

TEMPLATE FOR DRIVING A PILE ON A PREDETERMINED POSITION; METHOD
OF DRIVING A PILE ON A PREDETERMINED POSITION

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DESCRIPTION

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TECHNICAL FIELD

The invention relates to pile driving, and more particularly, but not exclusively, to underwater pile driving, e.g. for stabbing piles directly into the seabed.

BACKGROUND ART

20 It is known to provide a guide for aligning a pile with the surface of a substrate into which the pile is to be driven and to provide stability for a piling hammer, see, for example, Sea Steel Limited's WO99/11872 (Fast Frame Pile Guide), WO01/92645 (Finned Frame/Follower pile
25 guide) and WO03/074795 (Orientation Control Pile Guide).

Where a plurality of piles are to be driven into a substrate such that they are accurately positioned relative to one another, it is usual to provide a 'template' or

frame having a corresponding plurality of guides that are spaced according to the required relative positions of the piles on the substrate. Depending on the required dimensions, such a frame can be substantial in both size and weight, which in turn requires a large crane and associated vessel.

The present invention has as an objective the mitigation of one or more of these problems.

DISCLOSURE OF INVENTION

10 According to the present invention, there is provided:
a method of positioning piles relative to one another on a substrate (e.g. a seabed) into which the piles are to be driven, the method comprising the steps of: providing a template; releasably attaching a pile guide to a first
15 location on the template; driving a first pile into the substrate using the pile guide when attached to the first location; moving the pile guide and attaching it to a second location on the template, spaced from the first location; and driving a second pile into the substrate
20 using the pile guide when attached to the second location.

Providing a template to which a pile guide can be releasably attached at first and second spaced locations allows two piles to be positioned relative to one another on the substrate (e.g. the seabed) without the need for a
25 separate pile guide for each pile that is to be positioned. This enables the use of a smaller template than used hithertobefore for a given pile deployment, but also a smaller crane and vessel to deploy the template and pile

guide.

The pile guide may be releasably fixed to one of the first and second locations on the template such that during pile driving there is substantially no relative movement between the pile guide and template, at least parallel to the surface of the substrate, helping to ensure the accurate relative positioning of the piles on the substrate. Such releasable fixing may be achieved by means of two spaced apart attachment mechanisms. The use of two attachment mechanisms of this type substantially prevents unwanted relative movement between the pile guide and template. At least one attachment mechanism may be of the type in which a male member engages a female member (e.g. a pin engaging an aperture, such as formed by the rim of a bucket). Each of the two spaced apart attachment members may be of the type in which a male member engages a female member. The method may further comprise engaging one of the attachment mechanisms before the other. For example, where each of the two spaced apart attachment members comprises a male member and a corresponding female member, the male member of one attachment mechanism may be longer than the male member of the other attachment mechanism. Engaging the two spaced apart attachment members sequentially rather than simultaneously may be easier and/or quicker.

The method may further comprise anchoring the template to the substrate, at least to prevent translational movement parallel to the surface of the

substrate. This may be achieved by driving into the substrate a pin pile which passes through an aperture in the template. The or each aperture may be part of an integral guide in the template. Two such pin piles may be
5 driven into the substrate through respective apertures in the template, thereby ensuring that the template is anchored against both translational and rotational movement parallel to the surface of the substrate.

Anchoring the template to the substrate may be carried
10 out before moving the pile guide from the first to the second location, for example after the first pile has been driven.

The locations for attaching a pile guide may be on the periphery of the template when seen in plan view, i.e.
15 in a direction perpendicular to a plane parallel to the substrate. This allows maximum spacing of piles for a given size of template. Similarly, for a predetermined pile spacing, the template can be made smaller and consequently lighter.

20 In one embodiment, the template has a cross-shape with one location for attaching a pile guide thereto at the end of each leg of the cross-shape. In another embodiment, the template may be a square-shape, perhaps with truncated corner regions.

