

PILE CONSTRUCTION

Field of Invention

The present invention relates to pile construction. In particular, the present invention relates to a construction support, a pile-assembling arrangement, a means for maintaining a pile at a
5 desired depth or level, a kit, and a method of making an elongate pile in a bore.

Background

Piles are used to support overlying structures, such as buildings or bridges. Typically, a bore is formed in the ground, usually by drilling, and a pile formed in the bore. Such piles are
10 usually formed from concrete or similar material, and may be provided with reinforcement, such as steel bars or mesh. Many methods are known for constructing piles. For example, a pile may be formed in situ by casting concrete in the bore. This requires the transportation and use of large volumes of liquid cement/concrete, which may be undesirable. Alternatively, piles may be formed prior to insertion in the bore. This may present problems in handling
15 larger and/or longer piles, and it may be difficult to install a pre-formed pile vertically in a bore than has not been drilled vertically. In order to address these issues, it has been proposed to form a stack of pile sections in a bore. The stack is formed from the bottom up, but this can be difficult, particularly in deeper bores, and particularly when these deep bores use polymer or bentonite stability fluid essentially meaning that such stacking is carried out 'blind'. It may
20 also be difficult to attach adjacent pile sections together when working at depth, and the positioning of the stack within the bore can be difficult to manage. The present invention seeks to mitigate the above-mentioned problems. Alternatively or additionally, the present invention seeks to provide an improved way of constructing piles.

Summary of Invention

In accordance with a first aspect of the present invention, there is provided a construction support for supporting one or more pile sections during construction of a pile, the construction support comprising:

an opening for the receipt of, and passage therethrough, of a pile section, the construction support being configured to support one or more pile sections received through said opening; and

one or more positioners configured to position a pile section within the opening.

- 5 The construction support may optionally be configured to be at least partly received within a bore in which a pile is to be constructed. For the avoidance of doubt, a pile is a construction pile, typically being capable, on its own or with other piles, of supporting an overlying structure, such as a building or a bridge.

- 10 The construction support may optionally be configured to be attached to a casing, which casing is at least partly received within a bore in which a pile is to be constructed. The casing may comprise a sleeve portion. The casing may be in the form of a sleeve. The construction support is optionally configured to receive, and support, a pile section having an outer dimension (such as an outer diameter) that is substantially smaller than an internal dimension (such as the diameter) of the opening. The construction of a pile in a larger bore facilitates the
- 15 construction of vertical piles in a bore that is not vertical. This is of particular benefit for deep piles (such as piles having a depth of at least 20m, for example), because deeper piles have a tendency to be non-vertical. The construction support is optionally configured to receive, and support, a pile section having an outer dimension (such as an outer diameter) that is no more than 90% of the internal dimension (such as the diameter) of the opening, optionally
- 20 configured to receive, and support, a pile section having an outer dimension (such as an outer diameter) that is no more than 80%, optionally no more than 70%, optionally no more than 60% and optionally no more than 50%, of the internal dimension (such as the diameter) of the opening.

- 25 The construction support may comprise a portion to be at least partly received within a bore or within a casing to be received within a bore. Alternatively, the casing could be received by the portion of the construction support. Said portion of the construction support may be substantially cylindrical. Optionally, said portion may be tubular. Said portion may comprise one or more male or female portions for mating with one or more corresponding male or female portions provided by the casing. For example, the portion that is, in use, at least partly
- 30 received with a casing may comprise one or more recesses or apertures for receiving a corresponding projection provided by the casing. The construction support is optionally configured to be attached to the casing. Such an arrangement facilitates the transmission of

forces from a pile, into the construction support and into a casing. The casing is optionally configured to engage with, or be secured to, one or more bore wall(s). This arrangement facilitates the transmission of forces from a casing into the ground around a bore.

The construction support may comprise an outwardly-projecting flange. The flange may
5 project outwardly from a main body of the construction support. The main body may optionally comprise a substantially cylindrical portion and the main body may optionally be substantially cylindrical. The flange may optionally be substantially annular.

Optionally at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening comprises a member for contacting a pile section.
10 Optionally, at least one, optionally more than one and optionally each member for contacting a pile section comprises a roller. Optionally, at least one, optionally more than one and optionally each member for contacting a pile section comprises a wheel. Optionally, at least one, optionally more than one and optionally each member for contacting a pile section is configured to engage with a pile section to inhibit rotation of a pile section, optionally about a
15 longitudinal axis of a pile section. Optionally, at least one, optionally more than one and optionally each member for contacting a pile section is configured to be at least partly received by a female configuration provided by a pile section. Optionally, at least one, optionally more than one and optionally each member for contacting a pile section is configured to be at least partly received by a recess provided by a pile section. Optionally, at
20 least one, optionally more than one and optionally each member for contacting a pile section is configured to be at least partly received by a groove provided by a pile section.

Optionally at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening comprises a guide surface for guiding a pile section towards the opening. Such a positioner typically guides a pile section towards the opening,
25 thereby positioning the pile section within the opening. This may reduce the handling of the pile section that is needed. Optionally at least one, optionally more than one and optionally each guide surface for guiding a pile section towards the opening may flare outwardly from a first guide surface portion to a second guide surface portion, the first guide surface portion being located closer to the opening than the second guide surface portion. Such a positioner
30 typically helps guide a pile section towards the opening. Optionally at least one, optionally more than one and optionally each guide surface for guiding a pile section towards the opening may comprise a first guide surface portion located at a radial distance relative to a

centre of the opening that is smaller than the radial distance of a second guide surface portion.

As mentioned above, the construction support may comprise more than one positioner configured to position a pile section within the opening. For example, the construction support may comprise a plurality of positioners configured to position a pile section within the opening, each positioner comprising a guide surface for guiding a pile section towards the opening. The plurality of positioners may be located (optionally circumferentially) about the opening. Such an arrangement facilitates guiding of the pile section into the opening.

Optionally, the construction support is configured such that at least one, optionally more than one and optionally each member for contacting a pile section is resiliently urged into a portion of pile extending into or through the opening.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening comprises a biasing means (optionally a biasing member) for exerting a force on a pile section extending into or through the opening.

Optionally, the construction support is configured such that at least one, optionally more than one and optionally each biasing means urges a respective member for contacting a pile section into a pile section extending into or through the opening.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening is movable.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening is lockable in a plurality of different positions, optionally to facilitate receipt of different sized portions of pile.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening may be secured in a first position and in a second position, the first position being closer to a centre of the opening than a second position.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening may be secured in a plurality of positions, wherein in each position, the respective positioner configured to position a pile section within the opening is a different distance from the centre of the opening.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening may be secured in a plurality of different lateral or circumferential positions. Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening may be secured in a plurality of different lateral or circumferential positions, and a plurality of different positions in which the positioner is a different distance from the centre of the opening.

The ability to alter the positions of one or more of the positioners may facilitate the correct alignment of a pile in an off-centre bore, for example.

Optionally, at least one, optionally more than one and optionally each positioner configured to position a pile section within the opening is associated with, and optionally attached to, an upper surface of the construction support, such as an upper surface of a flange, if present.

Optionally, the construction support comprises a plurality of positioners configured to position a pile section within the opening. For example, the construction support may comprise 3 or 4 positioners configured to position a pile section within the opening.

Optionally, more than one and each of the plurality of the positioners configured to position a pile section within the opening are mutually-identical. Optionally, the plurality of positioners configured to position a pile section within the opening are distributed substantially uniformly around the opening.

