

Description

The invention relates to a prestressing anchor arrangement according to the generic part of claim 1 and to a method of producing a prestressing anchor arrangement according to the generic part of claim 5.

In concrete construction, "prestressing with subsequent bonding" is known where the prestressing elements are longitudinally moveable within encasing tubes and are tensioned after the concrete has set. Afterwards the space remaining in the tubes is filled with injected material. In this way, bonding is achieved after the entire length of the prestressing elements between them and the surrounding concrete, which gives added security both in the event of rupture and upon failure of an anchorage.

Besides the aforementioned "prestressing with subsequent bonding", a "prestressing without bonding" has been increasingly used for concrete ceilings and other structures in recent times. With the "prestressing without bonding" the prestressing element is prevented from coming directly in contact with the concrete. The prestressing element, surrounded by a layer of slushing grease, is situated in a plastic tube. After the concrete has set, the prestressing elements are tensioned, without any bonding to the surrounding concrete over the entire length between the two anchorages.

In such structures, especially in the case of long prestressing elements passing through a number of ceiling sections, it is a disadvantage that, upon local destruction of one ceiling section, those directly adjacent can also be affected under certain circumstances.

It can also happen that if one anchorage location of a

single prestressing element fails, the remaining, intact prestressing elements must compensate for the lost prestressing force of that single prestressing element, which will necessarily lead to a reduction of the resistance to rupture of such a part of the structure.

It has therefore been sought to incorporate by means of additional intermediate anchorages, preferably situated in the vicinity of supports, added reserves which become effective upon failure of one of the end anchorages so that only some of the ceiling sections become damaged.

Another advantage of such intermediate anchorages is that proportionate to the decrease in extension length of the prestressing elements, the build-up of stress, and hence the breaking strength, is increased accordingly.

In the German Patent DE-B-1 147 740 an intermediate anchorage is described called a prestressing element joint, wherein two adjacent prestressing anchors are secured to one another by means of threaded bolts prior to concreting in the second phase of construction. The two prestressing anchors are pressed against one another by the bolts with at least the prestressing force of the prestressing element. To avoid overstressing the plate-shaped prestressing anchor elements, an annular intermediate piece is placed between these, and between the clamping wedges and the two prestressing elements a rubber plate. This way, when the high-strength screws are tightened, the clamping wedges are pressed into the anchor cone with only part of the full prestressing strength of the two prestressing elements, this part being sufficient that when these elements are put under tension, no more slipping occurs, and the tensioned high-strength screws are practically not stretched any further. This prior art intermediate anchorage has the inherent drawback

that high-strength threaded bolts must be used, which together must withstand the tension force of the prestressing element; tightening of the nuts screwed on the bolts requires great skill and must be carried out very carefully since at least four high-strength screws must be tensioned simultaneously; and finally, no prestressing is exerted upon the concrete of that portion between the prestressing elements in the region of expansion joint by the rigid and not elastic joint. This means that precisely the part of the structure in the region of the joint is in danger of cracking during use and must be treated according to other statics criteria than "prestressed concrete without bonding".

In U.S. Patent No. 4,368,607 an intermediate anchorage is described having two prestressing anchors with appurtenant clamping wedges. Associated with the clamping wedges of each prestressing anchor is an operating member having a pipe piece surrounding the prestressing element and a hub surrounding the thicker ends of the wedges, as well as part of the prestressing anchor. The pipe pieces are threaded on the outside, and a tubular compression member provided with oppositely directed internal threads is screwed on these outside threads of the opposing pipe pieces of the operating members. The middle part of the compression member is hexagonal so that this member can be rotated about its longitudinal axis with the aid of a wrench, whereby the operating members are pressed apart, and the clamping wedges are pressed into the frustoconical recesses in the prestressing anchors. This prior art intermediate anchor arrangement is packed as a whole in polystyrene foam between the two anchor plates and thus forms a rectangular plastic clearance block, the operating member being in a position in which the clamping wedges project only partially into the frustoconical

recess and which makes it possible to thread in the individual prestressing elements subsequently.

To construct, for example, a concrete ceiling extending over a number of sections, the plastic foam clearance block is preferably disposed over the supports. Conventional prestressing anchors are set at the two ends of the prestressing element, and the whole ceiling is then concreted. After the concrete has set, the foam material surrounding the intermediate anchor arrangement is removed so that the compression members are accessible. The prestressing elements are then tensioned over their entire length in a manner known per se. After that, the compression member of each intermediate anchor arrangement is operated in such a way that the clamping wedges are pressed into the frustoconical recesses of the prestressing anchors, and the respective region of the prestressing element is thereby clamped fast in the prestressing anchors, so that the prestressing element can no longer be displaced longitudinally. Finally, the clearance spaces left free when the polystyrene foam is removed are filled with concrete.

