

Offshore Platform with Clamping Wedges

The invention relates to an offshore device comprising a structure and at least one elongate component, as well as to a method for clamping a structure onto at least one elongate component.

Offshore devices have of course been known for a long time in the prior art in the form of oil platforms, transformer platforms or the like. Known offshore devices comprise a platform on which superstructures such as drilling derricks or the like can be or are mounted.

The offshore devices have one or more, preferably three or four, support legs. Self-installing platforms and movable offshore platforms furthermore have support legs along which the platform can be moved. At the installation site, the support legs can be lowered for example by means of a jacking system and the platform can be raised by the same jacking system out of the sea, on which it floats, and brought to the operating height.

DE 31 22 401 C2 discloses a fastening device for a pile-shaped element, in which two toothed racks are arranged in the longitudinal direction along a support and toothed rack portions are displaced horizontally by pulling together two opposite, slanted sides by means of screwing spindles and are pressed with their teeth into the toothed racks and thus fix a platform onto the support.

In said document, openings or guides are provided in the platform, along which the support legs are moved relative to the platform. A certain degree of play necessarily exists between the openings in the platform and the outer wall of the support leg. At the operating height, the load of the platform acting along the leg axis must be transferred into the support leg by fastening devices. The problem exists that there is a degree of play between the outer wall of the support leg and the opening which, despite axial fastening, permits a relative movement of the support leg relative to the platform. Such relative movements may be disadvantageous because wave loads acting on the support leg are not transferred directly into the platform but rather may lead to the support leg hitting the guide and thus being damaged.

The object of the invention is therefore to provide an offshore device as mentioned in the introduction, which avoids the abovementioned disadvantages, and to provide a method for clamping a structure onto at least one elongate component in order to avoid the abovementioned disadvantages.

The object is achieved in its first aspect by an offshore device having the features of claim 1.

5 The object is achieved by an offshore device comprising a structure, which may for example be a platform but may by all means take other forms, having at least one component guide with a seabed-side opening, and at least one elongate component which may be for example a support leg but also a riser or a caisson, which has an outer wall and which can be or is introduced through the seabed-side opening into the component guide with a degree of play. The play is at least reduced by a clamping device according to the invention. By virtue of the clamping device, loads acting on the elongate component transversely to a longitudinal direction of the component can be transferred directly into the structure. By way of example, wave loads acting on a support leg, which may be of considerable orders of magnitude, can be transferred from the support leg into the structure, in particular into the platform structure.

15 According to the invention, the clamping elements are connected to in each case an adjusting device, by means of which the clamping elements are movable back and forth along a longitudinal direction of the elongate component and can be fixed in a clamping position. The clamping elements are thus advantageously movable vertically in the case of an installed offshore platform.

20 In one particularly advantageous embodiment of the invention, the clamping device has pressing faces which are arranged on the inner side of the platform and which are oriented at an angle to the outer wall, and wedge-shaped clamping elements which can be or are arranged between the outer wall and the pressing faces. This design of the clamping device is particularly stable and can even additionally be installed by retrofitting on known structures, in particular platforms.

Advantageously, the pressing faces are provided along a circumference of the component guide and particularly preferably along the circumference of the opening. The opening and/or the component guide may be circular in a horizontal cross-section, in order then to receive in particular support legs which are circular in cross-section. However, angular, in particular triangular, quadrangular or opening cross-sections having any greater number of angles and preferably corresponding support leg cross-sections may also be provided.

Advantageously, the pressing faces slope downwards in the direction of the outer wall towards the seabed. The opening is preferably surrounded along its circumference by angled pressing faces which are each at an angle, preferably are all at the same angle, relative to the outer wall of the elongate component, preferably of the support leg. The space between

the pressing face and the outer wall tapers in a wedge shape towards the seabed. In each case a wedge-shaped clamping element is arranged in this intermediate space in order to achieve a clamping effect and to reduce the play, wherein said clamping element can be and is pressed in the direction of the seabed onto the pressing face and the outer wall from the side of the pressing face facing away from the seabed.

The opening may be, but need not be, formed directly in the outer wall. The pressing faces may be arranged directly at the outer wall, preferably on the inner side of the platform along the opening. However, the pressing faces may also be arranged further inwards in the platform along the opening of an inner deck, for example of the double deck.

In the case of an offshore platform, the clamping elements are advantageously movable vertically and in particular can also be pushed in by a vertical movement between the pressing face and the outer wall, so that a vertical clamping effect can be generated by a horizontal adjusting movement.