The construction support may optionally comprise a pile section holder operable between a holding configuration in which a pile section is secured and a non-holding configuration in which the pile section is movable. In the holding configuration, the pile section is optionally secured sufficiently firmly to facilitate placement of another pile section on top of the pile section held by the pile section holder without movement of the pile section held by the pile section holder. Optionally, in the holding configuration, the pile section holder may be capable of supporting the weight of a complete pile. Optionally, in the holding configuration, the pile section holder may be capable of withstanding the upthrust exerted by a complete pile immersed in a liquid. The pile section holder may optionally be operable between an extended, holding configuration in which a pile section is secured and a retracted, non-holding configuration in which the pile section is movable.

The pile section holder optionally comprises one or more (and optionally a plurality of) pile section holder units. Optionally, at least one, optionally more than one and optionally each pile section holder unit is operable between a unit holding configuration in which a pile

section is secured and a unit non-holding configuration in which the pile section is movable. Optionally, at least one, optionally more than one and optionally each pile section holder unit is operable between an extended configuration in which a pile section is secured and a retracted configuration in which the pile section is movable. If the pile section holder

5 comprises a plurality of pile section holder units, then optionally the pile section holder units may be placed about the opening, optionally uniformly. Optionally, the pile section holder may comprise at least three, optionally four, and optionally no more than six pile section holder units.

Optionally, at least one, optionally more than one and optionally each pile section holder unit

10 comprises a first portion and a second portion, the second portion being movable relative to the first portion, and relative to the opening, optionally between a unit holding configuration in which a pile section is secured and a unit non-holding configuration in which the pile section is movable. In use, at least a part of the second portion may optionally be received by a recess formed in a pile section. Optionally, the location of part of the pile section holder

15 unit within a recess in the pile section secures the pile section in place. Optionally, in the unit holding configuration, the pile section holder unit is in an extended configuration, and in the unit non-holding configuration, the pile section holder unit is in a retracted configuration. The first portion or the second portion of the pile section holder unit may be at least partially received within the other of the first portion or the second portion. For example, the second

20 portion may be at least partially received by the first portion. Optionally the first and second portions may form a telescopic arrangement, with one of the first and second portions being at least partially received within the other of the first and second portions.

The pile section holder may optionally comprise one or more load sensors. The pile section holder may be provided with more than one load sensor. For example, optionally at least one

25 pile section holder unit, optionally more than one pile section holder unit and optionally each pile section holder unit comprises one or more load sensors.

The pile section holder may optionally comprise one or more level sensors for sensing the level of the pile section holder (or part thereof). In this context, level refers to orientation, as opposed to elevation i.e. the level sensors sense whether or not the pile section holder (or part

30 thereof) is level. The pile section holder may be provided with more than one level sensor. For example, optionally at least one pile section holder unit, optionally more than one pile

section holder unit and optionally each pile section holder unit comprises one or more level sensors.

The pile section holder may optionally comprise one or more levellers for adjusting the level of the pile section holder (or part thereof). In this context, level refers to orientation, as
5 opposed to elevation i.e. the levellers may be used to make the pile holder section (or part thereof) level. For example, optionally at least one pile section holder unit, optionally more than one pile section holder unit and optionally each pile section holder unit comprises one or more levellers for adjusting the level of the pile section holder unit. Optionally, a leveller may comprise a jacking arrangement.

10 The pile section holder may be attached to a flange of the construction support.

The construction support may comprise one or more surfaces for contacting one or more stop members attached to a pile section. Optionally, at least one, optionally more than one and optionally each such surface is an upper surface of the construction support. Optionally, at least one, optionally more than one and optionally each such surface may be a substantially
15 planar surface. Optionally, at least one, optionally more than one and optionally each such surface may be movable. Optionally, at least one, optionally more than one and optionally each such surface may be fixable in a plurality of positions. Optionally, at least one, optionally more than one and optionally each such surface may be fixable in a plurality of positions, wherein in each position the surface is a different distance from the centre of the
20 opening. Optionally, at least one, optionally more than one and optionally each such surface may be provided by a carrier. Optionally, at least one, optionally more than one and optionally each carrier may be fixable in a plurality of positions. Optionally, at least one, optionally more than one and optionally each carrier may be fixable in a plurality of
25 positions, wherein in each position the surface associated with the carrier is a different distance from the centre of the opening. Optionally, at least one, optionally more than one and optionally each carrier may be fixable in a plurality of positions, wherein in each position the carrier is a different distance from the centre of the opening.

The construction support may optionally comprise one or more lifting configurations, such as one or more lifting eyes to facilitate lifting of the construction support. Optionally, at least
30 one, optionally more than one and optionally each of the lifting configurations may be associated with an upper surface of the construction support. Optionally, more than one and

optionally all of the lifting configurations may be located on one side of the construction support.

The construction support may optionally comprise one or more securing means to facilitate fixing of the construction support to a pile section received within the opening. The

- 5 construction support may optionally comprise a plurality of securing means to facilitate fixing of the construction support to a pile section received within the opening. Optionally, the plurality of securing means to facilitate fixing of the construction support to the pile section may be distributed substantially uniformly around the opening. Optionally, at least one, optionally more than one and optionally each securing means may be associated with
- 10 one surface, optionally an upper surface, of the construction support. Optionally, at least one, optionally more than one and optionally each securing means may be associated with a flange (if present) of the construction support, and optionally with an upper surface of a flange of the construction support. Optionally, at least one, optionally more than one and optionally each securing means to facilitate fixing of the construction support to a pile section received
- 15 within the opening may comprise one or more apertures for the passage of a bolt or the like therethrough.

The construction support may optionally comprise one or more conduit retainers for inhibiting movement of a conduit for delivering curable composition to a space around a pile.

- Optionally, at least one, optionally more than one and optionally each conduit retainer may be
- 20 configured to inhibit movement of a respective conduit extending through the opening of the construction support, optionally external of a pile or pile section. Optionally, at least one, optionally more than one and optionally each conduit retainer may be movable between a retaining position in which movement of a respective conduit is inhibited and a non-retaining position. Optionally, at least one, optionally more than one and optionally each conduit
- 25 retainer is associated with an upper surface of the container support, optionally an upper surface of a flange (if present). Optionally, at least one, optionally more than one and optionally each conduit retainer comprises a bracket or a collar.

In accordance with a second aspect of the present invention, there is provided a construction support for supporting one or more pile sections during construction of a pile, the

- 30 construction support comprising:

an opening for the receipt of, and passage therethrough, of a pile section, the construction support being configured to support one or more pile sections received through said opening; and

- 5 a pile section holder operable between a holding configuration in which a pile section is secured and a non-holding configuration in which the pile section is movable.

The pile section holder may have one or more features of the pile section holder described above in relation to the construction support of the first aspect of the present invention.

- 10 The construction support of the second aspect of the present invention may comprise one or more positioners configured to position a pile section within the opening. The one or more positioners may comprise one or more of the features described above in relation to the construction support of the first aspect of the present invention. For the avoidance of doubt, the construction support of the second aspect of the presented invention may optionally comprise one or more features of the construction support of the first aspect of the present invention.

- 15 In accordance with a third aspect of the present invention, there is provided a pile-assembling arrangement for making an elongate pile in a bore, the pile-assembling arrangement comprising:

a construction support in accordance with the first and/or second aspect of the present invention; and

- 20 a casing at least partly received within the bore,
the construction support being attached to the casing.

The casing is typically configured to facilitate the transfer of load from the construction support into the ground in which the bore is formed.

