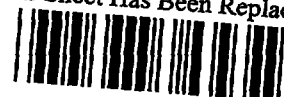


FOUNDATION PILE OF REINFORCED CONCRETE

The invention relates to a foundation pile of reinforced concrete with external threads and an internal hollow space for engagement by the revolving rod assembly applying the torsional force.

The production of such piles presents appreciable difficulties which, on the one hand, are based, above all on the conformation, which is complicated by the external thread, and, on the other, however, are also due to the high quality requirements, which arise primarily due to the forces, which must be absorbed during the screwing into the ground. The task of producing such foundation piles inexpensively in a manner suitable for absorbing torsional forces required presents just as many problems.

In the EP 0 127 221 A1, it has already been proposed for this purpose that the internal hollow space of the foundation pile be provided with a multi-angular cross section, which is engaged by a similarly shaped revolving rod assembly. This construction, however, makes the production of these piles extremely difficult. In this respect, the use of a steel plate, mounted at the head of the pile and having a cutout corresponding to the external contour of the engaging revolving rod assembly, is less problematical. The use of such a head steel plate is, however, exceedingly cost intensive. On the one hand, such a plate must first of all be fastened to the foundation pile while, on the other, after the pile has been screwed into the ground, it is no longer used. Furthermore, the use of this head steel plate also has the disadvantage that only limited lengths of foundation piles can be used, as otherwise, if the friction of the ground is high, the torsional force cannot be transferred from the head of the pile to its lower, advancing head plate and the danger of shearing off exists.



It is therefore an object of the invention to improve the foundation pile of the type disclosed in EP 0 127 221 A1, as well as the process of manufacturing such a pile, which can be inferred from said publication, so that the pile can be manufactured in a cost-saving manner and in a high quality with respect to the surface quality and the absence of cracks.

Pursuant to the invention, this objective is accomplished owing to the fact that the foundation pile is composed of at least two separately manufactured pile sections, in each case several wave anchors being provided, which are tied into the reinforcement and preferably are embedded in concrete equidistantly over the periphery, of which the one has a shell leading into the contiguous surface and the other has a pin, which engages the shell and protrudes over the opposite contiguous surface and which wave anchors are provided in each case with transverse recesses, aligned in the installed position for a connecting dowel, which can be inserted from the outside in a blind transverse recess of the concrete wall and owing to the fact that, in the - circular in cross section and facing the interior hollow space - concrete surface of the pile wall of the lowest section of the pile carrying the external threads, at least two flat-rolled steel profiles, the longitudinal axis of which is parallel to the longitudinal axis of the pile, are embedded at about the same angular distance from one another in such a manner, that they protrude with about half the width of their long cross sectional sides freely into the inner hollow space serving for the engagement of the revolving rod assembly and owing to the fact that the flat-rolled steel profiles are fastened and, preferably welded to the foot plate.

By means of the inventive arrangement, very long foundations piles can be assembled in a cost-saving manner from a plurality of shorter pile sections, which are easier to manufacture. At best, the lowest section and the head section are specially manufactured, different components while, between them, one or more identical pile



sections can be connected, in order to be able to achieve a length of these middle sections, which corresponds to a grid-like length extension.

Even for dimensions of foundation piles, which could actually still be manufactured in one piece, the inventive division has the advantage of significantly reducing costs, since it is much easier to manufacture the intermediate pieces than a single long foundation pile.

In a further development of the invention, provisions can advantageously be made so that the connecting dowel, the blind transverse recess and the transverse recess of the shell are constructed conically, so that, on the one hand, an exact fit is achieved when two sections of the pile are assembled and, on the other, tensile forces are exerted by the conical connecting dowel on the respective pin of the counter-wave-anchor of the contiguous pile section, so that the pile sections are pressed strongly together. Preferably, four or more wave anchors, distributed over the periphery of the pile, are provided at each contiguous surfaces of a pile section.

