METHOD AND MEANS FOR CHEMICALLY PRESTRESSING CONCRETE

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Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

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My invention relates to methods and means for prestressing concrete, and more particularly to post-tensioning methods of prestressing concrete and apparatus therefor. It is one of the purposes of my invention to utilize the expansive character of concrete that includes ingredients that cause the concrete mixture to expand. Such expansion is ordinarily brought about by generation of gases by finely divided particles of chemicals in the concrete mixture, the gases producing a cellular structure and causing the concrete to expand as it sets.

It is a purpose of my invention to provide prestressing means for embedment in an expanding concrete body portion in such a manner that as the concrete sets the expansion thereof will put a prestressing member under tension so as to place the concrete under compression, said prestressing member extending between spaced bearing plates that are embedded in the concrete and secured thereto so that the movement of the bearing plates away from each other under the expanding action of the concrete will put the prestressing member under tension.

This is preferably accomplished by providing enlargements on the ends of the prestressing member that are secured to the sides or faces of the bearing plates that are remote from each other so that when the assembly is placed in position for thepouring of the expanding concrete mixture around the same, said bearing plates will have a predetermined spaced relationship to each other with the prestressing member holding the same in such predetermined spaced relationship.

It is a further purpose of my invention to provide means for prestressing concrete that is in the form of a flat bar of high tensile strength steel having considerably greater width than thickness thereby utilizing a flat bar to even out the advantages of a flat tendon are obtained. Such flat tendons are particularly advantageous in a flat slab concrete construction, as such flat bar tendons make it possible to resist externally induced moments by internally created moments developed by less prestressing force than where a circular cross section tendon is utilized. This is because a flat tendon can be mounted in a concrete body so as to obtain a longer couple arm than with a round or thick tendon and at the same time maintain the required covering of concrete over the steel prestressing member to protect it against weather and fire.

It is a further purpose of my invention to provide a new and improved method of prestressing a concrete structure, which comprises mounting a pair of bearing plates on a high tensile strength steel prestressing member, such as the flat bar above referred to, providing enlargements on the opposite ends of the prestressing member, preferably by a cold upsetting method, securing one of the enlargements to the one bearing plate and the other enlargement in spaced relation to the other bearing plate, positioning the tendon, comprising said bearing plates and prestressing member provided with said end enlargements, in the concrete body portion so that the bearing plate spaced from an enlarged end of the prestressing member has one face exposed, sliding a coupling member laterally into position in engagement with the enlargement that is spaced from said bearing plate, and after the concrete has been cured sufficiently to reach maximum strength, pulling the coupling member to release the prestressing member from the bearing plate that has one face exposed and to which it was attached, and tension the prestressing member the desired amount, and inserting spacing means between the coupling member and the exposed face of the bearing plate to maintain the tension on the prestressing member.

In carrying out the above referred to method, a coupling member is utilized, which is preferably provided with undercut flanges thereon, similar to those provided on the coupling member disclosed in my co-pending application Serial No. 3,851, filed January 21, 1960, and now abandoned on Method and Apparatus for Post-Tensioning Concrete Prestressing Members, and the enlargement on the prestressing member is provided with corresponding undercut flanges thereon that engage with the undercut flanges of the coupling member, said coupling member being preferably provided with such undercut flanges at opposite ends thereof so that a prestressing member having a similar end enlargement can be engaged therewith so as to connect two such prestressing members together, should this be desirable.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined by the claims.

In the drawings:

FIG. 1 is a vertical sectional view through a structure of expanding concrete, showing my improved prestressing means embedded therein, the mid-section thereof being broken away.

FIG. 2 is a similar view of an ordinary concrete structure showing my improved prestressing means applied thereto, and showing the position of the parts after the prestressing means has been post-tensioned.

FIG. 3 is a fragmentary vertical sectional view through the concrete structure shown in FIG. 2 before the prestressing member has been post-tensioned.

FIG. 4 is a fragmentary elevational view taken substantially on the line 4--4 of FIG. 3.

