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Bernander et al.

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[54] **METHOD OF PRODUCING A PRESTRESSED CONCRETE MEMBER**

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[51] **Int. Cl.** **B28b 23/14**
[58] **Field of Search** .... 264/228, 229; 52/223 R, 52/223 L; 425/111

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[57] **ABSTRACT**

A prestressed concrete slab is cast with a concave top surface which is flattened when the hardened slab is bent upwards due to application of the prestressing forces.

6 Claims, 6 Drawing Figures

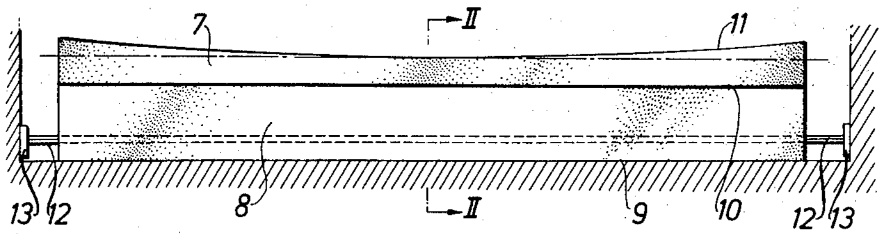


Fig.1

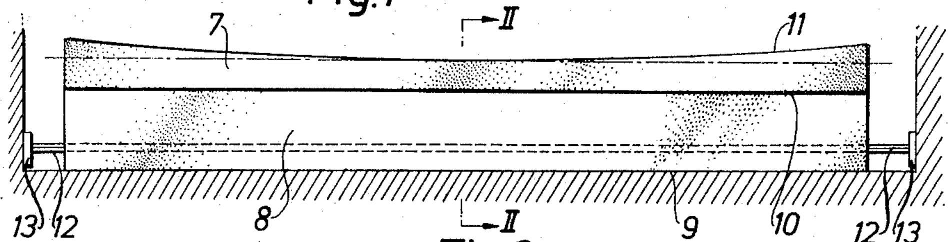


Fig.2

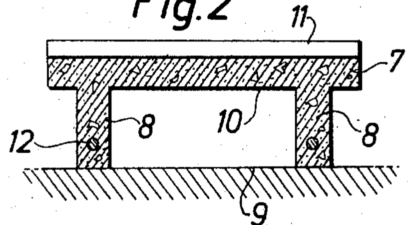


Fig. 3

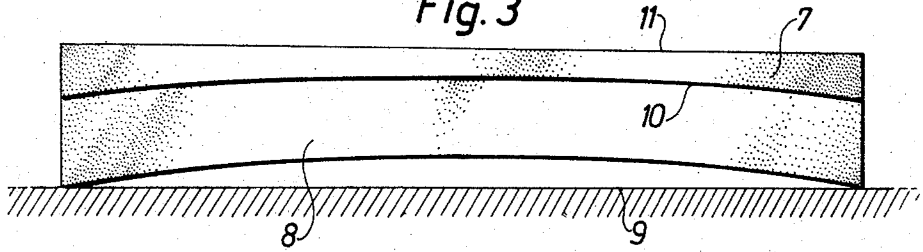


Fig.4

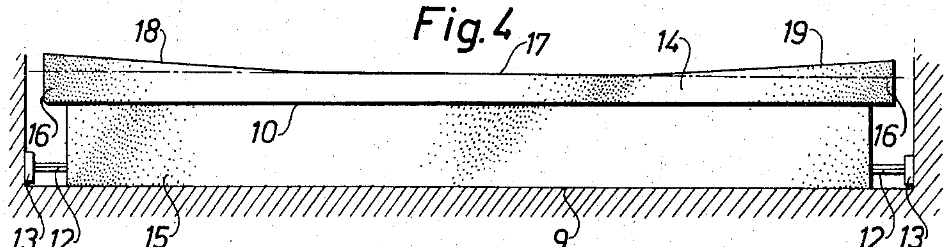


Fig.5

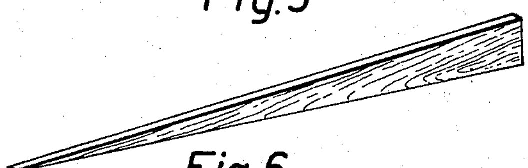
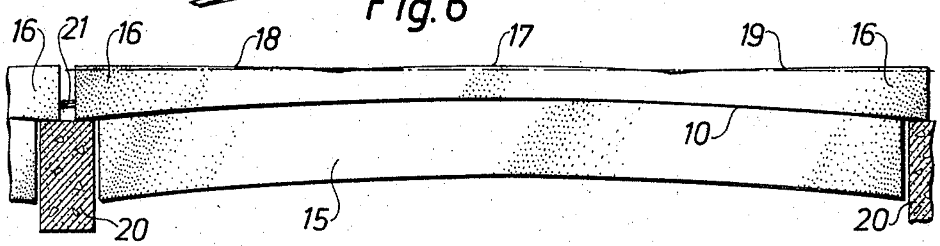


Fig.6



METHOD OF PRODUCING A PRESTRESSED CONCRETE MEMBER

BACKGROUND OF THE INVENTION

The invention relates to an improved method of producing a prestressed concrete member formed as a substantially rectangular slab cast integrally with at least one underlying beam which extends in the longitudinal direction of the slab and is provided with an embedded prestressed reinforcement. Typical concrete members of this kind may be T- or TT-shaped, upside down U-shaped or box-shaped in cross section.

