference to figures 2 and 3, which exerts on the concrete a pressure in transverse planes.

For protecting the hoop against outside agents, it is advisable to cover the hoop with a protecting sheath 13 which may be useful even if the hoop is embedded in a resin.

The concrete elements according to the invention are useful as beams, posts and other rigid structural elements, and are particularly useful for making a concrete cable.

According to the invention, the cable (figure 5) is made of a line of cable sections M moulded according to the invention, the sections being assembled by a common prestressing cable 4, which pass longitudinally through the whole of the sections. Advantageously, such a prestressing cable is the cable used for compressing the concrete in the tube before setting and which passes through tubes 5.

A cable made of several concrete sections is known (FR-A-2 484 355 and 2 535 281) but the fabrication of the sections and the way of assembling the sections are quite different from the teachings of the present invention.

The common prestressing cable may be made advantageously of carbon fibers embedded in a hardened synthetic resin.

Typically, the diameter of the concrete cable is 15 to 20 cm, possibly more.

5 It is intended to manufacture thereby cables having a length of several kilometers and made of sections having a length of about 10 to 15 meters.

The invention allows more particularly to manufacture concrete cable for making anchoring lines, shrouds and cables for holding a bridge.

10 Such cables are useful for replacing steel cables used for anchoring offshore platforms. Usually these cables are made of steel tubes having a diameter of about 40 to 60 cm and a wall thickness of about 2 to 3 cm, said tubes being made from tube sections which are assembled by welding or by mechanical means and rolled up on a drum.

15 The concrete cable according to the invention may have at least the same performance as the steel cable but the diameter and the weight of the concrete cable are substantially smaller, and it is no more necessary to make the assembly by welding or mechanically. Further, since the concrete cable has a smaller diameter, the effect of the swell on the cable is substantially reduced. Moreover the concrete cable is much less subject to
20 corrosion.

Of course, the cable sections M may be separated by intermediary elements while being assembled still by the common prestressing cable.

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CLAIMS

1. Concrete structural elements comprising a block of compressed concrete surrounded by a tubular hoop which exerts on the concrete a compression effect in transverse planes, this hoop being made of crossed wires which constitute at least two helical windings around the tube, these two windings having winding directions opposite to each other, and which are fixed at least at the ends of the tubular hoop, characterized in that the wires of the hoop constitute a tubular braid made of bands (9,10) which are woven together in order to constitute helicals whose winding directions are opposite and which are embedded into a cured synthetic resin.
2. Concrete structural elements according to claim 1, characterized in that the bands (9,10) are crossed at about 90° to each other.
3. Concrete structural elements according to claim 1 or 2, characterized in that each band is made of two superposed ribbons and in that, at each crossing of the two bands, one ribbon of a band passes between the two ribbons of the other band.
4. Concrete structural elements according to any of claims 1 to 3, characterized in that the bands (9,10) are made of carbon fibers.
5. Concrete structural elements according to any of claims 1 to 4, characterized in that the hoop is surrounded by a protective sheathing (13).
6. Concrete structural elements according to any of claims 1 to 5, characterized in that the concrete block comprises at least a longitudinal passage (5).
7. Concrete structural elements according to any of claims 1 to 6, characterized in that they are disposed in line and assembled by at least a common prestressing cable (4) which passes through said passages (5) of the elements, the whole constituting a concrete cable.
8. Concrete structural elements according to claim 7, characterized in that said prestressing cable (4) is made of carbon fibers embedded into a cured synthetic resin.