- 25 The construction support may be located at or proximate to an end of the casing. A part of the construction support may be received by the casing, optionally by a mouth of the casing. Optionally, a part of the casing may be receiving by the construction support.

A cylindrical portion of the construction support is optionally received by the casing. The cylindrical portion optionally has a substantially circular cross-sectional shape.

The casing is optionally in engagement with at least one wall of the bore. Optionally, the casing is attached to the ground in which the bore is formed.

The casing is optionally elongate. The casing may optionally comprise a plurality of casing sections, arranged along a longitudinal axis of the casing, adjacent casing sections being
5 attached to one another. Optionally, at least one, optionally more than one and optionally each casing section is tubular.

Optionally, the casing has a length of at least 2m, optionally at least 3m, optionally at least 4m, optionally at least 5m and optionally at least 6m. Optionally, the casing has a length of no more than 20m, optionally no more than 15m, optionally no more than 12m, optionally no
10 more than 10m, optionally no more than 8m and optionally no more than 6m. Optionally, the casing has a length of from 2m to 20m, optionally of from 3m to 15m, optionally of from 4m to 12m and optionally of from 5m to 10m. The length of the casing is typically determined taking into account the forces to be transferred from the construction support to the surrounding ground that defines the bore.

15 Optionally, the casing comprises a substantially tubular portion. Optionally, the casing is substantially tubular.

Optionally, the casing has a diameter of at least 0.3m, optionally at least 0.5m, optionally at least 0.75m, optionally at least 1.0m, optionally at least 1.25m. Optionally, the casing has a diameter of no more than 3.0m, optionally no more than 2.5m, optionally more than 2.0m and
20 optionally no more than 1.5m.

The pile-assembling arrangement of the third aspect of the present invention may comprise a lifting arrangement for lifting one or more pile sections.

The lifting arrangement may optionally comprise one or more pile section attachment portions attachable to a pile section. Optionally, at least one, optionally more than one and
25 optionally each of the pile section attachment portions comprises a stop surface for abutment with a surface of the construction support. Optionally, at least one, optionally more than one and optionally each stop surface is substantially planar. Optionally, at least one, optionally more than one and optionally each of the pile section attachment portions is configured so that when the pile section attachment portion is attached to a respective pile section, the
30 respective stop surface is oriented to facilitate abutment of the stop surface with a respective surface of the construction support. Optionally, at least one, optionally more than one and

optionally each of the pile section attachment portions comprises a pile section attachment point to facilitate lifting of the pile section.

The lifting arrangement for lifting one or more pile sections may optionally comprise a lifting frame. The lifting frame optionally comprises one or more frame lifting points for lifting a
5 pile section. Optionally, at least one, optionally more than one and optionally each frame lifting point is attached to a respective pile section attachment point, optionally via a cord. Optionally, more than one and optionally all of the frame lifting points for lifting a pile section are associated with one side of the lifting frame, such as a lower side of the frame.

The lifting arrangement may optionally comprise one or more frame lifting points for lifting
10 of the frame. Optionally, at least one, optionally more than one and optionally each frame lifting point for lifting the frame is attached to a means for lifting the pile section, optionally via a cord. Optionally, more than one and optionally all of the frame lifting points for lifting of the frame are associated with one side of the frame (typically, in use, an upper side of the frame), or an opposite side of the frame to the side of the frame with which the pile section
15 attachment points are associated.

The lifting frame optionally comprises a polygon of more than two sides. The lifting frame is optionally triangular.

The pile-assembling arrangement optionally comprises a means for maintaining a pile at a desired depth or level within the bore. In some bores, water may exert a significant upwards
20 force on a pile, and it is therefore desirable to maintain a pile at the desired depth or level within the bore, particularly so that a curable composition (such as cement) can be introduced around the pile. In use, the means for maintaining a pile at a desired depth or level extends downwards, towards and into a bore in which a pile is to be installed.

The means for maintaining a pile at a desired depth or level is optionally elongate.

25 The means for maintaining a pile at a desired depth or level optionally has an adjustable length.

The means for maintaining a pile at a desired depth or level is optionally modular, comprising a plurality of modules that may be attached to one another to change the length of the means for maintaining a pile at a desired depth or level. At least one, optionally more than one and
30 optionally each of those modules has an adjustable length. At least one, optionally more than one and optionally each of those modules comprises a frame. At least one, optionally more

than one and optionally each of those modules is sized to be able to pass through the opening of the construction support.

The means for maintaining a pile at a desired depth or level may optionally be configured to be attachable to the construction support.

- 5 The means for maintaining a pile at a desired depth or level may optionally be configured to be attachable to the pile. For example, the means for maintaining a pile at a desired depth or level may comprise a fastening mechanism for attaching the means for maintaining a pile at a desired depth or level to the pile. The means for maintaining a pile at a desired depth or level may optionally comprise an attachment member that is movable between a first position in
10 which the means for maintaining a pile at a desired depth or level is not attached to the pile, and a second position in which the means for maintaining a pile at a desired depth or level is attached to the pile.

- The means for maintaining a pile at a desired depth or level may optionally comprise one or more actuators that are configured to alter the depth or level of the pile within the bore. For
15 example, the one or more actuators may be configured to exert a force on the pile, thereby altering the depth or level of the pile within the bore.

The means for maintaining a pile at a desired depth or level may optionally comprise a tower.

- The means for maintaining a pile at a desired depth or level may optionally comprise a coupling portion to facilitate coupling the means for maintaining a pile at a desired depth or
20 level to a pile.

- The means for maintaining a pile at a desired depth or level may optionally be configured to be engaged by a pile section holder to facilitate the holding of the means for maintaining a pile at a desired depth or level. For example, the means for maintaining a pile at a desired depth or level may comprise one or more recesses for receiving part of the pile section holder.
25 The pile section holder may comprise any of the features described above in relation to the construction support of the first and/or second aspects of the present invention. For example, the means for maintaining a pile at a desired depth or level may be configured to be held by a pile section holder when the pile section holder is in a holding configuration. For example, the means for maintaining a pile at a desired depth or level may comprise one or more male
30 or female portions for mating with a corresponding portion provided by a pile section holder. For example, if a pile section holder comprises a male portion when the pile section holder is

in a holding configuration, then the means for maintaining a pile at a desired depth or level may comprise a female portion, such as a recess, for receiving the male portion of the pile section holder.

5 The pile-installing arrangement may optionally comprise one or more conduits for providing a curable composition around a pile, for example, between a pile and an internal surface of a bore. Optionally, at least one, optionally more than one and optionally each such conduit may be located inside the opening of the construction support. Such conduits are sometimes known as tremie pipes.

10 In accordance with a fourth aspect of the present invention, there is provided a means for maintaining a pile at a desired depth or level for use in the pile-assembling arrangement of the third aspect of the present invention. The means for maintaining a pile at a desired depth or level may comprise one or more of the features as described above in relation to the pile-assembling arrangement of the third aspect of the present invention.

15 In accordance with a fifth aspect of the present invention, there is provided a kit for the construction of one or more piles within one or more bores, the kit comprising:

a construction support in accordance with the first and/or second aspect of the present invention; and

one or more of:

a casing;

20 a lifting arrangement;

a means for maintaining a pile at a desired depth or level; and

a plurality of pile sections for constructing one or more piles.