When such members are mounted horizontally with their ends resting on supports the dominance of the prestressing moment over the dead-load moment causes the member to be bent in an arch upwards, and thus the initially flat top surface of the slab will get a camber which is too large to be accepted when the member has to be entered in a flooring, for instance. In such case it has been necessary to cover the uneven top surface with a reinforced concrete topping which must increase in thickness from the middle towards the ends of each slab if a flat floor surface is desired. As an example, it may be mentioned that the central portion of each of the floor-forming concrete members may be at a level about 80 mm higher than the ends of the member, and it is thus obvious that the casting of a topping involves a considerable work.

SUMMARY OF THE INVENTION.

The subject of the invention is to provide a method by which a prestressed concrete member of the kind here in question may be produced in such a way that the camber of the top surface is substantially compensated and thereby the need of a plaining layer is eliminated. In the customary way, the slab is cast integrally with one or more underlying beams, and a reinforcement is embedded in each beam and prestressed between anchoring means located outside the ends of the beam. Also, in the known way, the bottom surface of the slab is cast flat in a plane which is parallel to the prestressed reinforcement. According to the new method, however, the top surface of the slab is formed concave, as seen in a vertical section in parallel to the beam, and the depth of said concavity is selected such in relation to the prestressing moment and the intended permanent load of the slab that the top surface of the slab will be substantially plane when the prestressing force is transferred to the hardened concrete member.

A concrete member cast by this method will satisfy the need of an essentially plane top surface, the accuracy of which being limited only by the difficulty of predicting the camber arising during various conditions. In any case, however, the drawbacks of upwards camber are essentially eliminated so that the casting of a concrete topping at the working place can be replaced by a simple screed.

As mentioned, the bottom surface of the slab is cast plane, and when the prestressing force is applied this surface will thus be curved upwards into an arch having about the same curvature as the top surface initially formed. Moreover, owing to the design of the top and bottom surfaces of the slab the thickness of the slab increases from a central slab portion onto both ends, and this fact involves a special advantage when using a preferred embodiment, as will be explained hereinafter.

In practice, the original top surface concavity should have a depth of at least 15 mm for a concrete member of a length between 6 and 20 m, as a smaller depth is of minor interest, and a depth between 30 and 50 mm is often to prefer for slabs of said lengths. The concave top surface formed on the slab may have an arcuate curvature, but the casting procedure is simplified, if said surface is composed of a row of flat surface portions making obtuse angles with each other. In a preferred embodiment of this kind, the top surface may be divided in three such flat portions, i.e. one horizontal middle portion between two inclined end portions, and each of said end portions may then have a length amounting to ¼–⅓ of the total length of the slab. Such a design has the advantage of being rather simple to reproduce at a series fabrication of the concrete members.

According to a further preferred embodiment, the thickened end portions of the slab are arranged to protrude beyond the ends of the underlying beam or beams so as to form shoulders adapted to rest on horizontal supporting surfaces when the member is mounted. Such a mounting which reduces the structural depth, i.e. the sum of the depth of the support and the depth of the supported portion of the precast concrete member, has been made possible by the thickened slab end portions which may be made thick enough to transmit the loading in the supporting zones beyond the ends of the beams. This design has, in turn, been made possible due to the fact that the elimination of a structural topping permits an economical use of more material in said slab end portions.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS.

The invention will be described more detailed in the following with reference to the accompanying drawings which show preferred embodiments.

In the drawings: FIG. **1** is a side view of a cast concrete member before the prestressing has been applied;

FIG. **2** shows a cross section on the line II—II in FIG. **1**;

FIG. **3** shows the concrete member in FIG. **1** after the prestressing has been applied;

FIG. **4** is a side view of another embodiment of a concrete member before the prestressing has been applied;

FIG. **5** shows a detail pertaining to a mould for casting the member in FIG. **4**, and

FIG. **6** shows the member in FIG. **4** resting on supporting girders, after the prestressing has been applied.

The concrete member shown in FIGS. **1–3** is composed of a rectangular slab **7** and two underlying beams **8** cast integrally with the slab. The bottom surfaces of the beams **8** are plane and lie on a plane casting bed **9**. The rest of the mould has been removed for the sake of clearness. The bottom surface **10** of the slab **7** is also flat and lies in a plane in parallel to the bed **9**, while the top surface **11** of the slab is arcuately concave, as seen in a vertical section in the plane of the drawing. As usual when producing prestressed concrete members of this type, a longitudinal reinforcement indicated at **12** is kept stretched between anchors **13** located outside the ends of each beam, and these reinforcements are then embedded in the beams at the casting operation. The anchoring of the stretched reinforcements are maintained until the concrete member has hardened sufficiently to carry the stressing forces. The stretched reinforcements **12** which are preferably disposed within the lower beam sections, are indicated diagrammatically only and, in fact, each of them may in the known way consist of one or more cables or bundles of wires secured to the anchors **13** under tension. Though not shown, the beams **8** as well as the slab **7** may also contain other usual reinforcements such as longitudinally extending rods and vertical stirrups, for instance.

