

CONDUIT BALCONY

TECHNICAL FIELD

The present disclosure relates to a conduit balcony according to the preamble of claim 1. Moreover, the present disclosure relates to a floating unit comprising a conduit balcony.

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BACKGROUND

A floating unit may be used for drilling, producing or storing gases and/or liquids at sea. For example, a floating unit may be used for drilling, producing or storing hydrocarbons, such as oil and gas, at sea.

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To this end, one or more conduits may be connected to the floating unit. Purely by way of example, a conduit may be an electrical cable or an umbilical. As another example, a conduit may be a riser that provides a fluid communication between a bottom well in the seabed and the floating unit. As another example, a conduit may be an export riser that may be used for transporting fluid from the floating unit to e.g. a pipe line.

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The conduits may be supported by a conduit balcony that may be connected to the floating unit such that conduit loads are at least partially transferred to the floating unit via the conduit balcony.

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Thus, the one or more conduits that are supported by the conduit balcony may impart loads to the conduit balcony, which loads in turn result in stresses in at least portions of the conduit balcony. Moreover, possible deflections of the floating unit, for example due to it being acted on by waves, may result in additional stresses in at least portions of the conduit balcony.

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Depending on the load condition that is considered for the conduit balcony, stresses emanating from different loads and/or deflections may have to be combined in order to arrive at total stresses in the conduit balcony. Low total fatigue stresses in the conduit balcony are generally desired since too high total stresses may increase the risk of the conduit balcony being impaired from operating satisfactory.

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SUMMARY

An object of the present disclosure is to obtain a conduit balcony with an appropriately low risk that the conduit balcony is subjected to undesirably high total stresses.

- 5 This object is achieved by a conduit balcony according to claim 1.

As such, the present disclosure relates to a conduit balcony for a floating unit. The conduit balcony comprises a support portion adapted to support at least one conduit. The conduit balcony further comprises a connection portion adapted to connect the support portion to
10 the floating unit. The conduit balcony extends in a longitudinal direction and a transversal direction.

As used herein, the expression "support portion" relates to the portion of the conduit balcony from which one or more conduits may be suspended. Thus, the support portion is
15 related to the portion of the conduit balcony that is adapted to receive the load of one or more conduits.

The support portion may comprise one or more members that are separate from one or more members that form the connection portion. Optionally, the support portion and the
20 connection portion may form a unitary component. In such an event, the expression "support portion" is related to the portion of such a unitary component that is adapted to receive the load of one or more conduits.

The connection portion extends in the transversal direction from a first connection portion, adapted to be attached to the floating unit, to a second connection portion, attached to the
25 support portion. The support portion comprises an inner support portion located closest to the first connection portion in the transversal direction. The conduit balcony is such that a first prescribed elongation, in the longitudinal direction, of the first connection portion results in a second elongation of the inner support portion. The second elongation may be
30 in the longitudinal direction.

According to the present disclosure, the conduit balcony is configured such that the second elongation is less than or equal to 30 % of the first elongation.

As used herein, the expression "elongation" refers to the relative displacement between two end points of a member. As such, the expression "elongation in the longitudinal direction" relates to the relative displacement in the longitudinal direction between two longitudinal end points of a member.

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As such, at least a portion of the conduit balcony is relatively weak in at least the longitudinal direction. This in turn implies that possible longitudinal deflections of the floating unit hosting the conduit balcony will impart only moderate stresses to the support portion. Thus, the total stresses in the support portion may be reduced, as compared to a
10 conduit balcony that is relatively stiff in the longitudinal direction. Purely by way of example, the portion of the conduit balcony that is relatively weak may be the connection portion.

The above-mentioned portion of the conduit balcony being relatively weak may be a
15 portion of the conduit balcony being located more proximally to, e.g. closer to, the first connection portion in the transversal direction than the inner support portion of the support portion.

Purely as an example, the portion of the conduit balcony that is located closer to the first
20 connection portion in the transversal direction than the inner support portion of the support portion may have a lower longitudinal stiffness than the inner support portion. Thereby possible longitudinal deflections of the floating unit hosting the conduit balcony that are transferred to the conduit balcony at the first connection portion will impart only moderate stresses to the support portion.