25 The casing may optionally have one or more features of the casing described above in relation to the pile-assembling arrangement of the third aspect of the present invention. The lifting arrangement may optionally have one or more features of the lifting arrangement described above in relation to the pile-assembling arrangement of the third aspect of the present invention. The means for maintaining a pile at a desired depth or level may optionally have one or more features described above in relation to the pile-assembling arrangement of the third aspect of the present invention. One or more of the plurality of pile sections may
30 comprise one or more features of the pile described herein. At least one pile section

optionally comprises an end portion and one or more side walls. The end portion and one or more side walls optionally define a volume. Such a pile section may be a pile end section, for insertion first into a bore. The plurality of pile sections may be configured to form a pile. The pile is optionally hollow. The interior of the pile is optionally isolated from the bore.

- 5 Optionally, at least one, optionally more than one and optionally each pile section comprises at least one recess for receiving a portion of a pile section holder. Optionally, at least one, optionally more than one and optionally each pile section comprises a plurality of recesses for receiving a portion of a pile section holder. Optionally, the plurality of recesses for receiving a portion of a pile section holder is arranged about the periphery of the pile section,
- 10 optionally equally-spaced about the periphery of the pile section. Optionally, at least one, optionally more than one and optionally each pile section comprises a first plurality of recesses for receiving a portion of a pile section holder, the first plurality of recesses being arranged about the periphery of the pile section, and a second plurality of recesses for receiving a portion of a pile section holder, the second plurality of recesses being arranged
- 15 about the periphery of the pile section, the second plurality of recesses being spaced longitudinally from the first plurality of recesses.

In accordance with a sixth aspect of the present invention, there is provided a method of making an elongate pile in a bore, the method comprising:

- holding a first section of a plurality of pile sections in spaced relationship to the bore;
- 20 securing together the first section and a second section of the plurality of pile sections;
- and
- lowering the first section and the second section.

- Optionally, when a first section of the plurality of pile sections is held in spaced relationship to the bore, at least part of the first pile section is above a mouth of the bore. This facilitates
- 25 working on the first pile section. Optionally, when a first section of the plurality of pile sections is held in spaced relationship to the bore, it is held at least partly within, and/or directly above, the bore. Holding a first section of the plurality of pile sections in spaced relationship to the bore may be effected by one or more stop members, and optionally a plurality of stop members, that are optionally attached to the first section. The one or more
- 30 stop members optionally limit the movement of the first section relative to the bore. Optionally, at least one, optionally more than one and optionally each stop member may

comprise a stop surface for contacting a corresponding surface. Such a stop surface may optionally be substantially planar. The corresponding surface may optionally be located above the bore. The corresponding surface may optionally be located at least 0.3m, optionally at least 0.5m, optionally 0.8m and optionally at least 1.0m above a mouth of the bore. The
5 corresponding surface may be provided by a construction support. The construction support may comprise one or more of the features of the construction support described above in relation to the construction support of the first and/or second aspect of the present invention. The construction support may be substantially as described above in relation to the construction support of the first and/or second aspect of the present invention.

10 Holding a first section of the plurality of pile sections in spaced relationship to the bore may be effected by a pile section holder. The pile section holder may comprise one or more features of the pile section holder described above in relation to the construction support of the first and/or second aspects of the present invention. At least a portion of the pile section holder may optionally be received in a recess of the first pile section. Optionally, the first pile
15 section may comprise a plurality of recesses for the receipt of at least a portion of the pile section holder. The plurality of recesses may optionally be spaced peripherally about the first pile section.

The method may comprise causing the pile section holder to release the first pile section before lowering the first section and the second section. In this connection, the method may
20 comprise operating the pile section holder from a holding configuration to a non-holding configuration, as described above in relation to the construction supports of the first and/or second aspects of the present invention.

Optionally, a casing is provided at least partly within the bore. Optionally, the casing is temporary, and therefore the method may comprise removing the casing.

25 The casing is optionally tubular. The casing optionally comprises a casing opening for the passage of pile sections therethrough. The casing may comprise a sleeve. The casing may optionally be located at or proximate to a mouth of the bore. For the avoidance of doubt, the casing may comprise one or more of the features of the casing described above in relation to the pile-assembling arrangement of the third aspect of the present invention. The casing may
30 be substantially as described above in relation to the pile-assembling arrangement of the third aspect of the present invention.

Lowering the first section and the second section may comprise lowering the first section and the second section into, towards and/or within the bore. Lowering the first section and the second section may comprise lowering the first section and the second section into and/or through the casing, if a casing is provided.

- 5 Lowering the first second and the second sections may be effected using a lifting arrangement. The lifting arrangement may comprise one or more of the features of the lifting arrangement described above in relation to the pile-assembling arrangement of the third aspect of the present invention. The lifting arrangement may be substantially as described above in relation to the pile-assembling arrangement of the third aspect of the present
10 invention.

Holding a first section of the plurality of pile sections in spaced relationship to the bore may comprise holding the first section at least partly within the casing, optionally holding the first section at least partly within the casing opening.

- Optionally, one or more of the plurality of pile sections is cylindrical. Optionally, one or more
15 of the plurality of pile sections is tubular. In this case, one or more of the plurality of pile sections comprises a passage therethrough. The pile section passages form an elongate cavity within the pile.

- Optionally, at least one, optionally more than one and optionally each of the pile sections comprises a female configuration for receiving at least part of a respective member for
20 contacting a pile section, optionally a member for contacting a pile section provided by a construction support. Optionally, at least one, optionally more than one and optionally each female configuration may be located on an external surface of a respective pile section.
- Optionally, at least one, optionally more than one and optionally each female configuration may comprise a recess. Optionally, at least one, optionally more than one and optionally each
25 female configuration may comprise a groove. Optionally, at least one, optionally more than one and optionally each groove may be elongate, and optionally may extend parallel to a longitudinal axis of a pile section.

Optionally, one or more of the plurality of pile sections is formed from concrete.

- Securing together the first section and the second section may be performed using any
30 suitable method or means. For example, one or more brackets may be used to secure the first second and the second section. For example, a first portion of a bracket may be secured to the

first section of pile, and a second portion of the bracket may be secured to the second section of pile.

The method may comprise bringing the first and second sections of pile into mutual proximity to facilitate securing the first and second sections of pile. Bringing the first and second sections of pile into mutual proximity may comprise moving, and optionally lowering, the second section of pile. Bringing the first and second sections of pile into mutual proximity may comprise bringing the first and second sections of pile into contact with one another. Bringing the first and second sections of pile into mutual proximity may comprise bringing the first and second sections of pile into abutment with one another. If the first and second sections of pile are tubular and comprise a passage therethrough, the method may comprise bringing the first and second sections of pile into mutual proximity so that the passages of the first and second sections of pile are aligned.

Moving the second section of pile may be effected using a lifting arrangement. The lifting arrangement may comprise one or more of the features of the lifting arrangement described above in relation to the pile-assembling arrangement of the third aspect of the present invention. The lifting arrangement may be substantially as described above in relation to the pile-assembling arrangement of the third aspect of the present invention.

The method may comprise holding the first and second sections of the plurality of pile sections in spaced relationship to the bore.

The method may comprise bringing the second section of pile and a third section of pile into mutual proximity to facilitate securing the second and third sections of pile. The method may comprise securing together the second and third sections of pile. This may comprise moving the third section of pile. This may comprise moving the third section of pile into abutment with the second section of pile.

If a pile comprises a certain number of pile sections, then a pile precursor may be considered to comprise a plurality of pile sections, but less than the number of pile sections that make up the (completed) pile.

The method may comprise urging the pile or a pile precursor downwards. This may be required if, for example, the bore contains liquid, typically water. This may be the case, for example, if the bore is relatively deep, and may depend, for example, on the level of the water table.