Preferably, the clamping elements have a covering on a side facing towards the outer face. In particular, the covering has the task of compensating forces and homogenizing a force distribution and thus of improving the transfer of horizontal forces between the support legs and the platform. Said covering may comprise an elastomer. However, it is also conceivable that the outer faces have teeth or serrations which have a friction-increasing effect.

The clamping elements may have, on the side thereof pointing into the interior of the structure, fastening means such as one, two or any greater number of eyes for fastening hydraulically operated cylinders which drive a back-and-forth movement of the clamping elements along the longitudinal direction and which preferably fix the clamping elements in their clamping position.

A fixing may also take place or be aided by further fixing means. The fixing means may act in addition to or instead of the cylinders. The fixing means may be clamping screws, bolts, tension rods, and so on, which fix the clamping element in the clamping position.

In one further development of the invention, guides for the clamping elements are provided laterally at the pressing faces, which guides prevent any displacement of the clamping element transversely to the adjusting movement. The lateral guides may be part of a pocket for each of the clamping elements, said pocket preferably being watertight.

Advantageously, the clamping elements are arranged in watertight pockets. The clamping elements are preferably replaceable. To this end, there may be provided for example in the double deck an inspection opening for each clamping element, through which easy inspection of the clamping elements is possible from the structure.

5

The raising or lowering of the platform along the at least one elongate component, in particular in the form of at least one support leg, may take place by means of a known jacking system.

10 In its second aspect, the object is achieved by a method having the features of claim 9.

The method is suitable in particular for implementation with one of the offshore devices mentioned above. In the method, an elongate component having an outer wall is introduced through a seabed-side opening into at least one guide of a structure, and a play between the
15 elongate component and the guide is reduced by a clamping device. With this method according to the invention, it is possible to arrange a structure on an elongate component, in particular a platform of an offshore device on at least one support leg, initially in a conventional manner and, once the platform has been arranged on the support leg, preferably in the operating position, to secure it by a clamping device which reduces a play
20 between the support leg and the guide, wherein clamping elements of the clamping device are moved in the longitudinal direction of the elongate component and the clamping elements clamp the structure onto the elongate component in a clamping position.

Preferably, the clamping elements are each pressed in the direction of the seabed onto the
25 pressing face and an outer wall of the elongate component from the side of a pressing face of the structure facing away from the seabed. Advantageously, the clamping elements do not absorb any vertical loads, but rather only horizontal loads, and thus reduce the play.

Preferably, the clamping elements are each wedge-shaped with a wedge tip pointing towards
30 the seabed.

Advantageously, for this purpose, clamping elements are pressed simultaneously onto the pressing faces and the outer wall of the support leg.

35 The invention will be described in eight figures on the basis of an example of embodiment. In the figures:

Fig. 1 shows a perspective view, partially in section, of an offshore platform according to the invention with clamping device and support leg,

Fig. 2 shows a perspective view, on the seabed side, of the offshore platform of Fig. 1,

Fig. 3 shows a perspective view, partially in section, of clamping wedges arranged around the support leg,

Fig. 4 shows a perspective view at an angle from the left in Fig. 3,

Fig. 5 shows a clamping position of the clamping wedges with associated adjusting device around the support leg,

Fig. 6 shows a free position of a clamping wedge,

Fig. 7 shows a clamping wedge in side view,

Fig. 8 shows the clamping wedge of Fig. 7 in a perspective view.

Fig. 1 shows part of an offshore device 1 according to the invention with part of an offshore platform 2 and with a support leg 3. The offshore device 1 has a plurality of support legs 3, but just one of the support legs 3 is shown. The support legs 3 stand on a seabed (not shown), and the offshore platform 2 is arranged at an operating height above sea level. In its region on the seabed side in Fig. 1, the offshore platform 2 has a double deck 4 with a double deck opening 4a and an outer skin 6 on the sea side with an outer skin opening 6a.

A section of the support leg 3 is introduced vertically through the outer skin opening 6a and the double deck opening 4a. The section of the support leg 3, preferably the entire support leg 3, has an identical cross-section along its longitudinal extension in the longitudinal direction L. The support leg 3 is fastened to the platform 2 by fastening means (not shown), which in particular absorb the vertical forces. The outer skin opening 6a has a substantially circular opening cross-section with a diameter which is greater than a diameter of a cross-section of the support leg 3. The support leg 3 accordingly has a degree of play in the offshore platform 2. Due to the size difference between the cross-sections, the support leg 3 has a degree of play in the double deck 4 and the outer skin 6. At times and particularly when there is heavy swell, considerable wave loads act on the support leg and may lead to a

