

Description

The invention entails a process for producing a tension member to be anchored in the earth or in a structure and subjected to a load, and composed of a central member, and several outer members disposed concentrically with the central member, which tension member is intended to be removed for the most part from the earth or structure after its use, and a tension member produced by this process.

For the construction of structures which, for example, extend several floors down into the ground, the excavations are often enclosed by subterranean curtains or sheet piling which are anchored at the back by means of soil or rock anchors with tension members. The tension members are anchored in the ground by the soil or rock anchors, and are subjected to a load through prestressing.

The tension members may also be used in the structures themselves, however, as in the case of bridge supports, for instance. There, during construction of the bridge, the supports may be subjected to forces which necessitate their temporary reinforcement by means of tension members.

After use, the tension members are removed from the ground or from the structure, and may possibly be reused. In many countries, there are ordinances requiring that the soil or rock anchors be removed when construction is ended.

For partially or completely removing the tension members from the ground or structure, there are available "mechanical," "physical," "chemical," or other solutions.

In mechanical removal, the principle of a predetermined breaking location on the tension member may be applied, for example. By means of the predetermined breaking location, a reduction of a cross-sectional area of the tension member is achieved. This method is usually limited to rod-shaped steel tension members having a single tension rod. The tension member is torn apart at the breaking location by overstressing beyond the tensile strength and is for the most part removed from the ground or from the structure.

In DE-OS 30 39 080 a retrievable reinforcing element is described for a soil or rock anchor. The tension member for such an anchor consists of two or more steel rods. The basic concept of this prior art solution is to embed the individual steel rods of the tension member in the anchor body in spread-apart form by disposing spacers between these rods. By pulling out or destroying the detachably inserted spacers, a clearance space is created for the individual steel rods. Upon applying traction from the downstream anchoring end and overcoming the shear bond of the rods to the anchor body, the rods are pulled out of the anchor one after the other and thus retrieved.

In DE-PS 26 27 524 a soil or rock anchor having a tension member surrounded by a casing pipe is disclosed. The tension member in the form of a

steel-wire rope extends through the casing pipe and is slidingly disposed therein. The upstream end of the tension member is led through an anchor body and held by means of a sleeve braced against the anchor body. The basic concept of this solution is that an adhesive is applied as an intermediate layer between the sleeve and the tension member and firmly pressed against the tension member by the sleeve. The gripping effect of the sleeve is such that the maximum traction needed to pull the tension member out is somewhat greater than the force exerted upon the tension member in use.

The two prior disclosures mentioned above relate only to a soil or rock anchor.

The disadvantage of the removable anchor described in DE-OS 30 39 080 is that spacers must be inserted in the anchor with the tension member and subsequently pulled out again, thus complicating the anchor construction and increasing its cost.

In DE-PS 26 27 524 an adhesive is disposed between the outside surface of the tension member and the bore of the gripping sleeve, and must be of such nature that the loading capacity really is situated between the working load and the breaking strength; however, the tolerance in manufacturing is very small, and any inaccuracy may increase the instability factor in the loading capacity of the soil or rock anchor.

Underlying the invention stated in patent claim 1 is the aim to propose a process of producing a removable tension member in which the tension member can be fabricated by simple means, and the load needed for removing the tension member can be calculated in advance. Such a tension member can be used not only with soil or rock anchors, but also in other areas.

This aim is fulfilled through the features cited in the characterizing part of patent claim 1 and in patent claim 5. It is advantageous if, in addition to the central member, at least an outer member can be completely severed. If the outer member in the region of the part of the tension member to be anchored is severed completely, a supporting element is pressed on the tension member round about the point of separation of the central member as well the point of separation of the outer member.

In the following the invention will be described by way of embodiments with reference to the drawings, in which:

Figure 1 is a partial sectional view of a tension member consisting of a steel-wire cord, the central member of which has been completely severed, having a supporting means pressed round about the point of separation,

Figure 2 is a cross-section of the tension member taken on the line II-II of Figure 1,

Figure 3 is a partial sectional view of the tension member of Figure 1 which has been torn apart near the point of separation of the central member,

Figure 4 is a partial sectional view of a tension member consisting of a central rod and several concentrically disposed parallel steel rods, the

central member and one outer member of which tension member have been severed, having a supporting element pressed round about both points of separation.