Due to the exact positioning of the pile sections in the direction of rotation about the longitudinal axis of the pile, required during the assembly, the advantageous possibility also arises of inserting injection pipes easily in such a manner, that such pipes, which extend essentially axially parallel and discharge preferably in the region of the foot plate of the lowest pile section, are inserted in the walls of the pile sections. In the contiguous surfaces, the injection pipes are provided with coupling connections, which form a continuous connection between the aligned injection pipes simply by inserting one pile section into another during the assembly. These injection pipes may be constructed as flexible hoses or PVC pipes.

In the simplest case, two flat-rolled profiles, lying opposite one another on one diameter, are put in place in the wall. It is, however, also entirely possible to



mount three profiles, each offset by 120° , or also more profiles. Which embodiment is given preference depends here on the special features of the individual case.

Pursuant to the invention, the flat-rolled steel profiles are disposed in the region of the pile carrying the external threads. As is well known, the torsional forces can be transferred particularly well to the pile in this way.

Fastening and preferably welding the flat-rolled steel profiles to the foot plate forms a part of the invention. The torsional force, which must be applied for screwing in the foundation pile, then acts directly over the foot plate on the foot of the foundation pile.

One embodiment of the invention consists therein that, in the case of a foundation pile of the appropriate type, the flat-rolled steel profiles, fastened to the inner surface of the foot plate facing the inner hollow space, are constructed as driving projections of extremely short length in the direction of the longitudinal axis of the pile for acting upon the revolving rod assembly. This arrangement corresponds to the aforementioned embodiment. However, the flat-rolled steel profiles, which protrude from the pile wall into the inner hollow space, assume only an extremely short length here, which is expressed by the projections fastened to the foot plate. It is obvious that, in this case, boring rods of appropriate length are required. However, this has the advantage of a better force transfer to the tip of the pile.

In a further development of the invention, provisions can be made so that, at the flat-rolled steel profiles in the region of its upper end in its part protruding into the inner hollow space, recesses are disposed for engaging outer projections mounted at the revolving rod assembly. For this embodiment, the revolving rod assembly is moved into the inner hollow space of the pile, until the projections of the revolving rod assembly are



opposite recesses in the flat-rolled steel profiles. By twisting the revolving rod assembly slightly, the projections are caused to engage the recesses and thus lead to a connection between the revolving rod assembly and the flat-rolled steel profiles in the manner similar to that of the bayonet catch principle. Tensile forces can also be transferred in this manner from the boring rods to the foundation pile in order to prevent an excessive tightening of the pile when a torsional force is applied. With that, it is possible to do without the previously customary lugs at the head of the foundation pile, which are engaged by appropriate tensile means in order to be able to exert a tensile force on the pile. The handling during the putting in place of such foundation piles is simplified appreciably by these means.

Finally, the invention provides for the possibility of fixing the flat-rolled steel profiles in the wall at a distance from one another by several rings, which are disposed at a distance from one another in the axial distance of the pile and fastened to the outer edge of the flat-rolled steel profiles.

The invention is described in greater detail below with the help of a few preferred embodiments and by means of the drawing, in which

- Figure 1 shows a foundation pile in side view,
- Figure 2 shows the lower end of a foundation pile in section,
- Figure 3 shows a section along the line III-III of Figure 2,
- Figure 4 shows a first and
- Figure 5 shows a second embodiment of a revolving rod assembly for interaction with the flat-rolled steel profiles protruding into the interior hollow space,
- Figure 6 shows a further embodiment of the invention in section through the lower end of the pile,
- Figure 7 shows an enlarged plan view of the contiguous surface of a pile section and



Figure 8 shows an angled section, on the same scale as Figure 7, along the line VIII-VIII of Figure 7 in the region of contact between two pile sections.