The method may comprise maintaining the pile or pile precursor at a desired depth or level within the bore. This may comprise providing a means for maintaining a pile at a desired depth or level. The means for maintaining a pile at a desired depth or level may comprise one or more of the features of the means for maintaining a pile at a desired depth or level as described above in relation to the pile-assembling arrangement of the third aspect of the present invention.

The method may comprise altering the depth or level of the pile or a pile precursor within the bore.

The method may comprise introducing a curable composition into the bore. Optionally, the method may comprise introducing a curable composition between the pile, or pile precursor, and one or more bore walls.

Introducing the curable composition between the pile, or pile precursor, and one or more bore walls may optionally displace liquid from between the pile, or pile precursor, and one or more bore walls, and/or the method may comprise simultaneously introducing a curable composition between the pile, or pile precursor, and one or more bore walls, and removing liquid from between the pile, or pile precursor, and one or more bore walls.

The curable composition may, for example, comprise concrete.

The method may comprise permitting or causing the curable composition to cure to form a cured composition.

The method may comprise removing the means for maintaining a pile at a desired depth or level, optionally subsequent to the curing of the curable composition, and optionally subsequent to the removal of the construction support.

The method may comprise removing the construction support, optionally subsequent to the curing of the curable composition.

The method may comprise introducing a first curable composition between the pile, or pile precursor, and one or more bore walls, and introducing a second curable composition between the pile, or pile precursor, and one or more bore walls. The first curable composition is introduced between the pile, or pile precursor, and one or more bore walls before the second curable composition is introduced between the pile, or pile precursor, and one or more bore walls. The first curable composition is optionally introduced between a bottom of the

- pile, or pile precursor, and one or more bore walls adjacent the bottom of the pile, or pile precursor. The method may comprise curing the first curable composition before introducing the second curable composition between the pile, or pile precursor, and one or more bore walls. The method may comprise removing the means for maintaining a pile at a desired
- 5 depth or level subsequent to the curing of the first curable composition, and optionally before introducing the second curable composition. The first curable composition may optionally cure more quickly than the second curable composition. This means that under the same curing conditions, the first curable composition cures more quickly than the second curable composition.
- 10 The method may comprise removing the casing, optionally subsequent to the curing of the curable composition, and optionally subsequent to the removal of the construction support, and optionally subsequent to the removal of the means for maintaining a pile at a desired depth or level.

- It will of course be appreciated that features described in relation to one aspect of the present
- 15 invention may be incorporated into other aspects of the present invention. For example, the method of the invention may incorporate any of the features described with reference to the apparatus of the invention and vice versa.

DESCRIPTION OF THE DRAWINGS

- Fig. 1 is a perspective view from above of an example of an embodiment of a construction
- 20 support in accordance with the present invention;

Fig. 2 is a plan view of the construction support of Fig. 1;

Fig. 3 is a perspective view from below of an example of an embodiment of a construction support in accordance with the present invention;

- Fig. 4 is a simplified side-on view of an example of an embodiment of a pile-assembling
- 25 arrangement in accordance with the present invention;

Fig. 5 is a perspective view from above of a further embodiment of a construction support in accordance with the present invention;

Fig. 6 is a perspective view of a lifting arrangement used as part of the pile-assembling arrangement of Fig. 4;

Fig. 7 is a side-on view of an example of a pile spacing tower used to maintain the pile at a desired depth or level in the bore;

Fig. 8 is a simplified schematic representation of an example of a method of making a pile;

Fig. 9 is a schematic representation of an example of a method of making a pile;

- 5 Fig. 10 is a simplified schematic cross-sectional representation of a further example of an embodiment of a construction support in accordance with the present invention;

Fig. 11 is a schematic cross-sectional representation of part of the construction support of Fig. 10; and

Fig. 12 is a simplified schematic representation of an example of a method of making a pile.

10 DETAILED DESCRIPTION

A pile-assembling arrangement for making an elongate pile in a bore will now be described with reference to Figs. 1 to 4. The pile-assembling arrangement is denoted generally by reference numeral 50. The pile-assembling arrangement 50 comprises a construction support 100 and a casing 200 at least partly received within the bore B, and the construction support 100 is attached to the casing 200. Casing 200 is a steel sleeve, approximately 6m long and 1.5m diameter, which extends into the bore B by a distance of about 4.5m (approximately 1.5m of the casing projects about ground level G). The length of casing 200 is determined, amongst other things, by the forces to be transferred from construction support 100 to the ground that defines bore B. Casing 200 is attached to the ground in which the bore B is formed by conventional means. Bore B in this particular case is approximately 20m deep. Typically, a support fluid (not shown) is supplied to bore B as the bore B is being drilled. The support fluid is typically an aqueous solution of a water-soluble polymer that has a density greater than that of the ambient ground water. The support fluid inhibits ingress of ground water into the bore from the surrounding ground, which could encourage collapse of bore B. Construction support 100 has a cylindrical portion 101, a portion of which extends into the open end of casing 200, with the cylindrical portion 101 of the construction support 100 in close contact with the internal wall of casing 200. The end of casing 200 abuts the bottom 130 of strengthening members 140, only some of which are labelled. Bolts (not shown) are inserted through apertures 120 (only one of which is labelled) provided in the cylindrical portion of the construction support 100 to attach the construction support 100 to casing 200.

The attachment of the construction support 100 to the casing 200, and the attachment of the casing 200 to the ground that makes-up the bore ensures that any load applied to the construction support 100 as a pile is made as will be described below is distributed via the casing 200 to the surrounding ground.

- 5 Pile-assembling arrangement 50, and in particular construction support 100, facilitate the production of a pile from pile sections that are stacked end-to-end. Furthermore, while it is known to stack pile sections end-to-end to form a pile, the pile is made by stacking pile sections, starting at the bottom of the bore. Pile-assembling arrangement 50 allows the stacking of pile sections in a location that is more accessible, as will now be described.
- 10 Referring to Fig. 4, first pile section 300 is lowered into, and through opening 103 of construction support 100. Pile section 300 is tubular, and is hollow, best seen in Fig. 6. Pile section 300 may, in some circumstances, have a closed end i.e. pile section 300 has an end portion from which extends a cylindrical side wall. This defines a volume inside the pile section 300 that is isolated from the bore. Stop members 301, 302, 303 have been attached to
- 15 pile section 300 so that when pile section is lowered into, and through opening 103 of construction support 100, the planar lower faces of stop members 301, 302, 303 abut a respective planar surface 121, 122, 123 of the construction support when the pile section is in the appropriate position. Fig. 1 shows the location of stop members 301, 302, 303 when a pile section has been lowered into place. The pile section has been omitted from Fig. 1 for clarity.
- 20 Furthermore, for the avoidance of doubt, stop members 301, 302, 303 are not part of construction support 100. Stop members 301, 302, 303 are arranged uniformly around the circumference of pile section 300. Each surface 121, 122, 123 is provided by a respective carrier 124, 125, 126, which in this case is U-shaped in cross-section. Each carrier 124, 125, 126 and therefore each surface 121, 122, 123 may be fixed in a plurality of different
- 25 positions. In this connection, slots (two of which are shown 127, 128) provided in each carrier 124, 125, 126 permit movement of each carrier 124, 125, 126 towards and away from the centre of opening 103.