FIG. 5 is a fragmentary sectional view taken on the line 5--5 of FIG. 1, and FIG. 6 is a fragmentary detail view partly in section taken on the line 6--6 of FIG. 3.

Referring in detail to the drawings, in FIG. 1 is shown a body of expanding concrete 6, in which the bearing plates 7 and 8 are embedded. Expanding concrete comprises an aggregate and expansive or expanding cement made of the regular Portland cement clinker and a clinker principally of calcium sulfoaluminate or other material that expands during the setting of the concrete ground together in such proportions as to get the desired amount of expansion of the concrete. The prior art literature expresses the opinion that calcium sulfoaluminate is the most desirable product to use in such an expanding or expansive cement and that some free lime in the expansive cement is desirable. While some expansion continues for a long time after the concrete has set, the concrete, after such expansion during setting has taken place, can be said to be chemically expanded. A flat bar of high tensile strength steel 9, which preferably is about five or six times as thick, extends between the bearing plates 7 and 8. Said bearing plates 7 and 8 are provided with horizontally elongated slots 10 that are adapted to conform substantially to the cross sectional shape of the flat bar 9, the ends of said flat bar 9 extending through said slots 10, and enlargements 11 and 12 being cold formed under relatively slow pressure of 500,000 p.s.i. or greater, on opposite ends of the bar 9. The enlargements 11 and 12 are secured in fixed position on the faces of the bearing plates 7 and 8 that are remote from each other by any suitable means, such as by tack welds 13.
Due to the securement of the bearing plates 7 and 8 in this manner to the enlargements 11 and 12 provided on the bar 9, the pouring of concrete around the tendons made up of the members 7, 8 and 9 so as to embed the tendons completely in the body of concrete, will cause the bearing plates 7 and 8 to be held at a predetermined spaced relationship to each other. Before the concrete body 6 is poured, a lubricating coating is applied to the high tensile strength steel member 9 to prevent adhesion of the concrete to the metal bar 9. As the concrete of the body portion 6 expands during the setting, the spacing of the bearing plates 7 and 8 from each other will be increased, placing the prestressing member 9 under tension and compressing the concrete between the bearing plates 7 and 8.

Mounted in a concrete body 14 of ordinary concrete so as to be embedded therein is a bearing plate 15, which is a duplicate of the bearing plate 8, and mounted in said concrete body 14 adjacent one end face 16 thereof, so that one face of said bearing plate will be exposed, is a bearing plate 17. Said bearing plates 7, 8, 15 and 17 are of the same shape, the bearing plate 17 being shown in FIG. 4 as being of greater horizontal than vertical extent or elongated horizontally. Each of said bearing plates 7, 8, 15 and 17 are similarly slotted, the slot being indicated at 10 in FIG. 4, and extending with its length horizontally.

A flat high tensile strength steel bar 18 of the same cross section as the expanded end chlorox between the bearing plates 15 and 17 and through the slots 10 therein. An enlargement 19 is provided on one end of the bar 18, which engages the bearing plate 15 on the side thereof from remote from the bearing plate 17 and may be fixed thereto by tack welding, as indicated at 20. The bearing plate 17 is secured to the prestressing member 18 by any suitable means, such as by means of tacks welds 21, in spaced relation to the enlargement 22 provided on the end of said prestressing member 18 opposite the end having the enlargement 19 to thus space the enlargement 22 from the outer face of the bearing plate 17 for a purpose to be described below. A lubricating coating is applied to the prestressing member 18 before the concrete body 14 is poured to prevent adhesion of the concrete to the metal bar 18.

Said enlargement 22 is preferably provided with undercut grooves 23 therein, which form inclined shoulders extending lengthwise of the enlargement from the flat bar 18 to the outer extremity of said shoulders, said shoulders extending the full width of the bar 18 and being provided for engagement with similarly undercut shoulders 24 on the inner flanges of the coupling member 25, which is provided with a transverse web portion 26, and undercut shoulders 24 adjacent the opposite ends thereof, there being a passage 27 between the inner flanges on said coupling member 25 for receiving the portion of the flat bar 18 extending from the enlargement 22.