Figure 5 is a partial sectional view of the tension member of Figure 4 which has been torn apart near the two points of separation,

Figure 6 is a partial sectional view of a tension member consisting of a steel-wire cord, the central member of which has been severed, having a supporting element acting as a clamping wedge pressed round about the point of separation,

Figure 7 is a partial sectional view as in Figure 6, but of a tension element consisting of a central rod and several concentrically disposed parallel steel rods,

Figure 8 is a partial sectional view of the tension member of Figure 6, having a supporting element acting as a clamping wedge pressed round about the point of separation, the part of the tension member to be anchored being extended,

Figure 9 is a partial sectional view of the tension member of Figure 7, having a supporting element in the form of a collet pressed round about the point of separation, the part of the tension member to be anchored being extended, and

Figure 10 is a partial sectional view of the tension member of Figure 9, having a supporting element acting as a clamping wedge.

The procedure is as follows for making a tension member 1, composed of a central member 2 and several outer members 3 disposed concentrically thereto, intended to be anchored in the ground or in a structure, subjected to a load, and substantially removed from the ground or the structure after use: in a region L (see Figure 1) of the part 1a of tension member 1 to be anchored, central member 2 is severed completely. The tension member 1 of Figure 1 consists of a steel-wire rope. In this case, the drilled outer elements 3 of wire are spread apart, and through the opening thus produced the central member 2, also of wire, is sawn through. If tension member 1 consists of a central steel rod and several parallel outer steel rods disposed concentrically to the central rod, central member 2 consisting of the central steel rod, is sawn or cut through before tension member 1 is assembled.

After central member 2 has been severed completely, a supporting element 5 is pressed round about the point of separation 4. The supporting element 5 depicted in Figures 1, 3, 4, 5, and 9 is a collet pressed around tension member 1 in region L of part 1a. In Figures 6 and 8, supporting element 5, together with two wedge-shaped parts 14 and 15 disposed therein, acts as a wedge anchor. The surfaces of the inner wedge-shaped parts 14 and 15 resting against tension member 1 are provided with teeth 13. Figure 9 shows a lining 11 provided between the inside bore of collet 5 and the circumference of outer members 3, this lining being made of a material harder than that of collet

5 and tension member 1.

If a reduction of the load necessary for removing tension member 1 is desired, one or more of the outer members 3 is also severed. However, in no case are all the outer members 3 of the tension member 1 completely severed. Central element 2 is always severed completely. At least one outer element 3 is severed completely in region L of the part to be anchored 1a of the tension member 1, somewhere near the point of separation 4 of central member 2. Then, as described above, the supporting element 5 is pressed round about the tension member 1 in the region of the point of separation 4 and point of separation 6 of the outer member 3.

It is possible, however, to sever at least one outer element 3 outside zone L of the part to be anchored 1a of the tension member 1. In that case, supporting element 5 is pressed on the tension member 1 only around point of separation 4 of central element 2, while point of separation 6 of the outer element 3 remains without any supporting element.

In the tension member 1 made by the steps described above, the position of point of separation 4 of central member 2 can be fixed according to the size of the load P to be exerted on region L of the part to be anchored 1a of the tension member 1 during its removal. When the distance L_1 between point of separation 4 of central element 2 and the end of region L, lying in the direction of load to be applied P, is less than the distance L_2 between point of separation 4 and the end of region L lying in the opposite direction of the load to be applied P, the size of the load P to be exerted will be less than the load in the case where L_2 were smaller. In the critical range where $L_1 = L$ and $L_2 = 0$, the maximum required size of the load to be exerted for removing tension member 1 will be close to the breaking load of the intact tension member 1, without points of separation. Therefore, load P must be kept as small as possible, but greater than the required working load; one or more of the outer members 3 of tension member 1 can then also be severed in the vicinity of supporting element 5.

The load to be exerted for removing the assembled tension member 1 will be situated in the following critical range: required working load $<$ load P to be exerted for the purpose of removing the tension member $<$ breaking load of intact tension member.

In Figures 1, 3, 4, 5, 6 and 7 an abutment 8 is depicted against which the outer end of supporting element 5 is braced with its side turned away from the part to be anchored 1a. This abutment has the same function as the anchor body of a soil or rock anchor. Figures 6 - 10 show the active part of tension member 1 disposed in a protective pipe 9, the clearance space being filled with a lubricant 10.

The embodiments according to Figures 8 to 10 have an extended passive part 1a (the part of tension member 1 to be anchored) of the tension member 1 still anchored in a concrete body 12 behind supporting element 5. Outside

region L, collets 7 are shown on the parallel outer steel rods 3 disposed concentrically about a center rod 2. By means of these collets, the outer steel rods 3 are pressed against central rod 2 and are held together with the latter. Here an abutment is superfluous because concrete body 12 exerts a sufficient hold on supporting element 5 and passive part 1a.