With the intermediate anchor arrangement described above, the plastic foam must be removed after the concrete has set; and once the compression members have been securely tightened, the resultant hollow spaces in the concrete must be filled up again, which involves considerable extra work. Tightening of the compression members must be carried out very carefully because if the compression members are not tightened sufficiently, the clamping effect is too weak, and the intermediate anchor arrangement is not effective.

A further disadvantage is that the hollow spaces in the concrete are not filled up with concrete until the prestressing operations are terminated and areas are formed thereby which are

not prestressed.

It is the object of this invention to provide an improved intermediate anchor arrangement for prestressing structural components which does not have the aforementioned shortcomings and which can be utilized without problems.

The intermediate anchor arrangement according to the invention is characterized by the features cited in the characterizing part of claim 1.

The method according to the invention of producing an intermediate anchor arrangement is characterized by the features cited in the characterizing part of claim 5.

In the following the invention is explained more closely, by means of preferred embodiments, with reference to the drawing, in which:

Figure 1 is a greatly simplified depiction of a concrete ceiling in cross-section,

Figure 2, a longitudinal section through an embodiment of the intermediate anchor arrangement according to the invention, one of the prestressing anchors already embedded in concrete,

Figure 3, a longitudinal section through clamping wedges of the arrangement of Figure 2, with spacing means according to a second embodiment,

Figure 4, a section taken on the line IV-IV of Figure 3;

Figure 5, a section taken on the line V-V of Figure 3;

Figure 6, a longitudinal section through clamping wedges of the arrangement of Figure 2, with spacing means according to a third embodiment; and

Figure 7, a section through one of the prestressing anchors of the intermediate anchor arrangement in a preparatory stage after concreting in a preceding phase of construction.

Figure 1 shows a structural member, specifically a concrete

ceiling 1, in a greatly simplified sectional view so that one of the prestressing elements 2 extending through ceiling 1 is visible. The ends of ceiling 1 are supported by outside walls 3 shown only partially. Between the walls 3, there are pillars 4, metal supports, or partitions upon which ceiling 1 is additionally supported. At each end of prestressing element 2, which may be a tension cable of steel wires, for example, there is an end prestressing anchor 5. To prevent the prestressing force from being lost over the whole length of prestressing element 2, should one of the end prestressing anchors 5 loosen or prestressing element 2 break, so-called intermediate anchor arrangements 6 are disposed preferably in the areas above pillars 4. The invention described in the following relates to the design and production of such an intermediate anchor arrangement 6.

Figure 2 is a longitudinal section through one embodiment of such an intermediate anchor arrangement 6, comprising two prestressing anchors 7 and 8 which, singly, may also be used as the aforementioned end prestressing anchors 5 at each end of prestressing element 2. Each prestressing anchor has a supporting body 9, 10 including a flange 11, 12 projecting radially outward and a likewise outwardly projecting support rib 13, 14, adjoining which is a cylindrical extension 15, 16. Through each body 9, 10 there extends a passage for prestressing element 2 consisting of a cylindrical portion 17, 18 in the region of extension 15, 16 and a frustoconical portion 19, 20. Frustoconical portion 19 is intended to receive, for example, two clamping wedges 21, and the frustoconical portion 20 is intended to receive, for example, two clamping wedges 22. Clamping wedges 21 and 22 are provided on the inside with sawtooth ribs 23 which, when the clamping wedges are brought into operative position,

penetrate at least partially into prestressing element 2 in order to hold it fast.

Between the large end faces 24 of clamping wedges 21 and 22 there is a rigid tubular element 25, e.g., a pipe piece. The inside diameter of tubular element 25 is larger than the outside diameter of prestressing element 2 so that the latter can move freely within the former.

Screws, e.g., four in number, extend through bores distributed regularly around the peripheries of flanges 11 and 12. The purpose of screws 26 will be described more closely below.

Figure 3 shows only part of prestressing element 2 and clamping wedges 21' and 22' of the intermediate anchor arrangement. Clamping wedges 21' and 22' are rigidly connected to one another by means of bridging portions 27 which perform the function of the above-mentioned tubular element 25. Figure 4 is a section through bridging portion 27, and Figure 5 a section through clamping wedges 22'. Portion 27 is so arranged as not to touch prestressing element 2 when assembled.

Figure 6 also shows only prestressing element 2 and clamping wedges 21 and 22" of the intermediate anchor arrangement. Clamping wedges 21 are the same as the clamping wedges 21 illustrated in Figure 2. Clamping wedges 22" on the other hand, each include an extension 28, the free ends of which are intended to rest against the end faces 24 of clamping wedges 21. Extensions 28 are so arranged as not to touch prestressing element 2 when the clamping wedges are assembled. This embodiment is the most advantageous of the three embodiments thus far described as regards the means for holding the clamping wedges spaced at a given distance from one another.

