

European Patent 0 465 767

The invention relates to a reinforced concrete foundation pile made of reinforced, in particular prestressed concrete, having male thread turns and an inner cavity for engagement of the boring rod for imposing torsion. (Cf., for example, EP-A-0 127 221).

The manufacture of such piles involves considerable difficulties, which arise both from the complicated shaping due particularly to the male thread, and from the high standards of quality required, particularly in respect of the forces to be withstood when the pile is driven into the ground. Just as problematic is the task of manufacturing such foundation piles economically and yet such as to be capable of withstanding the necessary torsion stress. In general, the inner cavity is provided with a polygonal cross-section, into which a correspondingly formed boring rod engages; but this arrangement makes the manufacture of such piles extremely difficult. In this respect, it is less problematic to use a steel plate mounted at the head of the pile, having a recess corresponding to the outer contour of the engaging boring rod, although the use of such a steel head plate is extremely expensive. First of all the plate has to be fixed to the pile, and secondly it is of no further use once the pile has been driven into its functional position.

Efforts have therefore been oriented towards so forming foundation piles of the type mentioned in the introduction that, with the application of the known centrifuging technique they can be manufactured economically to a quality not achievable with conventional production methods. In particular, it is a question of improving the quality of the piles to the extent that the surface quality is decisively improved and is substantially free of cracks. These advantages have arisen from the application of the centrifuging method and the prestressing technique, which give rise to a foundation pile with perfect, concentric formation of the cavity with a circular cross-section. In order then to apply the necessary torsion via the boring rod, in this type of foundation pile at least two flat steel profiles are fixed in the pile wall, axially parallel and with approximately equal angular spacing, and project with approximately half their width freely into the inner cavity for engagement of the boring rod.

The step according to the invention assumes that such flat steel profiles can be exactly fixed in the centrifuging mould without great difficulty, so that when the pile is centrifuged, the cavity is formed virtually automatically with a perfect, circular cross-section, and the flat steel profiles can be so anchored in the pile wall that they are anchored with approximately half their width in the pile wall and project into the inner cavity of the pile with the other half of their width. A pile thus manufactured has all the advantages of the centrifuging technique. It is virtually crack-free and has a particularly high surface quality, and in a centrifuging mould, thread turns of a quality hitherto unknown can be made.

In the simplest case, two flat profiles lying diametrically opposite one another can be inserted into the wall, but three profiles, offset at 120° each, or more profiles can be mounted. The embodiment preferred depends on the special requirements of the application.

The invention provides the possibility, in a simple manner, of arranging the flat steel profiles in the region carrying the outer thread turns. In this manner, as is known, torsion can be transmitted particularly well to the pile. Another alternative is to dispose the flat steel profiles at the upper end of the pile, which permits better handling for driving in the pile and permits the use of a shorter boring rod.

It is within the scope of the invention, in the case of a foundation pile having a base plate carrying cutting blades, to fix, preferably weld, the flat steel profiles on to this base plate. The torsion to be exerted for driving the pile in then acts directly via the base plate on the base of the foundation pile. Another alternative is embodied in the independent notion of the invention that, in the case of a foundation pile of the corresponding type, driver projections for the boring rod to act on are fixed to the inner face of the base plate facing the inner cavity. This arrangement corresponds to the first embodiment mentioned, but here the flat steel profiles projecting from the pile wall into the inner cavity are only extremely short, which is obvious from the projections fixed to the base plate. Obviously in this case a correspondingly very long boring rod is required, but this has the advantage of improved power transmission to the pile tip.

In a further embodiment of the invention, recesses for the engagement of external projections disposed on the boring rod are provided on the upper end of the flat steel profiles, in the part projecting inside. In this embodiment, the boring rod is inserted into the cavity of the pile until the projections of the boring rod are level with the recesses in the flat steel profile. By slight rotation of the boring rod, the projections engage in the recesses and to a certain extent lead to a connexion between the boring rod and the flat steel profiles, according to the bayonet lock principle. In this manner, traction forces can be transmitted by the boring rod to the foundation pile in order to prevent the pile from being driven in too rapidly when torsion is applied. It is therefore no longer necessary to provide eyes on the head of the foundation pile, according to convention, for corresponding traction means to act on in order to exert traction on the pile. This considerably simplifies handling when such foundation piles are being inserted.

In a further embodiment of the fundamental notion of the invention, the boring rod is so formed that it almost fills the inner cavity of the pile and has longitudinally extending notches for the engagement of the flat steel profiles. Obviously, these notches and their arrangement correspond to the number and position of the flat iron profiles in the inner cavity of the pile. In this embodiment, torsion is effective over a considerable length of the pile. An alternative embodiment proposes, on the other hand, that the diameter of the boring rod is smaller than the radial distance between the flat steel profiles and that external drivers are provided on the boring rod to act tangentially on the flat steel profile and/or engage in the recesses of the flat steel profiles. In the former case, the boring rod acts in a more or less point-like manner on the flat steel profiles anchored in the wall of the pile.

The invention proposes, finally, that the flat steel profiles embedded in the wall are fixed at their outer circumference by a plurality of connecting rings spaced in the axial direction.