25 The present invention also provides apparatus for positioning piles relative to one another in a substrate, comprising a template and a pile guide releasably attachable to the template in any one of at least a first

location and a second location when guiding a pile into the substrate, the first and second locations being spaced apart to enable the pile guide to be releasably attached to the template in different positions relative thereto.

5 The template and pile guide may be configured, at each location, to be releasably attached together by two spaced apart attachment mechanisms such that during pile driving there is substantially no relative movement between the pile guide and template, at least parallel to
10 the surface of the substrate. Such an arrangement helps to ensure the accurate relative positioning of the piles.

At least one attachment mechanism may be of the type in which a male member on one of the template and pile guide engages a female member on the other of the template
15 and pile guide. The male member may include a pin and the female member may include an aperture, such as formed by the rim of a bucket. Each of the two spaced apart attachment mechanisms may be of the type in which a male member engages a female member. In one form, one of the
20 attachment mechanisms may be configured to engage before the other. For example, where each of the two spaced apart attachment members comprises a male member and a corresponding female member, the male member of one attachment mechanism may be longer than the male member of
25 the other attachment mechanism. The apparatus may further comprise an alignment member for aligning the template and pile guide when one attachment mechanism is engaged so that the other attachment mechanism may subsequently be

engaged. For example, the alignment mechanism may comprise a back stop mounted on the template, which may prevent over rotation of the pile guide relative to the template.

5 The template may comprise one or more apertures, each of which may be part of an integral guide for a pin pile for pinning the template to the substrate. The integral guide may have a flared surround for guiding a pin pile into the aperture.

10 The locations for attaching a pile guide may be on the periphery of the template when viewed in plan and in a direction perpendicular to the substrate when in operation. The template may be cross-shaped when viewed in plan with a location for attaching a pile guide at the end
15 of each leg of the cross.

The pile guide may have a substrate-engaging base with a central rectangular aperture when viewed in plan and may be configured to be releasably fixed to the template by two spaced releasable point attachments
20 respectively aligned with the two longer sides of that rectangular aperture. The pile guide may be any one of the pile guides disclosed in the aforementioned WO99/11872, WO01/92645 and WO03/074795.

The present invention also provides a template for use
25 in the aforementioned apparatus and comprising a body to which a pile guide is releasably attachable in any one of at least a first location and a second location when guiding a pile into a substrate, the first and second

locations being spaced apart to enable the pile guide to be releasably attached to the template in different positions relative thereto.

The body may have one or more apertures through which
5 a pin pile may be driven. The one or each aperture may be part of an integral guide in the template. The body may be configured to releasably attach a pile guide to the periphery of the member when viewed in plan and perpendicular to the surface of the substrate. The body
10 may be cross-shaped when viewed in plan and may be configured to attach a pile guide at the end of each leg of the cross.

Each location on the body that is configured to attach a pile guide in a particular position may be provided with
15 half parts of a pair of two-part coupling mechanisms (the corresponding half parts of the pair of two-part coupling mechanisms being located on the pile guide). The half parts of the pair of two-part coupling mechanisms may be spaced on the body such that, when engaged with their
20 respective other half parts on the pile guide, there is substantially no relative movement between the pile guide and template, at least parallel to the surface of the substrate.

The present invention also provides a pile guide for
25 use in the aforementioned apparatus and configured to be releasably attached to a template.

The pile guide may be provided with half parts of a pair of two-part attachment mechanisms (the corresponding

half parts of the pair of two-part attachment mechanisms being located on the template). The half parts of the pair of two-part attachment mechanisms may be spaced on the pile guide such that, when engaged with their respective other half parts on the template, there is substantially no relative movement between the pile guide and template, at least parallel to the surface of the substrate.

The half parts of the pair of two-part attachment mechanisms may be located on one side of the periphery of the pile guide. The pile guide may have a substrate-engaging base having a central rectangular aperture and the respective component parts of the attachment mechanism may be aligned with the two longer sides of that aperture.

