

BORED PILES

The present invention relates to bored piles, that is to say foundation piles of the type which are made by boring a hole into the ground and then substantially filling the hole with grouting material. Due to the fact that such bored piles are generally relatively small, they are commonly referred to as steel tube reinforced bored micropiles.

When known bored piles are installed, a hole is firstly drilled into the ground by means of a rotary auger or the like. An outer steel lining or casing is typically inserted into the hole as boring progresses to prevent collapse of the hole, the outer casing is usually installed in segments of e.g. 1 or 1.5 metres in length, adjacent ends of abutting segments being screw-threaded to permit them to be connected or spliced together. The outer lining is normally required only for the top few metres of soft soil. Water is typically pumped down into the bored hole so as to continuously remove drilled debris and to stabilise the hole. Once the required depth of the hole has been reached, the drill rod is removed. Steel reinforcement bars are then generally lowered into the hole. It is not usually practicable to use a single reinforcement bar whose length is the same as that of the hole and for this purpose the or each reinforcement bar is typically provided in a number of adjacent sections. It is necessary to connect together adjacent sections of the or each reinforcement bar to ensure that it has the necessary structural strength and integrity and for this purpose threaded couplings are provided at the ends of each reinforcement bar section. In practice, one, three or four reinforcement bars are used because there is generally not room for more than four such bars, particularly when threaded couplings are used since

these take up a considerable amount of space. When three or four reinforcement bars are used, the location of the couplings on each reinforcement bar usually have to be longitudinally offset because if they all occurred at the same longitudinal positions of the pile there would either frequently be
5 insufficient space for them or they would take up an unacceptably high proportion of the cross-sectional area of the pile.

Once the reinforcement bar or bars have been positioned, a grouting tube is lowered to the bottom of the hole and cementitious grout is pumped in to
10 displace the water and fill all the gaps. The grout acts as a filling confining medium and transfers the applied load from the reinforcement bars to the surrounding soil. Once the grouting process has been completed, the grouting tube is removed. The outer steel lining may then be removed or alternatively left in situ.

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It will be appreciated that the provision of threaded couplings at the ends of reinforcement tube sections considerably adds to their expense. Furthermore, the coupling together of adjacent ends of the reinforcement bar sections adds considerably to the complexity and time required for installing bored piles.
20 This latter problem is particularly acute if a number of reinforcement bars are used with their couplings longitudinally offset.

Accordingly, it is the object of the invention to provide a method of installing a bored foundation pile and a foundation pile in situ in which the above problems
25 are substantially eliminated or at least considerably reduced and which, in particular, enable a pile to be installed more cheaply and rapidly.

According to the present invention, a method of installing a foundation pile includes boring a hole in the ground, inserting a metallic reinforcing pipe substantially centrally into the hole, whereby the metallic pipe extends continuously over substantially the entire length of the hole, and subsequently
5 filling the remainder of the hole with grouting material.

Thus the method in accordance with the invention is generally similar to the known method but the one or more reinforcement bars which were previously used are replaced by a single substantially central metallic reinforcing pipe.
10 Such pipes are readily commercially available at low cost and the fact that only a single pipe is used instead of, typically, a number of reinforcement bars results in the installation process being considerably more rapid than previously.

It is preferred that the method includes lining at least a proportion of the length
15 of the hole in the ground, typically its upper portion, with a metallic liner to prevent collapse of the hole.

It is again generally not practicable for the metallic reinforcing pipe to be provided in a single length and it is therefore preferred that it constitutes two or
20 more sections and that the method includes connecting the said sections together. It will be appreciated that it is of course very much simpler and faster to connect together adjacent sections of a single metallic pipe rather than adjacent sections of a number of reinforcement bars.

The present invention also relates to a foundation pile produced by such a
25 method and therefore embraces a foundation pile in situ in a bored hole in the ground comprising solidified grouting material, embedded within which and

extending continuously over substantially the entire length of which is a metallic reinforcing pipe which extends substantially centrally. It is again preferred that at least a portion of the hole, typically only the upper portion of the hole, is lined with a metallic liner to prevent collapse of the hole.

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The metallic reinforcing pipe will typically comprise two or more sections which are connected together. The connection can be conveniently and rapidly effected by means of a rotary coupling which requires rotation through less than 180° to effect full connection or disconnection of each adjacent pair of pipe sections. It is preferred that the rotary coupling is of the type disclosed in British Patent Application No. 2266110, the disclosure of which is incorporated herein by reference. Thus it is preferred that one end of one of each adjacent pair of pipe sections includes a plate which extends axially on a diametral plane and projects out of the associated end of the pipe section, the projecting portion of the plate having respective opposed slots in its side surfaces, and the adjacent end of the other of the pair of pipe sections has an annular flange which is connected to the internal surface of the pipe section and is inclined to the radial plane of the pipe section and has two diametrically opposed discontinuities or holes in it, whereby the axial plate on the said one pipe section may be introduced into the said other pipe section through the holes in the annular flange until the slots are aligned with the annular flange, whereafter the two pipe sections may be rotated relative to another to lock them together. Alternatively, the coupling may be of the type disclosed in GB-A-2294078 or SG-A-9500315-8.

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Further features and details of the invention will be apparent from the following description of one specific embodiment of the invention which is described by

way of example with reference to the accompanying single diagrammatic drawing which is an axial sectional view of a bored pile in accordance with the invention in situ in a hole in the ground.

