

Pile guide comprising a base frame and a guide member

The invention relates to a pile guide comprising a base frame and a guide member for guiding a pile as it is driven into a substrate when the base frame rests thereon, the guide member comprising a plurality of guide parts that are movable, e.g. pivotally mounted on the base frame, between an operative position for supporting the pile and an inoperative position.

Pile guides are known and used to support, level and orientate free-standing impact-driven piles on a ground formation, e.g. on a seabed for a variety of offshore projects, including FPSO and FSO moorings, single point moorings, riserbase piles and pipeline initiation piles, offshore loading systems, and conductors.

As explained in WO 99/11872, it is known to provide a pile 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. Particularly when piling underwater, there is the problem that after the pile has been introduced into the seabed or the like, the guide must be removed to allow the pile to be driven into its final position, which removal is time consuming and thus expensive.

The pile guide in WO 99/11872 comprises a base frame and a pile guide member in turn comprising two parts, each of which is pivotally mounted on the base frame. In this way, each of the two parts is moveable relative to the base frame between an operative position and an inoperative position by rotation about a respective pivot axis. The two parts are held in the operative positions by a latch mechanism, and counterweights are provided to urge the parts into their inoperative positions when the latch mechanism is released. With such a pile guide, it is possible to drive piles fully into a substrate without having to interrupt piling to move the pile guide away from the pile once it has

been introduced into the substrate, simply by releasing the latch mechanism and allowing the parts of the pile guide to rotate in their inoperative positions and thus provide sufficient clearance for the hammer.

5 Pile guides are closed again by pulling the guide parts, e.g. sleeve halves, up by means of rigging connected to an offshore crane. It is important that the sleeves reach the operative position at substantially the same time, as the latches and associated mechanisms must align properly to
10 be able to lock. However, long crane wires, strong currents and/or low visibility, frequently complicate sufficiently accurate timing.

 It is an object of the present invention to provide an improved pile guide, in particular to facilitate pulling
15 guide parts to the closed position.

 To this end, the pile guide according to the present invention is characterised by a mechanism that couples the guide parts such that movement of a guide part towards the operative position results in movement of at
20 least one other guide part towards the operative position. In an embodiment, the mechanism couples the guide parts such that movement of a guide part towards the operative position results in a corresponding movement by at least one other guide part, preferably all guide parts.

25 Thus, the guide parts are forced to move together. E.g., if one guide part is pulled towards the closed position, e.g. by a lift rigging of a crane, the other guide part (in case of a total of two guide parts) or at least one other guide part (in case of more than two guide parts) is
30 moved by the mechanism to the same position relative to the base frame, in case of hinging guide parts e.g. rotated over the same or substantially the same angle.

 In an embodiment, to enable proper alignment of the guide parts, in particular of e.g. latches or alignment
35 elements (plates, pins) on the guide parts for maintaining

or supporting the closed position, the mechanism couples the guide parts such that if one part is in the operative position, at least one other guide part, preferably all guide parts, is respectively are in the operative position.

5 In another embodiment, the mechanism comprises at least two hydraulic cylinders, in particular passive hydraulic cylinders, each connected to a guide part and supported by the base frame, e.g. via a mount on the base frame. In a refinement, the hydraulic cylinders are coupled
10 via hydraulic lines, such that hydraulic fluid expelled from one cylinder is fed to at least one other cylinder. In an example, the extended position of the cylinders corresponds to the operative (closed) position of the guide parts and the retracted position of the cylinders corresponds to the
15 inoperative (open) position of the guide parts. In another refinement, providing a compact yet robust mechanism to force the guide parts to move together, each of the hydraulic cylinders is located between a guide part and the base frame and the sides of the cylinders nearest the guide
20 parts are connected, via hydraulic lines, to the side nearest the base frame of another cylinder. Thus, movement imposed on a first guide part generates hydraulic flow resulting in a corresponding movement of a further guide part or parts.

25 In an embodiment, the hydraulic cylinders are of equal capacity, i.e. an equal amount of hydraulic fluid exiting or entering the hydraulic cylinders results in equal displacement of the pistons and piston rods in the hydraulic cylinders.