The position of first pile section 300 within opening 103 is determined by pile section positioners 104, 105, 106. Each pile section positioner 104, 105, 106 comprises a respective

30 pile-contacting member 107, 108, 109 in the form of a wheel that is biased into contact with the pile section by a spring 118. Generally, the pile section positioners 104, 105, 106 will be configured to ensure that a pile section is received centrally within opening 103. However,

this need not be the case, and, in this connection, each pile section positioner 104, 105, 106 comprises a carrier 119, which comprises a plate 113, which in turn comprises two bolt-receiving slots 110, 111. The pile section positioner 104, 105, 106 can be moved towards, and away from, the centre of opening 103 by releasing the fastening bolts, and moving the slots 110, 111 accordingly before re-fastening the fastening bolts. Furthermore, the lateral position of each pile section positioner 104, 105, 106 may be altered by moving the positioner and the associated fastening bolts laterally within lateral slots 116, 117. The pile section positioners 104, 105, 106 may be moved to facilitate the correct alignment of a pile in an off-centre bore B. The strength of the spring 118 may be adjusted to suit.

Once first pile section 300 has been lowered into position, with stop members 301, 302, 303 abutting corresponding surfaces of the construction support 100, then construction of the pile may start. Fig. 5 shows a construction support 1100 that is slightly different from construction support 100, but illustrates the construction of the pile. Nine brackets, one of which 1200, is labelled, are attached to first pile section 300 using suitable bolts. A second pile section 320 is then lowered on to the first pile section 300 (parts A and B of Fig. 8). Brackets 320 are then attached to second pile section 320. Stop members 301, 302, 303 are then removed from the first pile section 300, and three more brackets are applied to the first 300 and second 320 pile sections. During this addition of three more brackets, the first 300 and second 320 pile sections are supported by a crane or similar from which the second pile section 320 is suspended, and will be described in more detail below. Once all of the brackets have been applied, the first 300 and second 320 pile sections are lowered into the bore B until stop members 301, 302, 303 of second pile section 320 abuts corresponding surfaces of construction support 100 (part C of Fig. 8). A third pile section 340 is then lowered onto second pile section 320, third pile section 340 attached to second pile section 320 (parts C and D of Fig. 8), the stop members 301, 302, 303 removed from second pile section 320 and a proto-pile comprising first 300, second 320 and third 340 pile sections is then lowered into the bore B until stop members 301, 302, 303 of third pile section 340 abuts corresponding surfaces of construction support 100 (part E of Fig. 8).

The method described above may be further described in relation to an example of an embodiment of the sixth aspect of the present invention, as will now be described with reference to Fig. 9. A method of making an elongate pile in a bore is denoted generally by reference numeral 1000. The method 1000 comprises holding 1001 a first section of a plurality of pile sections in spaced relationship to the bore, securing 1002 together the first

section and a second section of the plurality of pile sections; and lowering 1003 the first section and the second section. A key advantage of the present method 1000 is that the first section of pile is held above the bore B, at a suitable height to allow workers to attach the first and second sections together. The method 1000 further comprises holding 1004 the first and
5 second sections of a plurality of pile sections in spaced relationship to the bore, securing 1005 together the first, second and a third section of a plurality of pile sections; and lowering 1006 the first, second and third sections of pile. The steps of the method may, of course, be repeated until a pile of the desired length has been made.

Mention is made above of the lifting of the pile sections and the pile as it is being
10 constructed. In this connection, the pile-assembling arrangement 50 comprises a lifting arrangement denoted generally by reference numeral 400 as shown in Fig. 6. Lifting arrangement 400 comprises a triangular frame 401. Three lifting eyes 404, 405, 406 are provided on the upper side 402 of frame 401. Cables are attached to lifting eyes 404, 405, 406 and are attached to the lifting hook (not shown) of a crane. Three lifting eyes (only two of
15 which are visible 407, 408) are provided on the lower side 403 of frame 401. Cables (only two of which are labelled 409, 410) are used to attach the lifting eyes 407, 408 to corresponding lifting eyes 306, 307, 308 provided on stop members 301, 302, 303. The provision of three lifting eyes to the lower side of frame 401 and three lifting eyes 306, 307, 308 attached to first pile section 300 facilitates the safe and controlled lifting of first pile
20 section 300.

A slightly alternative construction support will now be described by way of example only with reference to Fig. 5. The construction support is denoted generally by reference numeral 1100, and it has the same general features of construction support 100 described above. Once again, each pile portion positioner 1104, 1105, 1106 comprises a pile portion contacting
25 surface in the form of a wheel 1108 that is biased into contact with a pile portion by a spring 1118. Furthermore, first pile section 300 comprises three grooves, one of which is shown 304. Each pile-contacting member 107, 108, 109 is received within a corresponding groove 104. The location of the pile-contacting members 107, 108, 109 within corresponding grooves 104 inhibits rotation of the first pile section 300 about its longitudinal axis.

30 Three conduits, only one of which is shown 305, are provided for the delivery of grouting into the space between the bore B and a pile. Three conduit retainers, only one of which is shown 1120, are used to retain the conduits 305 in position during the pumping of grout into

the space surrounding the pile. Fig. 5 shows conduit retainer 1120 in a retaining position in which movement of conduit 305 is inhibited. Conduit retainer 1120, which is in the form of a bracket, is movable between the retaining position and a non-retaining position.

It has been described above how it is possible to make a pile in a bore. In many cases, the bore B is relatively deep and may have a tendency to fill with water, depending on the depth of the bore, the water table and the soil type. Alternatively, a bore may be deliberately filled with a liquid. In such a case, water in a bore may exert a considerable upwards force on a pile. This may be the case, for example, when the pile is a hollow pile, with a closed bottom, defining an internal core of the pile that is filled with air and is isolated from the bore. This upwards force can be useful during the construction of the pile, because the upwards force reduces the effective weight of the pile on the construction support. However, it may be desirable to exert a downwards force on the pile (for example, to maintain the pile at a desired depth or level, or to urge a pile downwards). In this connection, a pile spacing tower as used in a pile-assembling arrangement in accordance with an embodiment of the present invention will now be described by way of example only with reference to Fig. 7. The pile spacing tower is denoted generally by reference numeral 500. The pile spacing tower 500 is attached to construction support 100, which is coupled to the ground in which the bore is formed. Pile spacing tower 500 comprises a frame portion 501 which comprises first 502, second 503 and third 504 portions. First frame portion 502 is attached to the bottom of construction support 100, and is of variable length in so far as the dimension of first frame portion 501 in a direction parallel to the longitudinal axis of the bore B may be set at several different values. Second frame portion 503 is attached to first frame portion 502, and third frame portion 504 is attached to second frame portion 503. In the present case, the lengths of the second 503 and third 504 frame portions are the same. Pile spacing tower 500 also comprises coupling portion 505 that facilitates coupling of the pile spacing tower 500 to pile P. In this connection, the uppermost pile section of pile P comprises two upwardly-projecting lugs 398, 399, each of which is provided with an aperture. Coupling portion 505 comprises two retractable and extendable bolts 510, 515 that, when in the extended configuration, extend through respective apertures in lugs 398, 399 and couple pile spacing tower 500 to pile P. A plate 520 also extends across the top of pile P. Coupling portion 505 also comprises an actuator (not shown) for exerting a downwards force on pile P via plate 520. This may urge pile P downwards in bore B. Furthermore, a pile depth micro-adjuster 600 is provided; this screw-threaded instrument permit the adjustment of the height of the construction support

100 above the surface G of the ground, and therefore permits the depth or level of the pile P to be adjusted. In reality, two or more such pile depth micro-adjusters would be provided, to facilitate symmetrical changes in pile depth. Load cells, only one of which is shown 700, are also provided. The load cells 700 monitor the buoyancy (uplift) force during the grouting
5 process. The construction support 100 may be removed when the uplift force is below a pre-determined level, at which point the pile is able to support its own weight.