The foundation pile 1 consists of a shaft 2 of concrete. It is produced by a centrifugal method and has, in the region of its lower end 3, an exterior thread 4 and, at its lower end, a foot plate 5, to which cutting knives 6 or the like can be fastened. For the embodiment shown here, two lugs 32 for handling the pile are mounted at the head 31 of the pile 1. For the embodiments shown in the Figures, the wall 7 of the pile 1 has a thickness 8, beyond which the threads 4 protrude on the outside in the region of the lower end 3 in the case of the embodiment reproduced in the drawing. The wall 7 is provided with a reinforcement 9. In the region of the lower end 3 carrying the threads 4, two flat-rolled steel profiles 10 are brought into the wall 7 in such a manner, that they are embedded with their outer half 11 in the wall 7, while the inner half 12 protrudes by the width 13 into the inner hollow space 14 of the pile 1. In the case of the embodiment reproduced here, the flat-rolled steel profiles 10 are welded at their lower end 15 to the foot plate 5. They are furthermore connected by three steel rings 16, 17, 18, which are disposed at a distance from one another, and, with that, fixed relative to one another. In the case of the embodiments reproduced in the drawing, the angular distance between the two flat-rolled steel profiles 10 is always 180° .

A torque is exerted on the foundation pile 1 by the revolving rod assembly 20, which approximately fills the inner hollow space 14 in the case of the embodiment reproduced in Figure 4. At two diametrically opposite sides, the revolving rod assembly 20 is provided with a notch 21, which extends in the longitudinal direction and, during the insertion of the revolving rod assembly 20, is brought into alignment with the flat-rolled steel profiles 10, so that the profiles 10, during the lowering of the revolving rod assembly 20, finally engage the notches 21 of the boring rods. On the other hand, in the case of the embodiment of Figure 5, a significantly thinner revolving



rod assembly 22 is used, at the outer wall 23 of which two mutually opposite external projections 24 are fastened which, after appropriate further insertion of the revolving rod assembly 22, engage the flat-rolled steel profiles upon rotation of the revolving rod assembly 22 and can exert their torsional force on these profiles 10 and, with that, on the shaft 2 of the pile 1. The diameter 25 of this revolving rod assembly 22 is slightly less than the distance 26 between the two flat-rolled steel profiles 10.

Figure 6 shows an embodiment for which, in the region of the upper end 27 of the flat-rolled steel profiles 10, in the part 12 of the flat-rolled steel profiles 10 protruding into the inner hollow space, notches 28 are provided in opposite arrangement. In an appropriate manner at the outer periphery 23 of the revolving rod assembly 20, external projections 29 are fastened, which are intended to engage the notches 28 in order to be able to transfer from the revolving rod assembly an appropriate tensile force in the direction of arrow P on the pile 1.

The foundation pile 1, described above, is assembled from three separately manufactured pile sections 1a, 1b and 1c. If necessary, several middle pieces 1b can be inserted additionally, in order to achieve a corresponding extension of the foundation pile. At the places of contact between joined pile sections, wave anchors, which are constructed in a complementary manner to one another, are provided in the contiguous surfaces. This will be explained by means of the transition between the pile sections 1b and 1c by means of Figures 7 and 8.

In the wall 7 of the middle pile section 1b, four wave anchors 32 are embedded, which are offset in each case by 90° from one another, are tied in to the reinforcement 9, 33 by welded-on anchoring rods 33 and otherwise embedded in concrete in the wall 7. The wave anchor 32 has a shell 34, which leads into the

contiguous surface 31. This shell 34, as is the blind transverse recess 35 in the wall 7, is constructed conically, in order to be able to take up a conical connecting dowel 36.

The respective counter-component, that is, the pile section 1c in the present case, is provided with a wave anchor 32', which is embedded in the same manner once again over the anchoring rod 33 in the reinforcement. The wave anchor 32' has a pin 37, which protrudes over the opposite contiguous surface 31' of the pile section 1c into the shell 34 and is also provided with a transverse borehole 38, which optionally is also conical. The connecting dowel 36 in the blind transverse recess 35 penetrates the transverse recess of the shell and of the pin and locks these firmly together, aided by the conical construction with mutual bracing.