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Optionally the conduit balcony is configured such that the second elongation is less than or equal to 20 %, preferably less than or equal to 10%, more preferred less than or equal to 5%, of the first elongation. The conduit balcony may have a longitudinal stiffness selected such that the second elongation is less than or equal to 20 %, preferably less
30 than or equal to 10%, more preferred less than or equal to 5%, of the first elongation.

As used herein, the expression "conduit" relates to any type of conduit that is adapted to be connected to a floating unit in order to transport matter and/or energy and/or information to and/or from the floating unit. Purely by way of example, a conduit may be
35 an electric cable, an umbilical or a riser.

Optionally, the support portion of a conduit balcony is adapted to support at least one riser. As used herein, the expression "riser" relates to any type of conduit that is adapted to be used for transporting fluid to and/or from a floating unit.

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Moreover, the expression "floating unit" comprises any type of unit that is adapted to float in a body of water. Purely by way of example, the expression "floating unit" encompasses a ship, a floating production storage and offloading unit (FPSO), a semi-submersible unit, a barge, a SPAR buoy, a tension leg platform (TLP) or the like.

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Optionally, the conduit balcony is configured such that the second elongation is greater than or equal to 0.01 % of the first elongation.

The fact that the second elongation is greater than or equal to 0.01 % of the first elongation implies that conduit loads in the longitudinal direction may be transferred to the floating unit in an appropriate manner.

Optionally, the conduit balcony is configured such that the second elongation is greater than or equal to 0.05 %, preferably greater than or equal to 0.1 %, more preferred greater than or equal to 0.2 %, of the first elongation.

Optionally, the first connection portion further comprises a longitudinal load transmitting means adapted to transmit longitudinal conduit loads from the support portion to the floating unit.

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Optionally, the longitudinal load transmitting means comprises at least one longitudinal load transmitting panel. The use of a panel implies that a cost efficient and robust longitudinal load transmitting means may be obtained. Optionally, the longitudinal load transmitting panel extends in a substantially horizontal direction, i.e. in the longitudinal and transversal directions.

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Optionally, the conduit balcony is configured such that when a longitudinal load is applied to the support portion, at least 70%, preferably 90%, more preferred 95%, of the load is transferred to the first connection portion via the at least one longitudinal load transmitting panel.

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Optionally, the connection portion comprises a plurality of connection plates, each one of which extending at least in the transversal direction.

- 5 Optionally, the conduit balcony further has an extension in a vertical direction, with each one of the connection plates further extending substantially in the vertical direction.

Optionally, each one of the connection plates has a bending stiffness, around a longitudinal axis parallel to the longitudinal direction, which is at least 100 times greater,
10 preferably at least 10000 times greater, than the bending stiffness around a vertical axis parallel to the vertical direction.

The fact that the connection plate has a bending stiffness around a longitudinal axis that is substantially larger than the bending stiffness around a vertical axis implies that the
15 connection plate may be able to transfer relatively large loads in a vertical direction whereas the connection plate may deflect when one end thereof, in the transversal direction, is subjected to a displacement in the longitudinal direction.

Optionally, the longitudinal load transmitting means is located between two adjacent
20 connection plates.

Optionally, the conduit balcony comprises a transversal centre line extending in the transversal direction. The conduit balcony comprises a distal bracket space between two adjacent connection plates. The conduit balcony further comprises a proximal bracket
25 space between two adjacent connection plates. The proximal bracket space is located closer, in the longitudinal direction, to the transversal centre line than the distal bracket space. The longitudinal load transmitting panel is located in the proximal bracket space.

A possible longitudinal deflection of a floating unit hosting the conduit balcony will
30 generally impart larger deflections of the longitudinal ends of the conduit balcony as compared to the longitudinal centre thereof. Thus, the placement of the longitudinal load transmitting panel in the proximal bracket space, i.e. closer to the longitudinal centre of the conduit balcony than the position of the distal bracket space, implies that a relatively low amount of the unit's longitudinal deflections will be transferred to the support portion
35 via the longitudinal load transmitting panel. As such, the above discussed placement of

the longitudinal load transmitting panel may result in that a longitudinal conduit load may be transferred to the unit in an appropriate manner but that deflections of the unit will not impart excessive stresses to the support portion of the conduit balcony.