horizontal relative movement of the support leg 3 relative to the platform 2. In order to avoid the relative movement between the support leg 3 and the platform 2 due to horizontal wave loads being introduced from the support leg 3 into the platform 2, a clamping device 8 according to the invention is provided. The clamping device 8 comprises a plurality of clamping wedges 10, which are each movable back and forth in the longitudinal direction L of the support leg 3 via two hydraulically driven cylinders 11 and can be fixed by the cylinders 11 in their respective clamping position between the outer wall of the support leg 3 and an associated pressing face 13, and a fastening means 12 for fastening the cylinders 11 to the platform 2. In each case one end of the cylinders 11 is connected in an articulated manner to the fastening means 12, and in each case another end of the cylinders 11 is connected in an articulated manner to the clamping wedge 10 assigned to the cylinder. Between the double deck 4 and the outer skin 6 on the sea side, the platform 2 has the angled pressing faces 13 which surround the double deck opening 4a and the outer skin opening 6a. The pressing faces 13 are flat here, other forms also being conceivable, and are angled relative to the outer wall of the support leg 3 and in relation to the longitudinal direction L.

A relative arrangement of the outer face of the support leg 3 and the pressing face 13 is defined in such a way that in each case one clamping wedge 10 can be introduced in a form-fitting and force-fitting manner into the intermediate space formed between the pressing face 13 and the outer wall of the support leg 3. In particular, horizontal movements of the support leg 3 are thus transferred by the clamping wedge 10 directly into the platform 2.

Fig. 2 shows a view of the platform 2 of Fig. 1 from below, that is to say from the direction of sea level. The outer skin opening 6a is substantially circular and is reinforced by an annular plate 20 surrounding the outer skin opening 6a on the sea side. For each of its support legs 3, the platform 2 has a guide in which the associated support leg 3 is guided and which runs vertically through the platform 2 or at least one section of the platform 2. The cross-section of the outer skin opening 6a is larger than the cross-section of the support leg 3, the latter being of constant circular shape along its entire longitudinal direction L. The clamping wedges 10, which are introduced into the intermediate space between the pressing faces 13 surrounding the support leg 3 and the outer wall of the support leg 3 and which likewise surround the support leg 3, reduce or prevent a play of the support leg 3 relative to the platform 2.

Fig. 3 shows the arrangement of Fig. 1 in a perspective sectional view in the region of the double deck 4. In Fig. 3, four clamping wedges 10 can be seen, which surround the support leg 3 in a manner spaced equidistantly from one another. The support leg 3 is surrounded by a total of eight clamping wedges 10. The clamping wedges 10 are identical to one another

and have in particular an identical wedge angle α pointing towards the surface of the sea in the clamping position. Consequently, the angle of inclination α between the pressing faces 13 and the outer wall of the support leg 3 is also identical in each case and corresponds in each case to the wedge angle α of the clamping wedges 10. Fig. 3 shows in particular that the clamping wedges 10 are guided by in each case two lateral cheeks 30 which run along edges of the pressing faces 13 and perpendicular to the pressing faces 13, so that a horizontal displacement of the clamping wedges 10 perpendicular to the longitudinal direction L is prevented.

Each clamping wedge 10 has, on the side facing away from the seabed, that is to say facing towards the interior of the platform 2, two circular eyes 31 which are intended in pairs for fastening the seabed-side end of one of the hydraulic or mechanical cylinders 11.

Fig. 4 shows an arrangement as in Fig. 3 from a different viewing angle, wherein the part of the offshore device 1 shown in Fig. 4, on the side facing away from the seabed, is formed more by the support leg 3 and by the platform 2 than the part in Fig. 3. In particular, it can be seen in Fig. 4 that the support leg 3 within the platform 2 is surrounded at least in some sections by a guide tube 21 which is identical to the cross-section of the outer skin opening 6a and which has, only in the region of the clamping wedges 10, cutouts for enabling the clamping wedges 10 to act directly on the outer wall of the support leg 3. The hydraulic or mechanical cylinders 11 (not shown in Fig. 4) run outside of the guide tube 21. In particular, the clamping wedges 10 can be operated and easily replaced from the interior of the platform 2 since an inspection opening 33 for the respective clamping wedge 10 is formed between the two guide cheeks 30 of each of the clamping wedges 10.