30 In a further embodiment, one or more hydraulic valves, e.g. ball valves, are provided in the hydraulic lines between the cylinders, the valves having a closed position preventing flow of hydraulic fluid between the cylinders and an open position allowing flow of hydraulic
35 fluid between the cylinders. In a refinement, a hydraulic

override, e.g. a so-called hot stab connection, is provided to control the hydraulic cylinders independently when the valves are in the closed position. In another refinement, the valves provide a further position, wherein the hydraulic cylinders function as dampers, e.g. by directing flow from one end of a cylinder, preferably of each of the cylinders individually, to the other end of that cylinder (no flow between the cylinders).

In an embodiment, each guide part comprises a latch and a latch counterpart and, in the operative position, the latches and latch counterparts are aligned and locked.

It is generally preferred that the guide member comprises at least two guide parts, preferably has precisely two guide parts, together forming, in the operative position, a hollow member for enclosing the pile during pile driving. In an embodiment, the hollow member has a circular cross-section.

For the sake of completeness, attention is drawn to the following prior art.

WO 2013/014416 relates to a pile guide for supporting a pile as it is driven into a substrate, comprising: a base frame; and a pile guide member which is mounted on the base frame and defines a passageway with an inner peripheral surface to which a plurality of elongate members are attached. The plurality of elongate members are configured to engage a pile and guide it in a predetermined direction through the passageway as it is driven into a substrate.

WO 2014/057034 relates to a pile guide comprising a base frame and a pile guide member for guiding the pile as it is driven into a substrate when the base frame is resting thereon. The pile guide member comprises plural guide parts each moveable between an operative position and an inoperative position, each guide part being pivotally mounted on the base frame.

The invention will now be explained in more detail with reference to the Figures, which show a preferred embodiment of a pile guide frame according to the present invention.

5 Figures 1 and 2 are side views of a pile guide with its guide member in the operative and inoperative positions, respectively.

10 Figure 3 is a schematic representation of a mechanism coupling the movement of the guide parts of the guide member.

It is noted that the Figures are schematic in nature and that details, which are not necessary for understanding the present invention, may have been omitted.

15 Figures 1 and 2 show a pile guide 1 comprising a base frame 2 resting on, in this example, a seabed 9. The base frame 2 has a substantially rectangular footprint made up of so-called mud mats with a centrally placed aperture through which a pile 7 can be guided. The pile guide 1 comprises an open-ended generally vertical tubular guide member 3 supported on the base frame 2 and adapted to
20 slidingly receive a pile 7 to be driven into the seabed 9 by means of a hammer 6 connected to a rigging 23, see Figure 2. The upper end 5 of the guide member 3 is flared outwardly to form a guide cone to facilitate entry of a pile 7 into the
25 guide member.

30 The tubular guide member 3 comprises two similar semi-cylindrical guide parts or sleeve halves 4, which are moveable between the operative or closed position shown in Figure 1 and the inoperative or open position shown in Figure 2. In the operative position (Figure 1), the sleeve halves 4 are held together and aligned by a latch 14 and by alignment plates 13. The respective sleeve halves 4 are mounted on counterweighted arms 10, 11 which are pivoted, via hinges 12, on the base frame 2 such that the arms 10, 11

and thus the sleeve halves are biased under gravity into the inoperative (open) position shown in Figure 2.

In the example shown in Figures 1 and 2, braces 16 connect the outer ends of the arms 10, 11 and upper portions of the parts 4 in the interests of rigidity. Each latch 14 is disengaged automatically by downward movement of the pile 7 as it is driven into the seabed 9. E.g., the pile is provided with a latch trigger or detent 8 which engages a latch plate which is rotated by continued downward movement of the trigger 8 to push the plate outwardly so that the latch is released. The sleeve halves 4 then fall under gravity into the position shown in Figure 2. In this way, it is possible to continue driving the pile into the seabed without the need for removing the pile guide or the hammer from the pile, since the two sleeve halves 4 of the guide are moved clear of the pile and the driving hammer 6.

The pile guide is moved back into its working condition by operation of slings or cables 17 arranged to lift the pile guide, the slings 17 being connected to lifting eyes 15 on the outer ends of the arms 10, 11. During driving the slings 17 are slack to allow the frame 2 to sit fully on the seabed.

Figure 3 schematically shows a hydraulic mechanism installed in a pile guide and comprising two hydraulic cylinders 20 of equal capacity, each with its upper end connected to one of the sleeve halves 4 and with its lower end supported by the base frame 2. The hydraulic cylinders are coupled via hydraulic lines 21, such that hydraulic fluid expelled from one cylinder is fed to the other cylinder. In this example, the sides 20A of the cylinders 20 nearest the guide parts 4 are connected, via hydraulic lines 21, to the sides 20B of the cylinders 20 nearest the base frame.