Figure 7 shows part of the intermediate anchor arrangement

according to the invention after the concreting of the preceding phase of construction. Before the concreting of the preceding phase of construction the prestressing element 2 was pushed through the prestressing anchor 7 and the prestressing anchor 7 was fixed with screws 26 to an only partially shown form board 29, the prestressing anchor 7 being held at a distance from the form board 29 by a filler 30, e.g. of styropore. 31 designates the concrete poured in during the first phase of construction.

Since the intermediate anchor arrangement described above is used for producing structural components such as concrete ceilings, floor slabs, runways, bridge members, etc., with "prestressing without bonding", the sections of prestressing element 2 extending through the concrete are enclosed in a protective sheath or tube (not shown). To prevent the concrete from penetrating inside prestressing anchor 7, a sleeve 32 is provided to form a protective transition part between the end of the aforementioned sheath or tube (not shown) and cylindrical extension 15.

After the concrete 31 has set, form board 29 and filler 30 are removed. The latter leaves a recess 33 (see Figure 2) into which prestressing anchor 7 partially projects. Clamping wedges 21 are then inserted in the frustoconical portion 19 of the passage through prestressing anchor 7, and the section of prestressing element 2 extending through the set concrete 31 is prestressed to the prescribed value by means of a prestressing device known per se and therefore not further described here. After prestressing, clamping wedges 21 assume within prestressing anchor 7 the position shown in Figure 2 and prevent the said section of prestressing element 2 from relaxing.

Now, tubular element 25 first and then prestressing anchor 18 (sic), initially without the clamping wedges 22, is slipped on

to prestressing element 2, until tubular element 25 rests against end faces 24 of clamping wedges 21. Afterwards clamping wedges 22 are inserted into frustoconical portion 20 of the passage through prestressing anchor 8, and the latter is pushed toward prestressing anchor 7, already embedded in concrete, until end faces 24 of clamping wedges 22 rest against tubular element 25 and screws 26 pass through flange 12 of prestressing anchor 8. By means of nuts 34 screwed onto the ends of screws 26 and tightened only moderately, prestressing anchor 8 is held coaxial with prestressing anchor 7. Nuts 34 are tightened only to the extent that all clamping wedges 21 and 22 rest snugly against tubular element 35, that clamping wedges 22 are not pushed completely into frustoconical portion 20 of the passage through prestressing anchor 8, and that only a very slight clamping effect is thus exerted upon prestressing element 2. This condition is illustrated in Figure 2.

After a further sleeve 32 has been placed on the end of extension 16 of prestressing anchor 8 and anticorrosive tape 35 has been wrapped around the gap 36 between the two prestressing anchors 7 and 8, the concrete for the next phase of construction is poured, at which time recess 33 is also filled with concrete. Anticorrosive tape 35 prevents concrete from penetrating into the space between clamping wedges 21 and 22.

After setting of the concrete poured in this next phase of construction, the respective section of prestressing element 2 is prestressed to the prescribed value mentioned above. At the end of this section, an end prestressing anchor 5 or the prestressing anchor 7 of a succeeding intermediate anchor arrangement may be disposed. Because clamping wedges 22 of prestressing anchor 8 exert virtually no clamping action upon prestressing element 2, the prestressing of the second section of prestressing element 2

takes effect all the way to the part of prestressing element 2 gripped by clamping wedges 21, whereby prestressing element 2 is prestressed at least close to uniformly over its entire length, regardless of the number of intermediate anchor arrangements existing between the end locations of prestressing element 2.

Even after prestressing of the succeeding section of prestressing element 2, prestressing anchors 7 and 8, as well as their associated clamping wedges, remain in the position illustrated in Figure 2, i.e., clamping wedges 21 of prestressing anchor 7 exert their full clamping action upon prestressing element 2, whereas clamping wedges 22 of prestressing anchor 8 exert almost no clamping action upon prestressing element 2.

A significant advantage of the intermediate anchor arrangement described above is that element 2 can be substantially uniformly prestressed throughout, i.e., even in the vicinity of the intermediate anchorages.

If prestressing anchor 5 at the other end of the first section of prestressing element 2 should suddenly come loose, or if the prestressing element should snap in the first section, clamping wedges 21 of prestressing anchor 7 will be pulled to the right, as viewed in Figure 2, by the prestressing in the remaining portion of prestressing element 2. This movement will instantaneously be transmitted via tubular element 25 to clamping wedges 22 of prestressing anchor 8, whereby clamping wedges 22 will necessarily be urged into their operative position, i.e., they will be pushed completely into the frustoconical portion 20 of the passage in prestressing anchor 8. Hence the clamping action of clamping wedges 21 will be transmitted to clamping wedges 22.