When the cast concrete member has hardened sufficiently, the stretched reinforcements **12** are cut outside the ends of the beams **8**, and then the prestressing forces applied cause the member to assume the configuration shown in FIG. **3**, i.e. the top surface **11** will be substantially plane, while the bottom surface **10** of the slab **7** and also the bottom surfaces of the beams **8** are curved upwards. Generally, this curvatures will be of about the same order as the original concavity of the top surface **11**. As already mentioned, a good levelling of the top surface **11** will be dependent on a correct balancing of the original surface concavity, the prestressing forces applied and the loading acting on the member, and these factors must be determined in each individual case.

The concrete member shown in FIGS. **4** and **6** is also composed of a rectangular slab **14** and two or more underlying beams **15**, but the slab has here end portions **16** protruding a little distance beyond the ends of the beams **15**. As an example, said distance may be 6 – 15 cm. The protruding end portions **16** extend transversely across the whole width of the slab **14** to serve as shoulders which may be caused to rest on supporting surfaces when the member is mounted in a horizontal position. In the same way as in FIG. **1**, the beams **15** have plane bottom surfaces resting on a plane bed **9**, and the bottom surface of the slab **14** is plane. Also, the reinforcements **12** stretched between the anchors **13** may be of the same kind. The top surface of the slab **14** is concave according to the requirement, but the arcuate profile is here replaced by a number of straight lines, i.e. a central surface portion **17** lies in a horizontal plane and borders on two inclined but plane surface portions **18,19** extending from said central portion to the ends of the slab. Of course, the angle between the central surface portion **17** and each of said inclined surface portions **18,19** must be selected with regard to the desired depth of the concavity. As mentioned each of the inclined surfaces may extend along ⅓– ¼ of the total length of the slab **14**. The top surface configuration described has the advantage that the concrete member can be cast in a common mould which need only be supplemented by two wedge-shaped boards at each end. Such a board is shown in FIG. **5**.

In FIG. **6**, the prestressing is applied to the hardened member which is thereby bent upwards in the same way as is shown in FIG. **3**. The surface portions **17,18,19** together forming the top surface of the slab **14** have here obtained profiles which are a little convex in longitudinal section, as indicated in exaggerated scale in FIG. **6**. In reality, this small deviation from an exactly plane top surface may generally be neglected, or otherwise a simple screed of the surface is sufficient. The average level of the top surface of the slab **14** is indicated by a dotted line.

In FIG. **6**, the protruding ends **16** of the slab **14** rest on supporting girders **20**, between which the slab beams **15** are hanging down. The thickened slab ends **16** may be dimensioned to carry the weight of the member and the load acting thereon, and thereby the structural depth is essentially reduced when compared with a mounting, where the ends of the beams are arranged to rest on the supporting girders. Further, the load is effectively distributed over the whole width of the concrete member.

The supporting girders **20** are rectangular in cross section, and the spaces between the end surfaces of the beams **15** and the opposite vertical side surfaces of the girders **20** may then be filled with a hardening mass such as cement mortar, whereby the beams **15** are engaged to contribute to the load carrying capacity. Above each girder **20** the slab ends resting thereon may, in the known way, be connected by reinforcement rods, as indicated at **21**, whereupon the space between the slab ends may be filled with mortar.

What we claim is:

1. A method of producing a prestressed concrete member comprising the steps of: casting a substantially rectangular slab integrally with at least one underlying beam extending in the longitudinal direction of said slab, said slab having a concave upper surface in the longitudinal direction thereof and said beam having a planar bottom surface so as to impart a varying cross-section to said concrete member along its length, said concrete member having the center of gravity located in the beam portion; embedding at least one longitudinally extending reinforcement in said beam below said center of gravity; prestressing said reinforcement between anchoring means located exteriorly of the ends of said beam; permitting said concrete member to harden; and releasing said prestressed reinforcement from said anchoring means so as to impart an upward camber to said concrete member with the bottom of said beam being displaced upwardly to an extent corresponding to the upward movement of said slab whereby the upper surface of said slab assumes a substantially planar and the bottom surface of said beam a concave configuration.

2. A method as claimed in claim **1**, wherein said concavity of the top surface of the slab has a depth of at least 15 mm, for a member having a length of 6–20 meters.

3. A method as claimed in claim **1**, wherein said slab has shoulder end portions protruding beyond the ends of said beam for resting on supporting surfaces.

4. A method as claimed in claim **3**, wherein said protruding end portions of said slab have a length of 6–15 cm.

5. A method as claimed in claim **1**, wherein the concave top surface of said slab has a central surface portion lying substantially in a horizontal plane, and two inclined flat surface portions each extending from said central portion to one end of said slab.

6. A method as claimed in claim **5**, wherein each of said inclined surface portions extends along ¼ to ⅓ of the total length of the concrete member.

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