Thus, if one guide part is pulled harder than the other, hydraulic fluid is expelled from the upper portion of

the cylinder connected to that guide part is expelled from the cylinder and fed to the lower side of the other cylinder, thus forcing the piston rod of that cylinder and the guide part connected to that cylinder up at a substantially equal rate and over a substantially equal (rotational) distance. As a result, the guide parts reach the operative position simultaneously and the latches align and lock inherently.

In this example, the hydraulic mechanism comprises a hydraulic ball valve 22 in each of the hydraulic lines 21, which valves are configured to be operated by a remotely operated vehicle (ROV), e.g. are provided with a so-called bucket WROV tap 23. The valves have a closed position preventing flow of hydraulic fluid between the cylinders and an open position allowing flow of hydraulic fluid between the cylinders.

The invention is not restricted to the embodiment described above and can be varied in numerous ways within the scope of the claims. E.g., in another example, the guide member comprises three of four hinging guide parts and the passive hydraulic cylinders are connected in series, i.e. movement imposed on a first guide part generates hydraulic flow resulting on a corresponding movement of a second guide part, which in turn generates hydraulic flow resulting on a corresponding movement of a third guide part. In yet another example, the guide parts are coupled via gears or via a chain or cable and chain wheels or pulleys, respectively, to positively couple the guide parts such that movement of one guide part towards the operative position results in an equal movement the other guide part(s) and in the guide parts arriving at the operative position simultaneously.

CLAIMS

1. Pile guide (1) comprising a base frame (2) and a guide member (3) for guiding a pile (7) as it is driven into a substrate (9), the guide member (3) comprising a plurality of guide parts (4) that are movable between an operative
5 position for supporting the pile and an inoperative position, wherein the guide parts (4) are mounted on the base frame (2) via hinges (12), **characterized by** a mechanism (20, 21) that couples the guide parts (4) such that movement of a guide part (4) towards the operative position results
10 in movement of at least one other guide part (4) towards the operative position.

2. Pile guide (1) according to claim 1, wherein the mechanism (20, 21) couples the guide parts (4) such that movement of a guide part (4) towards the operative position
15 results in a corresponding movement by at least one other guide part (4), preferably all guide parts (4).

3. Pile guide (1) according to claim 1 or 2, wherein the mechanism (20, 21) couples the guide parts (4) such that if one guide part (4) is in the operative
20 position, at least one other guide part (4), preferably all guide parts (4), is respectively are in the operative position.

4. Pile guide (1) according to any one of the preceding claims, wherein the mechanism (20, 21) comprises
25 at least two hydraulic cylinders (20), each connected to a guide part (4) and supported by the base frame (2).

5. Pile guide (1) according to claim 4, wherein the hydraulic cylinders (20) are coupled via hydraulic lines (21), such that hydraulic fluid expelled from one cylinder
30 is fed to at least one other cylinder.

6. Pile guide (1) according to claim 4 or 5, wherein each of the hydraulic cylinders (20) is located between a guide part (4) and the base frame (2) and wherein

the sides (20A) of the cylinders (20) nearest the guide parts (4) are connected, via hydraulic lines (21), to the sides (20B) of the cylinders (20) nearest the base frame (2).

5 7. Pile guide (1) according to any one of claims 4-6, wherein the hydraulic cylinders (20) are of equal capacity.

 8. Pile guide (1) according to any one claims 5-7, comprising one or more hydraulic valves (22) in the
10 hydraulic lines (21) between the cylinders (20), the valves (22) having a closed position preventing flow of hydraulic fluid between the cylinders (20) and an open position allowing flow of hydraulic fluid between the cylinders (20).

 9. Pile guide (1) according to any one of the
15 preceding claims, wherein each guide part (4) comprises a latch (13) and a latch counterpart and wherein, in the operative position, the latches (13) and latch counterparts are aligned and locked.

 10. Pile guide (1) according to any one of the
20 preceding claims, comprising at least two guide parts (4), preferably two guide parts (4), together forming, in the operative position, a hollow member (3) for enclosing the pile (7) during pile driving.

 11. Pile guide (1) according to claim 10, wherein
25 the hollow member (3) defines a circular lumen.