Injection pipes 39, which extend essentially axially parallel, are embedded in the wall 7 of the foundation pile. For the sake of better clarity, these injection pipes are shown only in Figures 7 and 8. The injection pipes 39 are formed either from flexible hoses or from PVC pipes and are provided with hose coupling sections 40 and 40', which lead into contiguous surfaces 31, 31' in order to form a continuous injection pipe connection when two pile sections are assembled and connected. These injection pipes discharge at various places in the region of the tip of the pile, that is, in the region of the foot plate, as well as optionally also in the region of the walls, in order to be able to attain consolidation of the ground around the injection pile by injecting suitable sludges. This is not shown in detail in the drawings.





Claims

1. A foundation pile of reinforced concrete with external threads and an internal hollow space for engagement by the revolving rod assembly applying the torsional force, characterized in that the foundation pile is composed of at least two separately manufactured pile sections (1a, 1b, 1c), in each case several wave anchors (32, 32') being provided, which are tied into the reinforcement (9, 30) and preferably are embedded in concrete equidistantly over the periphery, of which the one (32) has a shell (34) leading into the contiguous surface (31) and the other has a pin (37), which engages the shell (34) and protrudes over the opposite contiguous surface (31') and which wave anchors (32, 32') are provided in each case with transverse recesses, aligned in the installed position for a connecting dowel (36), which can be inserted from the outside in a blind transverse recess of the wall (7) and in that, in the - circular in cross section and facing the interior hollow space (14) - concrete surface of the pile wall (7) of the lowest section (1a) of the pile carrying the external threads (4), at least two flat-rolled steel profiles (10), the longitudinal axis of which is parallel to the longitudinal axis of the pile, are embedded at about the same angular distance from one another in such a manner, that they protrude with about half the width (13) of their long cross sectional sides freely into the inner hollow space (14) serving for the engagement of the revolving rod assembly (20, 22) and in that the flat-rolled steel profiles (10) are fastened and, preferably welded to the foot plate (5).

2. The foundation pile of claim 1, characterized in that the connecting dowel (36), the blind transverse recess (35) as well as the transverse recess of the shell are constructed conically.





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3. The foundation pile of claims 1 or 2, characterized in that essentially axially parallel injection pipes (39), which discharge at the tip or the wall of the pile, are inserted in the wall (7) of the piles sections (1a, 1b, 1c) for introducing an injection material and are provided at their contiguous surfaces (31, 31') with coupling connections (40, 40').

4. The foundation pile of claim 3, characterized in that the injection pipes (39) are flexible hoses or PVC pipes.

5. The foundation pile of one of the claims 1 to 4, characterized in that the flat-rolled steel profiles (10), fastened to the inner surface of the foot plate (5) facing the inner hollow space (14), are constructed as driving projections of extremely short length in the direction of the longitudinal axis of the pile for engaging the revolving rod assembly (20, 22).

6. The foundation pile of one of the claims 1 to 5, characterized in that recesses (28) for engaging external projections (29) mounted on the revolving rod assembly (22) are disposed at the flat-rolled steel profiles (10) in the region of its upper end (27) in its part (12) protruding into the inner hollow space (14).

7. The foundation pile of one of the claims 1 to 6, characterized in that the flat-rolled steel profiles (10) are fixed in the wall (7) at a distance from one another by several rings (16, 17, 18), which are disposed at a distance from one another in the axial direction of the pile (1) and fastened to the outer edge of the flat-rolled steel profiles (10).





8. A method for the production of a foundation pile of one of the claims 1 to 7, characterized in that the pile sections are covered by concrete by a centrifugal method, the flat-rolled steel profiles being fixed in a centrifugal mold and, during the centrifuging of the pile, being embedded with about half the width of their long cross sectional side in the wall of the pile.