- 5 A second aspect of the present disclosure relates to a floating unit comprising a conduit balcony according to the first aspect of the present disclosure.

Optionally, the length in the longitudinal direction of the conduit balcony is 20 %, preferably less than 6%, of the length in the longitudinal direction of the floating unit. The
10 fact that the conduit balcony is relatively short in relation to the length of the floating unit implies that a relatively small portion of the total elongation of the floating unit, for instance during sagging or hogging, will be imparted to the conduit balcony.

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 With reference to the appended drawings, below follows a more detailed description of embodiments of the disclosure cited as examples.

In the drawings:

- 20 Fig. 1 illustrates a floating unit comprising a conduit balcony;

Fig. 2 illustrates an embodiment of a conduit balcony;

- Fig. 3 illustrates a portion of the Fig. 2 conduit balcony when being subjected to an
25 elongation;

Fig. 4 illustrates a first cross-section, IV, of the Fig. 2 conduit balcony;

- Fig. 5 illustrates a second cross-section, V, of the Fig. 2 conduit balcony;
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Fig. 6 a floating unit comprising a conduit balcony;

Fig. 7 illustrates a test method for determining the elongation of a conduit balcony, and

Fig. 8 illustrates a test method for determining the load transfer through a conduit balcony.

It should be noted that the appended drawings are not necessarily drawn to scale and that the dimensions of some features of the present invention may have been exaggerated for the sake of clarity.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Embodiments of the conduit balcony and a floating unit will be presented hereinbelow. It is to be understood, however, that the embodiments are included in order to explain principles of the invention and not to limit the scope of the invention.

Fig. 1 illustrates a floating unit 10. The floating unit 10 is in Fig. 1 exemplified as a floating production storage and offloading unit (FPSO). However, it should be noted that embodiments of the conduit balcony may instead, or in addition, be suitable for another type of floating unit such as a ship, a semi-submersible unit, a barge, a SPAR buoy, a tension leg platform (TLP) or the like.

The floating unit 10 is adapted to float in a body of water 12 with a still water surface 14.

The floating unit 10 may be equipped with a station-keeping arrangement (not shown). Purely by way of example, the station-keeping arrangement may comprise at least one mooring line (not shown) and/or at least one thruster (not shown).

Fig. 1 further illustrates three conduits 16, 18, 20, each one of which being connected to the floating unit 10 via a conduit balcony 22. In Fig. 1, the conduit balcony 22 is adapted to be located beneath the still water surface 14. However, other embodiments of the conduit balcony 22 may be adapted to be located at or above the still water surface 14.

Irrespective of the position of the conduit balcony 22, a purpose of a conduit balcony is generally to support loads, in particular vertical loads, from the conduits 16, 18, 20.

Purely by way of example, a conduit may extend from the floating unit 10 to a sea bed (not shown). As another non-limiting alternative, a conduit may extend from the floating

unit 10 to another unit (not shown) that may be floating, or may be at least partially submersed, in the body of water 12.

In the example illustrated in Fig. 1, each one of the three conduits is a riser. A riser may be rigid or flexible. Purely by way of example, a riser may comprise a metal pipe, such as a steel pipe. As another non-limiting example, a riser may comprise a tube with a plastic layer. As a further non-limiting example, a riser may comprise a composite tube, e.g. a tube comprising a plastic layer and a steel layer.

Moreover, it should be noted that other embodiments of the conduit balcony may also, or instead, be suitable for being connected to other types of conduits, such as electric cables (not shown) and/or umbilicals (not shown).

Moreover, Fig. 1 illustrates that each one of the conduits 16, 18, 20 may comprise a corresponding upper portion 17, 19, 21 which extends from the conduit balcony 22 to another portion of the floating unit. The upper portion may form a unitary component with the corresponding portion of the conduit that extends downwards from the conduit balcony 22.

As another option, at least one of the upper portions 17, 19, 21 may be separate from the portion of the conduit that extends downwards from the conduit balcony 22. Purely by way of example, such an upper portion may be referred to as a hard pipe.

As another non-limiting example, at least one of the upper portions 17, 19, 21 may be adapted to accommodate the corresponding conduit 16, 18, 20 such that a portion of that conduit extends through the upper portion 17, 19, 21 and possibly to another portion of the floating unit.