Should the anchorage in the following section let go, the prestressing in the preceding section of prestressing element 2

will be maintained by clamping wedges 21 of prestressing anchor 7, which are already in clamping position.

As already mentioned with reference to Figures 3 and 6, clamping wedges 21' and 22', rigidly interconnected by bridging portion 27, may be used instead of clamping wedges 21 and 22 and tubular element 25; or, preferably, clamping wedges 21 and 22" may be utilized, clamping wedges 22" including extension 28. This last embodiment of the spacing means is particularly advantageous because it is easier to assemble as compared with the tubular spacing means.

The intermediate anchor arrangement described above is effective even in the event of trouble, such as when a degree of tension in excess of the prescribed value is applied to prestressing element 2 during a succeeding phase of construction. In this case, it may be that clamping wedges 21 of prestressing anchor 7 move a little to the right, as viewed in Figure 2, thus reducing the clamping effect of clamping wedges 21. However, tubular element 25 transfers the displacement of clamping wedges 21 to clamping wedges 22 in such a way that the clamping action of clamping wedges 22 increases to the extent that that of clamping wedges 21 decreases. As a side effect, prestressing element 2 is in turn uniformly subjected to tension over its entire length. If a defect should occur to one side or the other of the intermediate anchor arrangement, the clamping wedges will react in the same way as described above, i.e., in the event of trouble, those clamping wedges facing the affected area are always automatically brought into their fully operative position.

Because the purpose of screws 26 is to hold form board 29 while prestressing anchor 7 is being embedded in concrete, to hold prestressing anchor 8 during assembly, and to cause tubular element 25 or extension 28 to lie snugly against the end faces of

the clamping wedges, they are not subjected to any great load and therefore may be ordinary screws.

Patent Claims

1. Intermediate anchor arrangement for prestressing structural components, particularly concrete ceilings, which are produced in several phases of construction, by means of at least one prestressing element (2) extending through the structural members, with two prestressing anchors (7, 8) having at least one clamping wedge (21, 22) each, and with screws (26) for holding the two prestressing anchors together after the carrying-out of the preceding phase of construction and during the following phase of construction, at least one rigid spacer means (25; 27; 28) being disposed between the clamping wedges (21, 22) of the two prestressing anchors (7, 8) for communicating the clamping effect of the clamping wedges of the one prestressing anchor to the clamping wedges of the other prestressing anchor, and the dimension of the spacer means (25; 27; 28) in the direction of the prestressing element (2) being so chosen for keeping a distance between the clamping wedges that either only the clamping wedges of the one prestressing anchor are in full clamping effect or the clamping wedges of both prestressing anchors are only partially in clamping effect.

2. Intermediate anchor arrangement according to claim 1, characterized in that the spacer means is a tubular rigid element (25) having a larger inside diameter than the outside diameter of the prestressing element, that the tubular element surrounds the prestressing element (2), and that the tubular element (25) is



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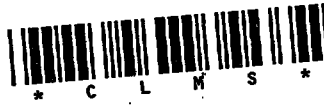
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disposed between the opposite end faces (24) of the clamping wedges of the two prestressing anchors.

3. Intermediate anchor arrangement according to claim 1, characterized in that the rigid means are formed by extensions (28) on the clamping wedge (22") of one of the prestressing anchors, and that the said extension does not touch the prestressing element.

4. Intermediate anchor arrangement according to claim 1, characterized in that the rigid means are formed by a crosspiece (27) rigidly connecting the clamping wedges (21', 22') of the prestressing anchors, and that the crosspiece is so formed that it does not touch the prestressing element.

5. Process for prestressing structural components which are produced in several phases of construction, having an intermediate anchor arrangement according to claim 1, by embedding the first prestressing anchor (7) of the intermediate anchor arrangement in concrete during the preceding phase of construction and by prestressing the respective section of the prestressing element after the setting of the concrete, characterized in that thereafter the second prestressing anchor (8) traversed by the prestressing element is so fastened by means of screws (26) to the first prestressing anchor (7) embedded in concrete that the clamping wedges (21, 22) of the two prestressing anchors rest against the spacer means (25; 27; 28), that the said screws are tightened only to the extent that the second prestressing anchor remains stationary during the concreting of the following phase of construction and the clamping wedges (22) of the second prestressing anchor are in the



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starting phase of the clamping position, that after the setting of the concrete poured during the following phase of construction the associated section of the prestressing element (2) is prestressed like the preceding section during the preceding phase of construction.