Further features, details and advantages of the invention will appear from the following description of a few preferred embodiments of the invention and with the aid of the drawing, in which:

Fig. 1 shows a foundation pile viewed from the side;

Fig. 2, the lower end of a foundation pile in section;

Fig. 3, a section along the line III-III in Fig. 2;

Fig. 4, a first and

Fig. 5, a second embodiment of the boring rod for cooperation with the flat steel profiles projecting into the inner cavity, and

Fig. 6, a further embodiment of the invention viewed in section through the lower end of the pile.

The foundation pile 1 consists of a concrete shaft 2. It is manufactured by the centrifuging process and bears a male thread 4 in the region of its lower end 3 and a base plate 5 at its lower end, to which cutting blades or the like 6 can be fixed. At the head 31 of the pile 1, in the embodiment shown here, two eyes 32 are provided to facilitate handling of the pile 1. The wall 7 of the pile 1 has in the embodiment shown in the Figures a thickness 8 above which, in the embodiment shown in the drawing, the thread turns 4 project on the outside in the region of the lower end 3 of the pile 1. The wall 7 is provided with a reinforcement 9. In the region of the lower end 3 having the thread turns 4, two flat steel profiles 10 are so mounted in the wall that they are embedded in the wall 7 with their outer half 11, whilst their inner half 12 projects into the inner cavity 14 of the pile 1 by the breadth 13. In the embodiment shown here, the flat steel profiles 10 are welded at their lower end 15 to the base plate 5. They are furthermore connected, and thus fixed relative to one another, by three spaced steel rings 16, 17, 18. The angular spacing of the two flat steel profiles 10 is 180° each in the embodiments shown in the drawing.

A torque is applied to the foundation pile 1 by the boring rod 20, which almost fills the inner cavity 14 in the embodiment shown in Fig. 4. The boring rod is provided at two diametrically opposite sides with a respective notch 21, which extends in the longitudinal direction and, upon insertion of the boring rod 20, is brought flush with the flat steel profiles 10, so that the profiles 10 finally engage in the notches 21 of the boring rod when the boring rod 20 is lowered. In the embodiment according to Fig. 5, on the other hand, a substantially thinner boring rod 22 is used, to the outer wall 23 of which two opposing, external projections 24 are fixed, which act on the flat steel profiles 10 when the boring rod 22 is inserted sufficiently far and rotated, and can thus transmit their torsion to these profiles 10 and hence to the shaft 2 of

the pile 1. The diameter 25 of this boring rod 22 is slightly smaller than the distance 26 between the two flat steel profiles 10.

Fig. 6 shows an embodiment in which, in the region of the upper end 27 of the flat steel profiles 10 notches 28 are formed opposite one another in the part of the flat steel profiles 10 projecting into the inner cavity. Correspondingly, external projections 29 are fixed to the outer circumference 23 of the boring rod 20 and are intended to engage in the notches 28 in order to transmit a corresponding traction in the direction of the arrow 30, from the boring rod to the pile 1.



Claims

1. Reinforced concrete foundation pile (1) made of reinforced, in particular prestressed concrete, having male thread turns (4) and an inner cavity (14) for engagement of the boring rod for imposing torsion, characterised in that at least two flat steel profiles (10) are fixed in the pile wall (7) in an axially parallel manner and at an approximately equal angular distance, said profiles projecting with approximately half their width (12) freely into the cavity (14) for engagement of the boring rod (20, 22).
2. Reinforced concrete foundation pile according to claim 1, characterised in that the flat steel profiles (10) are arranged in the lower region (3) bearing the male thread turns (4).
3. Reinforced concrete foundation pile according to claim 1, characterised in that the flat steel profiles (10) are located in the upper end region.
4. Reinforced concrete foundation pile according to claim 1, having a base plate bearing a blade, characterised in that the flat steel profiles (10) are fixed, preferably welded, to the base plate (5).
5. Reinforced concrete foundation pile according to one of claims 1 to 3, characterised in that driver projections for the boring rod (20, 22) to act on are fixed to the inner face of the base plate (5) associated with the inner cavity (14).
6. Reinforced concrete foundation pile according to one or more of claims 1 to 5, characterised in that recesses (28) for the engagement of external projections (29) located on the boring rod (22) are disposed at the upper end (27) of the flat steel profiles (10) in the the inner projecting part (12).
7. Reinforced concrete foundation pile according to claims 1 to 5, characterised in that the boring rod (20) approximately fills the cross-section of the inner cavity (14) and has longitudinal notches (21) for the engagement of flat steel profiles (10).



8. Reinforced concrete foundation pile according to claims 1 to 6, characterised in that the diameter (25) of the boring rod (22) is smaller than the radial distance (26) between the flat steel profiles (10), and external drivers (24) are disposed on the boring rod (22) for tangential engagement with the and/or engagement in the recesses (28) of the flat steel profiles.

9. Reinforced concrete foundation pile according to at least one of claims 1 to 8, characterised in that the flat steel profiles (10) are fixed in the wall (7) by a plurality of axially spaced rings (16, 17, 18) fixed at their outer edge.