In prestressing a concrete structure with the tendons shown in FIGS. 2, 3 and 4, the concrete body portion 14 is poured with the bearing plate 15 so positioned that it and the enlargement 19 will be completely embedded in the concrete, while the bearing plate 17 will be mounted at the end face 16 of the concrete body with just the one face thereof exposed. The enlargement 22 will then be spaced from the body 14 in the manner illustrated in FIG. 3, the spacing of the enlargement 22 being sufficient from the bearing plate 17 that the inner flanges of the coupling member 25 can be readily slid laterally into position, that is, in a direction lengthwise of the enlargement 22, or transversely of the prestressing bar 18, in the position that it will have the undercut shoulders 24 that form the enlarged member 23 of the enlargement 22. When the concrete has been set so as to attain its ultimate strength, a pulling member is connected with the coupling member 25 and the coupling member 25 is pulled to the position thereon of shown in FIG. 2. When such pulling takes place, the welds 21 will be broken and the bar 18 will be released from the bearing plate 17 and will be tensioned. When the desired tension has been applied to the bar 18, suitable spacing members, such as the shims 28, are inserted between said bar 18 and said coupling member 25, to maintain the tension on the prestressing member 18. The pulling means can now be removed and, if desired, another prestressing member 18, having a similar enlargement 22, can be applied to the coupling member at the end thereof that is remote from the bearing plate 17, should it be otherwise desired.

What I claim is:

1. In a concrete structure, a body portion of chemically expanded concrete and means for putting said body portion under compression comprising spaced flat faced bearing plates embedded in said body portion in spaced relation to each other, a smooth surfaced high tensile strength steel tension member having a lubricating coating thereon embedded in said body portion and extending between said bearing plates, said bearing plates having openings therein through which said tension member extends, said tension member having an enlargement thereon at each end thereof and means for securing said enlargements snugly in fixed position to the sides of said bearing plates remote from each other, said bearing plates, tension member and enlargements on said tension member being completely enclosed within said body portion of chemically expanded concrete.

2. In a concrete structure, a body portion of chemically expanded concrete and means for putting said body portion under compression comprising spaced flat faced, rectangular bearing plates embedded in said body portion in spaced relation to each other, a smooth surfaced, flat bar of high tensile strength steel embedded in said body portion, with the width thereof disposed horizontally, and extending between said bearing plates, said bar having a lubricating coating thereon, said bearing plates each having a horizontally elongated opening therein conforming substantially to the cross section of said bar throught which said bar extends, said bar having an integral enlargement thereon at each end thereof and means securing said enlargements snugly in fixed position to the sides of said bearing plates remote from each other, said bar, bearing plates and enlargements on said bar being completely enclosed within said body portion of chemically expanded concrete.

3. The method of prestressing a concrete structure comprising mounting a pair of bearing plates on a high tensile strength steel prestressing member with said prestressing member extending through openings in said bearing plates, cold upsetting the ends of said prestressing member to provide end enlargements thereon, securing said enlargements in fixed position in snug engagement with the sides of said bearing plates remote from each other, coating said prestressing member with a lubricating coating from one of said bearing plates to the other bearing plates, and completely enclosing said assembly of plates and the entire length of said prestressing member including said enlargements in a body of concrete that expands by chemical action during setting.

4. In a concrete structure, a body portion of chemically expanded concrete having bottom and top faces and means for putting said body portion under compression comprising spaced flat faced, rectangular bearing plates mounted in said body portion, said plates having horizontally extending slots therein and a smooth surfaced, flat bar of high tensile strength steel mounted in said body portion extending between said plates and through said slots, said bar having a lubricating coating thereon from one of said bearing plates to the other bearing plate, the width of said bar extending parallel to said top and bottom faces of said body portion, said bar having an enlargement thereon elongated transversely of said bar at each end.
thereof, said enlargements being tack welded in snug engagement with the sides of said bearing plates remote from each other, said bar, bearing plates and enlargements on said bar being completely enclosed within said body portion of chemically expanded concrete.

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