Upon application of a load exceeding the tensile strength, all the non-severed outer members 3 of such a tension member 1 break in the vicinity of the supporting element 5, so that the major part of the tension member can, if necessary, be removed from the ground or the structure for reuse. The size of the load will be ascertained as a function of the proportion $L_1 : L_2$.

Patent Claims

1. Process for producing a tension member (1) to be anchored in the earth or structure and subjected to a load, composed of a central member (2) and several outer members (3) disposed concentrically with the central member (2), which tension member is intended to be removed for the most part from the earth or structure after its use, characterized in that at least the central member (2) of the tension member (1) is completely severed in the region (L) of its part (1a) to be anchored, after which a supporting element (5) is pressed round about the point of separation (4) of the tension member (1).

2. Process according to patent claim 1, characterized in that besides the central member (2) at least one outer member (3) is completely severed.

3. Process according to patent claims 1 and 2, characterized in that the outer member (3) is completely severed in the region (L) of the part (1a) of the tension member (1) to be anchored, after which a supporting element (5) is pressed on the tension member (1) round about the point of separation (4) of the central member (2) as well as the point of separation (6) of the outer member (3).

4. Process according to patent claim 2, characterized in that the outer member (3) is completely severed outside of the region (L) of the part (1a) of the tension member (1) to be anchored.

5. Tension member (1) produced by the process according to patent claim 1, consisting of a central member (2) and several outer members (3) disposed concentrically with the central member (2), having a central member (2) completely severed in the region (L) of its part (1a) to be anchored and a supporting element (5) pressed round about the point of separation (4), the position of the point of separation (4) of the central member (2) being determined according to the size of the load (P) to be exerted on the tension member (1) in the region (L) of the part (1a) of the tension member (1) to be anchored.

6. Tension member according to patent claim 5, characterized in that it

region L, collets 7 are shown on the parallel outer steel rods 3 disposed concentrically about a center rod 2. By means of these collets, the outer steel rods 3 are pressed against central rod 2 and are held together with the latter. Here an abutment is superfluous because concrete body 12 exerts a sufficient hold on supporting element 5 and passive part 1a.

Upon application of a load exceeding the tensile strength, all the non-severed outer members 3 of such a tension member 1 break in the vicinity of the supporting element 5, so that the major part of the tension member can, if necessary, be removed from the ground or the structure for reuse. The size of the load will be ascertained as a function of the proportion $L_1 : L_2$.

Patent Claims

1. Process for producing a tension member (1) to be anchored in the earth or structure and subjected to a load, composed of a central member (2) and several outer members (3) disposed concentrically with the central member (2), which tension member is intended to be removed for the most part from the earth or structure after its use, characterized in that at least the central member (2) of the tension member (1) is completely severed in the region (L) of its part (1a) to be anchored, after which a supporting element (5) is pressed round about the point of separation (4) of the tension member (1).

2. Process according to patent claim 1, characterized in that besides the central member (2) at least one outer member (3) is completely severed.

3. Process according to patent claims 1 and 2, characterized in that the outer member (3) is completely severed in the region (L) of the part (1a) of the tension member (1) to be anchored, after which a supporting element (5) is pressed on the tension member (1) round about the point of separation (4) of the central member (2) as well as the point of separation (6) of the outer member (3).

4. Process according to patent claim 2, characterized in that the outer member (3) is completely severed outside of the region (L) of the part (1a) of the tension member (1) to be anchored.

5. Tension member (1) produced by the process according to patent claim 1, consisting of a central member (2) and several outer members (3) disposed concentrically with the central member (2), having a central member (2) completely severed in the region (L) of its part (1a) to be anchored and a supporting element (5) pressed round about the point of separation (4), the position of the point of separation (4) of the central member (2) being determined according to the size of the load (P) to be exerted on the tension member (1) in the region (L) of the part (1a) of the tension member (1) to be anchored.

6. Tension member according to patent claim 5, characterized in that it



consists of a steel-wire rope.

7. Tension member according to patent claim 5, characterized in that it consists of a central steel rod and several outer steel rods running concentrically about the central steel rod and parallel to one another.

8. Tension member according to patent claim 7, characterized in that the outer steel rods are pressed against the central steel rod from the outside by collets (7) disposed outside of the region (L) of the part (1a) to be anchored.