Fig. 2 illustrates a top view of an embodiment of a conduit balcony 22. The conduit balcony 22 comprises a support portion 24 adapted to support at least one conduit (not shown in Fig. 2). As a non-limiting example, a support portion 24 may be adapted to support at least three conduits. The Fig. 2 support portion 24 is adapted to support eight conduits.

Purely by way of example, the support portion 24 may comprise a recess or an opening for each one of the conduits that it is adapted to receive. In the Fig. 2 implementation of the support portion 24, the support portion 24 comprises one opening 25 for each one of the eight conduits.

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The Fig. 2 conduit balcony 22 further comprises a connection portion 26 adapted to connect the support portion 24 to the floating unit 10. The conduit balcony 22 extends in a longitudinal direction L and a transversal direction T. Purely by way of example, the support portion 24 may be fixedly attached to the connection portion 26 by means of a joint, e.g. a weld joint and/or a bolt joint.

Fig. 2 further illustrates that the connection portion 26 extends in the transversal direction T from a first connection portion 26', adapted to be attached to the floating unit 10, e.g. to the outer skin 13 of the floating unit 10, to a second connection portion 26'', attached to the support portion 24. Purely by way of example, the first connection portion 26' may be adapted to be attached to the floating unit by means of a weld joint and/or a bolt joint. In the embodiment illustrated in Fig. 2, the first connection portion 26' is adapted to be attached to the hull outer skin 13 of the floating unit 10. Purely by way of example, the floating unit 10 may comprise web frames 11' that are attached to the inside of the outer skin 13 of the floating unit 10.

Moreover, as may be gleaned from Fig. 2, the support portion 24 comprises an inner support portion 24' located closest to the first connection portion 26' in the transversal direction T.

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Fig. 3 illustrates a portion of the Fig. 2 conduit balcony 22 when the first connection portion 26' is imparted an elongation in the longitudinal direction L. The conduit balcony 22 is such that a first prescribed elongation Δ_1 , in the longitudinal direction L, of the first connection portion 26' results in a second elongation Δ_2 of the inner support portion 24'. The second elongation Δ_2 is less than or equal to 30 % of the first elongation Δ_1 .

In the Fig. 2 embodiment of the conduit balcony 22, the connection portion 26 comprises a plurality of connection plates 28, each one of which extending at least in the transversal direction T. Moreover, the conduit balcony 22 further has an extension in a vertical direction V. Each one of the connection plates 28 further extends substantially in the

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vertical direction V. A connection plate 28, such as one of the plates that is illustrated in Fig. 2, may also be referred to as a connection bracket.

Fig. 2 further illustrates that the location, in the longitudinal direction L, of a connection plate 28 may be the same as the longitudinal location of a web frame 11' of the floating unit 10. In this way, it is possible to obtain a load transfer between the conduit balcony 22 and the floating unit 10 without subjecting the panels forming the outer skin 13 of the floating unit 10 to undesirably large stresses.

Fig. 4 illustrates a side view of a Fig. 2 connection plate 28. The Fig. 4 implementation of the connection plate 28 has an extension in the transversal direction T and in the vertical direction V. Purely by way of example, the Fig. 4 connection plate 28 comprises a metal plate, such as a steel plate. As a non-limiting example, the height H, i.e. the maximum extension in the vertical direction V, of the connection plate 28 may be within the range of 2 to 15 meters, preferably within the range of 4 to 10 meters.

Moreover, and again as a non-limiting example, the width W, i.e. the maximum extension in the transversal direction T, of the connection plate 28 may be within the range of 0.5 to 5 meters, preferably within the range of 0.8 to 1.5 meters. Purely by way of example, the thickness of the connection plate 28 may be within the range of 10 to 50 mm, preferably within the range of 15 to 40 mm.

Preferably, the Fig. 4 connection plate 28 has a bending stiffness at the first connection portion 26', around a longitudinal axis parallel to the longitudinal direction L, which is at least 100 times greater, preferably at least 1000 times greater, more preferred at least 10000 times greater, than the bending stiffness around a vertical axis parallel to the vertical direction V.