- 5 As a first step, an elongate circular section hole 2 is drilled downwardly by a conventional drill or auger into a body of soil 4. As drilling proceeds, a steel lining tube 6 is initially inserted into the upper portion of the hole, as it is drilled, so as to prevent the sides of the hole collapsing. In practice, this is only necessary, if at all, over the top few metres of the hole because soil is generally
- 10 sufficiently consolidated below this depth to be stable and thus not to collapse inwardly into the hole. When the hole has been drilled to the desired depth, the drill or auger is removed. A reinforcing steel tube or pipe 8 is then lowered down into the hole over its entire length and positioned so as to extend substantially coaxially with it. In practice, it is not possible for the reinforcing
- 15 pipe to constitute a single unitary unit and it is in the form of a plurality of pipe sections. Accordingly, a plurality of pipe sections are successively connected together by means of coupling elements at the adjacent pairs of ends to form couplings 10. These couplings are in accordance with the disclosure in British Patent Application No. 2266110 and will therefore not be described in detail.
- 20 Suffice it to say, that the coupling elements are such that rotation of one pipe section relative to the adjacent pipe section through 180° or less is sufficient to rigidly connect the adjacent pipe sections together. In order to ensure that the reinforcing pipe 8 is situated substantially centrally in the hole 2, resilient spacer elements 12 are provided on its exterior, e.g. one on each pipe section,
- 25 which are dimensioned substantially so as to contact the opposite edges of the hole. These spacers 12 are of light resilient construction and are either connected to or, more preferably, are simply slipped over the associated pipe

section. They are constructed to engage or at least closely approach the surface of the hole at three or more angularly spaced positions and thus maintain the pipe sections, and thus the entire pipe, substantially centrally within the hole.

- 5 During the drilling process, water is constantly introduced into the hole to remove drilling debris and to maintain the sides of the hole stable, in the usual manner. This water fills the hole to the top and is still within the hole when the reinforcing pipe is inserted. However, once the reinforcing pipe has been inserted, a grout supply pipe is lowered to the bottom of the hole, either inside
- 10 or outside the pipe, and grout 18, typically of cementitious type, is pumped into the hole. This progressively fills the hole from the bottom and displaces the water. It is desirable that the interior of the reinforcing pipe 8 also be filled with grout, so as to displace the water within it and prevent corrosion and to assist the structural stability of the pile, and for this purpose the pipe is lifted
- 15 slightly during the grouting process so that grout may fill the interior of the pipe at the same time as it fills the space outside the pipe. Alternatively, once the interior of the hole outside the reinforcing pipe has been filled with grout, the grout supply pipe is removed and then lowered into the interior of the reinforcing pipe which is then filled with grout. Alternatively, the interior of
- 20 the reinforcing pipe may be filled with grout before the remainder of the hole.

- As may be seen, the upper section of the reinforcing pipe 8 extends a certain distance above ground level, as also does the steel lining pipe 6. A bearing plate 14 is then attached, e.g. by welding, to the upper end of the pipes 6 and 8.
- 25 Steel bars 16 may then be attached to the bearing plate 14, e.g. by welding, to form a secure anchor for concrete or the like. A concrete raft or concrete beam is then typically poured or cast around the protruding end of the pile and the

bearing plate 14 and the steel bars 16 which are thus anchored firmly within the concrete, once solidified.

CLAIMS

1. A method of installing a foundation pile including boring a hole in the ground, inserting a metallic reinforcing pipe substantially centrally into the hole, whereby the metallic pipe extends continuously over substantially the entire length of the hole, and subsequently filling the remainder of the hole with grouting material, the metallic pipe including two or more sections and the method including connecting adjacent pairs of pipe sections together by means of a rotary coupling which requires rotation through less than 180° to effect full connection or disconnection of the pair of pipe sections.
2. A method as claimed in Claim 1 which includes lining at least a proportion of the length of the hole in the ground with a metallic liner to prevent collapse of the hole.
3. A method as claimed in Claim 2 in which only the upper portion of the hole is lined with the metallic liner.
4. A foundation pile in situ in a bored hole in the ground comprising solidified grouting material embedded within which and extending continuously over substantially the entire length of which is a metallic reinforcing pipe which extends substantially centrally, the metallic pipe comprising two or more sections which are connected together, each adjacent pair of pipe sections being connected by means of a rotary coupling which requires rotation through less than 180° to effect full connection or disconnection of the pair of pipe sections.
5. A pile as claimed in Claim 4 in which at least a portion of the hole is lined with a metallic liner.
6. A pile as claimed in Claim 4 in which only the upper portion of the hole is lined with a metallic liner.
7. A pile as claimed in any one of Claims 4 to 6 in which one end of one of each adjacent pair of pipe sections includes a plate which extends axially on a diametral plane and projects out of the associated end of the pipe section, the projecting portion of the plate having respective opposed slots in its side surfaces, and the adjacent end of the other of the pair of pipe sections has an annular flange which is connected to the internal surface of the pipe section and is inclined to the radial plane of the pipe section and has two diametrically opposed discontinuities or

holes in it, whereby the axial plate on the said one pipe section may be introduced into the said other pipe section through the holes in the annular flange until the slots are aligned with the annular flange, whereafter the two pipe sections may be rotated relative to another to lock them together.