BRIEF DESCRIPTION OF DRAWINGS

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of an embodiment of the apparatus according to the present invention and comprising a template and a pile guide;

Figure 2 is a plan view of the embodiment of figure 1 when viewed in a direction perpendicular to the substrate into which a pile is to be driven;

Figure 3 is a flow chart detailing the steps of the method of the present invention;

Figure 4 is a perspective view of an alternative template to the template shown in Figure 1; and

Figure 5 is a side view of a structure erected on

piles that have been driven according to the present invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENT

Figures 1 and 2 are perspective and plan views respectively of an embodiment of the apparatus 8 according to the present invention and comprising a template 10 and a pile guide 12 for use in positioning piles relative to one another in a substrate 14. The pile guide 12 is releasably attachable to the template 10 in any one of four different locations 20, 22, 24, 26 spaced around its periphery. In figures 1 and 2, the pile guide 12 is releasably attached to the template 10 in a first location 20, but may readily be moved relative to the template 10 in order to be releasably attached to any of the other locations 22, 24, 26.

Template 10 has a framework body 28 having a cross shape when viewed in plan and in a direction perpendicular to the seabed 14 on which it rests. The cross-shaped body 28 has four legs 30, 32, 34, 36 and the mutually-spaced locations 20, 22, 24, 26 on the template 10 to which the pile guide 12 can be releasably attached are on the outer periphery of the template, i.e. on the ends of the legs 30, 32, 34, 36. The body 28 includes apertures 38 with flared openings and defining integral guides for pin piles to pin the template 10 to the substrate 14 during pile driving with pile guide 12.

The pile guide 12 is of the kind known from WO99/11872, and comprises a pile guide member 40 mounted on

a substrate-engaging base 42. The base 42 has a central rectangular aperture 44 through which a pile is driven whilst being guided by the pile guide member 40.

As shown in Figures 1 and 2, the pile guide 12 is 5 releasably attached to the template 10 at location 20 by a pair of spaced apart attachment mechanisms 50. Each attachment mechanism 50 comprises a first part 52 (in this case a male member in the form of a pin 54) mounted on an arm 56 extending from the substrate engaging base 42 of the 10 pile guide 12, and a second part 60 (in this case a female member in the form of a bucket 62) mounted on the leg 30 of the template 10. The first parts 52 are configured to matingly engage the second parts 60 when registered together by lowering the pile guide 12 onto the substrate 15 14 alongside the template 10. Additional pairs of second parts 60 are additionally provided on the other legs 32, 34, 36 so that the first parts 52 may engage each in turn as the pile guide is moved around and docks with the template in the other locations 22, 24, 26.

20 As set out in the flow chart of figure 3, once the template 10 has been provided (step 101) and the pile guide 12 releasably attached in a first position to a first location 20 on the template 10 (step 102), the pile guide can then be used when driving a first pile into the 25 substrate 14 (step 103). Pile guide 12 is then moved to a second position and releasably attached to a second location 22 on the template 10, spaced from the first location 20 (step 104). A second pile is then driven into

the substrate, 14 whilst guided by the pile guide 12 in this second position (step 105). If pin piles are used to anchor the template 10 to the substrate 14, these may be driven into the substrate through apertures 38 between 5 steps 103 and 104.

It will be evident that the relative positions of the two piles driven in this manner will be accurately determined by the dimensions of the template 10 and the pile guide 12. However, only a single moveable pile guide 10 12 is required to achieve this accuracy. Moreover, the template 10 is much smaller and lighter than a conventional template for the same pile spacing and having fixed pile guides.

In the embodiment shown, third and fourth piles can 15 be accurately driven relative to the first and second piles by moving the pile guide 12 to third and fourth positions and releasably attaching the pile guide 12 to third and fourth locations 24, 26 on the template 10 respectively.