In order to construct the pile spacing tower, a method is used that is similar to that used to making the pile. In this connection, coupling portion 505 is passed through opening 103 of construction support 100, and is attached to the topmost portion of pile P. The pile portion
10 positioners 104, 105, 106 may be used to facilitate alignment of the coupling portion 505. The pile with the attached coupling portion 505 is then moved downwards in the bore. Third frame portion 504 is then passed through the opening 103 of construction support 100 and is attached to coupling portion 505. The pile with the attached coupling portion 505 and frame portion 504 is then moved downwards in the bore. Second frame portion 503 is then passed
15 through the opening 103 of construction support 100 and is attached to third frame portion 504. The pile with the attached coupling portion 505, third frame portion 504 and second frame portion is then moved downwards in the bore. First frame portion 502 is then passed through the opening 103 of construction support 100 and is attached to second frame portion 503. The pile with the attached coupling portion 505, and first, 502, second 503 and third 504
20 frame portions is then moved downwards in the bore. First frame portion 502 is attached to the bottom of construction support 100. The length of first frame portion 502 may be adjusted at any suitable time in the construction process.

It has been described above how it is possible to make a pile and maintain the pile at a desired depth or level in the bore. Once the pile is at the desired depth or level, a curable
25 material, typically in the form of grout, is introduced into the space between the pile and the internal surface of bore B. At the same time, support fluid is removed from the space between the pile and the internal surface of the bore. The grout typically has a higher density than the support fluid, and therefore replacement of the support fluid by the grout causes an increase in the buoyancy of the pile. The construction support and the pile spacing tower 500 should
30 be able to withstand such an increase in buoyancy.

The grout cures over time to form a solid. Once the grout is set, pile spacing tower 500 may be removed. Alternatively, a different process may be used. For example, once the pile is at

the desired depth or level, a fast-curing grout may be provided into the space between a bottom of the pile and the internal surface of bore B adjacent to the bottom of the pile. Once that fast-curing grout has set, pile spacing tower 500 may be removed, and conventional grout then introduced into the space between the pile and the internal surface of the bore B above
5 the now-set fast-curing grout.

An example of an embodiment of a construction support for supporting one or more pile sections in accordance with the first and second aspects of the present invention will now be described by way of example only with reference to Figs. 10 and 11. The construction support is denoted generally by reference numeral 700, and comprises a cylindrical main
10 body 701 from which projects an annular flange 702. Construction support 700 comprises an opening 750 for the receipt of, and passage therethrough, of a pile section, and one or more positioners 704, 705, 706 configured to position a pile section within the opening 750. In this case, there are four positioners, three of which 704, 705, 706 are shown. Each positioner 704, 705, 706 comprises a respective guide surface 707, 708, 709 for guiding a pile section
15 towards the opening 750. Each guide surface 707, 708, 709 approximates to a sector of a circle, and is tilted away from a centre of the opening 750 such that a first portion 707a, 708a of the respective guide surface 707, 708 proximate to the opening is radially closer to the centre of opening 750 than a second portion 707b, 708b of the respective guide surface 707, 708 that is further from the opening 750. The guide surfaces 707, 708, 709 flare outwardly
20 from first portion 707a, 708a to second portion 707b, 708b. This flaring of guide surfaces 707, 708, 709 helps to guide the pile section that is being lowered towards the opening 750, and positions the pile section within the opening 750.

Construction support 700 also comprises a pile section holder 710 that holds a pile section in place once the pile section has been positioned within opening 750. The use of the pile
25 section holder 710 dispenses with the need for the stop members 301, 302, 303 that are described above. As will now be described, pile section holder 710 is operable between a holding configuration in which a pile section is secured and a non-holding configuration in which the pile section is movable. Pile section holder 710 comprises four pile section holder units, three of which 711, 712 and 713 are shown. The pile section holders 711, 712, 713 are
30 uniformly spaced around opening 750, and are attached to flange 702. Each pile section holder 711, 712, 713 comprises first 714, 715, 716 portions and second 717, 718, 719 portions, the second 717, 718, 719 portions being telescopically received within, and movable relative to, the respective first 714, 715, 716 portion. In the holding configuration, second

portions 717, 718, 719 are in an extended position, as shown by the dashed lines in Fig. 10. In this holding configuration, second portions 717, 718, 719 extend into respective recesses 350 of a pile section 300, securing the pile section so that a further pile section may be placed on top of the pile section or sections held by pile section holder 710. In the non-holding configuration, second portions 717, 718, 719 are retracted into the respective first portion 714, 715, 716. In this non-holding configuration, the second portions 717, 718, 719 no longer extend into the recesses 350 of the pile section, and the pile section is free to be moved.

Referring to Fig. 11, a rack 720 and pinion 721 type arrangement is used to move the second portion of the pile second holder unit relative to the first portion. In this connection, first portion 714, 715, 716 comprises a powered rotatable pinion 721, whose teeth engage with the teeth of the rack 720 provided on the second portion 717, 718, 719. Rotation of the pinion 721 causes movement of the rack 720 and therefore movement of the second portion 717, 718, 719.

Each second portion 717, 718, 719 comprises a load sensor 722 located in the forward part 723 of the second portion 717, 718, 719, which forward part 723 is located in the recess 350 of the pile section 300 when the pile section holder 710 is in the holding configuration. The load sensor 722 is then in a position to monitor loads.

Each pile section holder unit 711, 712, 713 comprises a jacking arrangement (not shown) for levelling the pile section holder unit 711, 712, 713. The jacking arrangement comprises a stepper motor coupled to a M36 stud, the stepper motor controlling the extension of the M36 stud, the extension of the M36 stud determining the height of the pile section holder unit 711, 712, 713 and therefore determining whether or not pile section holder unit 711, 712, 713 is level. Each pile section holder unit 711, 712, 713 is provided with a level sensor for determining whether or not the pile section holder unit 711, 712, 713 is level. The level sensor is in a feedback loop with the jacking arrangement to facilitate levelling of the pile section holder unit 711, 712, 713.

As mentioned above, when in the holding configuration, the pile section holder 710 secures the pile section 300 so that a further pile section may be placed on top of the pile section or sections held by pile section holder 710. In the present example, when the pile section holder 710 is in the holding configuration, it is capable of supporting the weight of a complete pile. Furthermore, in the holding configuration, the pile section holder 710 may be capable of

withstanding the upthrust exerted by a buoyant, complete pile immersed in a liquid, such as liquid grout.

The construction support 700 is described as comprising positioners configured to position a pile section within the construction support opening 750. This need not be the case; the
5 construction support 700 may be used without the positioners.

Furthermore, the construction support 700 may be used in conjunction with a means for maintaining a pile at a desired level or depth, such as the pile spacing tower 500 described above in relation to Fig. 7. In this connection, pile section holder 710 may be used to hold the pile spacing tower 500, much as it is used to hold a pile section. For example, pile spacing
10 tower 500 may be provided with recesses that, in use, receive the second portions 717, 718, 719 of the pile section holder units 711, 712, 713. The engagement of the second portions 717, 718, 719 in said recesses holds pile spacing tower 500 and facilitates holding a pile as a desired height/depth. For example, first frame portion 502 of pile spacing tower 500 may be provided with recesses that, in use, receive the second portions 717, 718, 719 of the pile
15 section holder units 711, 712, 713.