Fig. 5 schematically shows the arrangement of the clamping wedges 10 in the clamping position on the support leg 3. The clamping wedges 10 are moved by in each case two of the hydraulic cylinders 11. The clamping wedges 10 are movable in particular in the longitudinal direction L, that is to say up and down in Fig. 5, but are also movable transversely to the longitudinal direction L. An associated hydraulic control means is not shown. The fastening of the hydraulic cylinders 11 to the fastening means 12 in the interior of the platform 2 is also not shown.

Fig. 6 shows the position of a clamping wedge 10 in a free position, in which the clamping wedge 10 has been pulled out of the intermediate space between the pressing face 13 and the outer wall of the support leg 3 in the direction away from the seabed. In this position, the platform 2 is not clamped to the support leg 3.

Fig. 7 shows a clamping wedge 10 in a side view. The clamping wedge 10 possibly has on its side facing towards the support leg 3 a friction-increasing or force-compensating covering 70. This may be a rubber covering or plastic covering, but serrations, teeth or the like are also in principle conceivable as the covering 70.

Fig. 8 shows the clamping wedge 10 in a perspective view. The side of the clamping wedge 10 facing towards the pressing face 13 is formed for example of smooth steel. On the side of the clamping wedge 10 facing away from the seabed, in each case two eyes 80 are provided for the articulated fastening of in each case one of the cylinders 11.

List of references

	1	offshore device
	2	offshore platform
5	3	support leg
	4	double deck
	4a	double deck opening
	6	outer skin on the sea side
10	6a	outer skin opening
	8	clamping device
	10	clamping wedges
15	11	cylinder
	12	fastening means
	13	pressing faces
	20	annular plate
20	21	guide tube
	30	lateral cheeks
	31	circular eyes
25	33	inspection opening
	70	force-compensating covering
	80	eyes
30		
	L	longitudinal direction
	α	wedge angle, angle of inclination
35		

Claims

1. Offshore device comprising
a structure (2) having at least one component guide (21) with a seabed-side opening
5 (6a) and comprising
at least one elongate component (3) having a longitudinal direction (L) and having an
outer wall which is introduced through the opening (6a) into the component guide (21)
with a degree of play,
comprising a clamping device (8) which reduces the play, **characterized in that** the
10 clamping device (8) has clamping elements (10) and the clamping elements (10) are
connected to in each case an adjusting device (11), by means of which the clamping
elements (10) are movable back and forth along the longitudinal direction (L) of the
elongate component (3) and can be fixed in a clamping position.
- 15 2. Offshore device according to claim 1,
characterized in that the clamping device (8) has pressing faces (13) which are
arranged on the inner side of the platform and which are oriented at an angle to the
outer wall,
and has wedge-shaped clamping elements (10) which can be arranged between the
20 outer wall and the pressing faces (13).
3. Offshore device according to claim 2,
characterized in that the pressing faces (13) are arranged along a circumference of the
opening (6a).
25
4. Offshore device according to claim 1, 2 or 3,
characterized in that the pressing faces (13) slope downwards in the direction of the
outer wall towards the seabed.
- 30 5. Offshore device according to any one of claims 1 to 4,
characterized in that the clamping elements (10) have, on a side facing towards the
outer face, a covering (70) which homogenizes a force distribution.
6. Offshore device according to any one of claims 1 to 5,
35 characterized in that the clamping elements (10) have, on the side thereof pointing into

the interior of the structure (2), eyes (31) for fastening hydraulically operated cylinders (11).

7. Offshore device according to any one of claims 1 to 6,
5 characterized in that clamping element guides (30) are provided laterally at the pressing faces (13).
8. Offshore device according to any one of the preceding claims,
10 characterized in that the pressing faces (13) delimit a double deck (4) on the opening side and the clamping elements (10) can be replaced from the structure inner side of the double deck (4).
9. Method for installing a structure (2) on at least one elongate component (3) having a
15 longitudinal direction (L), in which the at least one elongate component (3) having an outer wall is introduced through a seabed-side opening (6a) into a component guide (21) with a degree of play and the play between the elongate component (3) and the component guide (21) is reduced by a clamping device (8), wherein clamping elements (10) of the clamping device (8) are moved in the longitudinal direction (L) of the
20 elongate component (3) and the clamping elements (10) clamp the structure (2) onto the elongate component (3) in a clamping position.
10. Method according to claim 9,
characterized in that the clamping elements (10) are each pressed in the direction of
25 the seabed onto the pressing face (13) and an outer wall of the elongate component (3) from the side of a pressing face (13) of the structure (2) facing away from the seabed.
11. Method according to claim 9 or 10,
characterized in that the wedge-shaped clamping elements (10) are pressed
30 simultaneously onto the pressing faces (13) and the outer wall.