20 Figure 4 shows an alternative template 110 which has an octagonal footprint, but still provides four docking locations 120,122,124,126 for a pile guide (not shown). In contrast with the arrangement of Figures 1 and 2, it is noted that the template 110 has a long pin 154 and a short 25 pin 156 in each docking location 120,122,124,126 in place of female members in the form of buckets. Each pair of the long and short pins 154,156 will matingly engage corresponding apertures in the pile guide (not shown)

which together will form the attachment mechanisms for releasably coupling the pile guide to the template 110. The long pin 154 acts as an initiation probe and is configured to matingly engage its respective aperture 5 before the short pin 156 matingly engages its respective aperture. Once the long pin 154 has engaged its respective aperture, but before the short pin has engaged its respective aperture, the pile guide may rotate relative to the template 110 about an axis defined by the 10 long pin 154. Such rotation may help with registering the short pin 156 with its respective aperture, particularly by using the back stop 170 on the template 110 as an alignment member to prevent over-rotation of the pile guide relative to the template 110. Once both the long 15 and short pins 154,156 engage their respective apertures in the pile guide, the template 110 and pile guide will be held together to resist relative movement therebetween at least in the plane of the seabed on which they rest.

An arrangement of four accurately-positioned piles 20 can be used, for example, for a well head. As shown in Figure 4, the piles 180 are typically driven such that they extend 2m above the seabed 14. A well head drilling jacket 182 is then mounted on the piles 180, the deck section 184 of the jacket 182 carrying, for example, a 25 drilling derrick 186.

CLAIMS

1. A method of positioning piles relative to one another on a substrate (e.g. a seabed) into which the piles are to be driven, the method comprising the steps of: providing a
5 template; releasably attaching a pile guide to a first location on the template; driving a first pile into the substrate using the pile guide when attached to the first location; moving the pile guide and attaching it to a second location on the template, spaced from the first
10 location; and driving a second pile into the substrate using the pile guide when attached to the second location.
2. A method according to claim 1, in which the pile guide is releasably fixed to a location on the template such that during pile driving there is substantially no
15 relative movement between the pile guide and template, at least parallel to the surface of the substrate.
3. A method according to claim 2, in which such releasable fixing is achieved by means of two spaced apart attachment mechanisms.
- 20 4. A method according to any preceding claim, further comprising anchoring the template to the substrate, at least to prevent translational movement parallel to the surface of the substrate.
5. A method according to claim 4, in which anchoring
25 comprises driving into the substrate a pin pile which passes through an aperture in the template.
6. A method according to claim 5, in which anchoring comprises driving two pin piles into the substrate through

respective apertures in the template, thereby ensuring that the template is anchored against both translational and rotational movement parallel to the surface of the substrate.

5 7. A method according to any one of claims 4 to 6, in which anchoring the template to the substrate is carried out before moving the pile guide from the first to the second location.

8. Apparatus for positioning piles relative to one
10 another in a substrate, comprising a template and a pile guide releasably attachable to the template in any one of at least a first location and a second location when guiding a pile into the substrate, the first and second locations being spaced apart to enable the pile guide to
15 be releasably attached to the template in different positions relative thereto.

9. Apparatus according to claim 8, in which the template and pile guide are configured, at each location, to be releasably attached together by two spaced apart
20 attachment mechanisms such that during pile driving there is substantially no relative movement between the pile guide and template, at least parallel to the surface of the substrate.

10 Apparatus according to claim 9, in which each
25 attachment mechanism is of the type in which a male member on one of the template and pile guide engages a female member on the other of the template and pile guide.

11. Apparatus according to claim 9 or claim 10, in which

one attachment mechanism is configured to couple together the pile guide and template before the other attachment mechanism.

12. Apparatus according to any one of claims 8 to 11, in 5 which the template comprises one or more apertures, each of which defines part of an integral guide for a pin pile for pinning the template to the substrate.

13. Apparatus according to claim 12, in which the integral guide has a flared surround for guiding a pin 10 pile into the aperture.