Whilst the present invention has been described and illustrated with reference to particular embodiments, it will be appreciated by those of ordinary skill in the art that the invention lends itself to many different variations not specifically illustrated herein. By way of example only, certain possible variations will now be described.

20 The Examples above describe the use of spring-biased wheels or guide surfaces to position a pile section in the opening of the construction support. Those skilled in the art will realise that other arrangements would be possible, for example, using resiliently-deformable material.

The Examples above describe the use of three or four pile section positioners to position the
25 pile section in the opening of the construction support. Those skilled in the art will realise that fewer or more pile section positioners may be used.

The Examples above describe a particular arrangement of tower that is used to maintain a pile at the desired depth or level in a bore. Those skilled in the art will realise that other possible arrangement may be used. For example, one or more telescopic members may be used to
30 maintain a pile at the desired depth or level in a bore.

The Examples above describe each pile section as being hollow. Those skilled in the art will realise that this need not be the case.

Water may be provided to the hollow core of a pile to oppose any uplift of the pile. In this case, the first pile section may comprise a base to inhibit egress of water from the bottom of
5 the first pile section.

Where in the foregoing description, integers or elements are mentioned which have known, obvious or foreseeable equivalents, then such equivalents are herein incorporated as if individually set forth. Reference should be made to the claims for determining the true scope of the present invention, which should be construed so as to encompass any such equivalents.

10 It will also be appreciated by the reader that integers or features of the invention that are described as preferable, advantageous, convenient or the like are optional and do not limit the scope of the independent claims. Moreover, it is to be understood that such optional integers or features, whilst of possible benefit in some embodiments of the invention, may not be desirable, and may therefore be absent, in other embodiments.

15

CLAIMS

1. A construction support for supporting one or more pile sections during construction of a pile, the construction support comprising:
 - an opening for the receipt of, and passage therethrough, of a pile section, the
 - 5 construction support being configured to support one or more pile sections received through said opening; and
 - one or more positioners configured to position a pile section within the opening.
2. The construction support of claim 1 comprising a pile section holder operable
- 10 between a holding configuration in which a pile section is secured and a non-holding configuration in which the pile section is movable.
3. The construction support of claim 2, wherein the pile section holder comprises a plurality of pile section holder units, each of which is operable between a unit holding configuration in which a pile section is secured and a unit non-holding configuration
- 15 in which the pile section is movable.
4. The construction support of claim 3, wherein each pile section holder unit comprises a first portion and a second portion, the second portion being movable relative to the first portion, and relative to the opening, between a unit holding configuration in which a pile section is secured and a unit non-holding configuration in which the pile
- 20 section is movable.
5. The construction support of claim 4, wherein each second portion of the pile section holder unit is at least partially received within the respective first portion of the pile section holder unit.
6. The construction support of any preceding claim, the construction support being
- 25 configured to be attached to a casing.
7. The construction support according to any preceding claim, comprising an outwardly-projecting flange, which flange projects outwardly from a main body of the construction support, wherein the main body comprise a substantially cylindrical portion.
- 30 8. The construction support according to any preceding claim, wherein at least one positioner configured to position a pile section within the opening comprises a member for contacting a pile section, wherein the member is biased towards a pile section present in the opening.

9. The construction support according to any preceding claim, wherein at least one positioner configured to position a pile section within the opening is movable.
10. The construction support of any preceding claim, wherein at least one positioner comprises a guide surface for guiding a pile section towards the opening.
- 5 11. The construction support according to any preceding claim comprising a surface for contacting one or more stop members attached to a pile section.
12. The construction support according to any preceding claim comprising one or more lifting configurations to facilitate lifting of the construction support.
- 10 13. A construction support for supporting one or more pile sections during construction of a pile, the construction support comprising:
an opening for the receipt of, and passage therethrough, of a pile section, the construction support being configured to support one or more pile sections received through said opening; and
a pile section holder operable between a holding configuration in which a pile section
15 is secured and a non-holding configuration in which the pile section is movable.
14. A pile-assembling arrangement for making an elongate pile in a bore, the pile-assembling arrangement comprising:
a construction support in accordance with any preceding claim; and
a casing at least partly received within the bore;
20 wherein at least part of the construction support received by the casing and the construction support is attached to the casing.
15. The pile-assembling arrangement of claim 14, wherein the construction support is located at or proximate to an end of the casing.
16. The pile-assembling arrangement of claim 14 or claim 15 comprising a lifting
25 arrangement for lifting one or more pile sections.
17. The pile-assembling arrangement of any of claims 14 to 16, wherein the lifting arrangement comprises one or more pile section attachment portions attachable to a pile section, at least one of the pile section attachment portions comprising a stop surface for abutment with a surface of the construction support.
- 30 18. The pile-assembling arrangement according to any of claims 14 to 17 comprising a means for maintaining a pile at a desired depth or level within the bore.
19. The pile-assembling arrangement according to claim 18, wherein the means for maintaining a pile at a desired depth or level is elongate.

20. The pile-assembling arrangement according to claim 18 or claim 19, wherein the means for maintaining a pile at a desired depth or level optionally has an adjustable length.
21. The pile-assembling arrangement according to any of claims 18 to 20, wherein the means for maintaining a pile at a desired depth or level is configured to be attachable to the construction support and/or to be attachable to a pile.
22. A means for maintaining a pile at a desired depth or level for use in the pile-assembling arrangement of any of claims 18 to 21.
23. A kit for the construction of one or more piles within one or more bores, the kit comprising:
a construction support according to any of claims 1 to 13 and
one or more of:
a casing;
a lifting arrangement;
a means for maintaining a pile at a desired depth or level; and
a plurality of pile sections for constructing one or more piles
24. A method of making an elongate pile in a bore, the method comprising:
holding a first section of a plurality of pile sections in spaced relationship to the bore;
securing together the first section and a second section of the plurality of pile sections;
and
lowering the first section and the second section.
25. The method according to claim 24, wherein, when a first section of the plurality of pile sections is held in spaced relationship to the bore, it is held at least partly within, and/or directly above, the bore.
26. The method according to claim 24 or claim 25, wherein holding a first section of the plurality of pile sections in spaced relationship to the bore is effected by one or more stop members attached to the first section.
27. The method according to any of claims 24 to 26, wherein lowering the first section and the second section comprises lowering the first section and the second section into, towards and/or within the bore.
28. The method according to any of claims 24 to 26, comprising holding the first and second sections of the plurality of pile sections in spaced relationship to the bore, bringing the second section of pile and a third section of pile into mutual proximity to

facilitate securing the second and third sections of pile, and securing together the second and third sections of pile.

- 5 29. The method according to any of claims 24 to 28, wherein the bore contains liquid, and the method comprises maintaining the pile, or a pile precursor (said pile precursor comprising a plurality of pile sections, but less than the number of pile sections that make-up a completed pile) at a desired depth or level within the bore.
- 10 30. The method according to any of claims 29, comprising introducing a curable composition between the pile, or pile precursor, and one or more bore walls, while removing said liquid from the bore, and subsequently permitting or causing the curable composition to cure to form a cured composition.
- 15 31. The method of claim 30, comprising introducing a first curable composition between a bottom portion of the pile, or pile precursor, and one or more bore walls adjacent to said bottom portion, permitting or causing the first curable composition to cure, and then introducing a second curable composition between the pile, or pile precursor, and one or more bore walls.