Fig. 4 further illustrates that the support portion 24 may comprise a support box assembly which in turn comprises an upper panel 27' and a lower panel 27''. The upper and lower panels 27', 27'' may preferably be connected to one another by one or more webs 29', 29'' and possibly also by partial webs (not shown in Fig. 4). Purely by way of example, each one of the upper panel 27' and a lower panel 27'' may be a metal panel, such as a steel panel. Moreover, although purely by way of example, each one of the upper panel 27' and a lower panel 27'' may have a thickness within the range of 10 – 150 mm,

preferably within the range of 30 – 100 mm. As a non-limiting example, the vertical distance between the upper panel 27' and a lower panel 27'', i.e. the distance between a bottom surface of the upper panel 27' and an upper surface of the lower panel 27'', may be within the range of 300 – 1000 mm, preferably within the range of 500 – 700 mm.

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Moreover, the Fig. 2 conduit balcony 22 is configured such that the second elongation Δ_2 is greater than or equal to 0.01 % of the first elongation Δ_1 . As such, the conduit balcony 22 is configured so as to have a certain longitudinal stiffness. The longitudinal stiffness may be advantageous since it may allow that longitudinal conduit loads be transferred to

10 the floating unit.

The above discussed longitudinal stiffness of at least a portion of the conduit balcony 22 may be obtained in a plurality of ways. Purely by way of example, one or more connection plate 28 could be designed so as to have a relatively large bending stiffness around a

15 vertical axis parallel to the vertical direction V.

However, as a non-limiting example, the first connection portion 26 could comprise a longitudinal load transmitting means 30 adapted to transmit longitudinal conduit loads from the support portion to the floating unit.

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Fig. 2 illustrates an implementation of the longitudinal load transmitting means 30 that comprises at least one longitudinal load transmitting panel. In fact, the Fig. 2 implementation of the illustrates two longitudinal load transmitting means 30, each one of which comprising a load transmitting panel, viz a first load transmitting panel 32 and a

25 second load transmitting panel 34.

Purely by way of example, the conduit balcony 22 may be configured such that when a longitudinal load is applied to the support portion 24, at least 70%, preferably 90%, more preferred 95%, of that load is transferred to the first connection portion 26' via the at least

30 one longitudinal load transmitting panels 32, 34.

A cross-section of the Fig. 2 embodiment of the conduit balcony 22, illustrating the position of the second load transmitting panel 34, is presented in Fig. 5.

Irrespective of the design of the longitudinal load transmitting means 30, the longitudinal load transmitting means 30 may preferably be located between two adjacent connection plates 28. In other words, a longitudinal load transmitting means 30 may preferably be located in a bracket space between two adjacent connection plates 28.

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Fig. 2 illustrates that the embodiment of the conduit balcony 22 illustrated therein comprises a transversal centre line 38 extending in the transversal direction T. As such, the transversal centre line 38 is located in the longitudinal centre of the conduit balcony 22.

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The Fig. 2 embodiment of the conduit balcony 22 comprises a distal bracket space 42 between two adjacent connection plates 28. Moreover, the Fig. 2 conduit balcony comprises a proximal bracket space 44 between two adjacent connection plates 28.

15 The proximal bracket space 44 is located closer, in the longitudinal direction L, to the transversal centre line 38 than the distal bracket space 42. The longitudinal load transmitting means 30 is located in the proximal bracket space 44. In the Fig. 2 embodiment of the conduit balcony 22, the proximal bracket space 44 is the bracket space that is located closest to the transversal centre line 38.

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As another non-limiting example, a load transmitting panel 32, 34 may have a thickness within the range of 5 – 60 mm, preferably within the range of 15 – 40 mm.

As another non-limiting example, a load transmitting panel 32, 34 may be fixedly attached
25 to its two adjacent connection plates 28. Moreover, as another non-limiting example, a load transmitting panel 32, 34 may also, or instead, be fixedly attached to at least one of the support portion 24, e.g. the inner support portion 24', and the floating unit 10 such as the outer skin 13 thereof. Purely by way of example, the fixed attachment of a load transmitting panel 32, 34 to any one of the above components may be achieved by a weld
30 joint and/or a bolt joint.

It should be noted that although the embodiments of the conduit balcony 22 that have been described hereinabove comprises a connection portion 26 that in turn comprises connection plates 28 and possibly also one or more load transmitting panels 32, 34, it is

also envisaged that embodiments of the conduit balcony may comprise a connection portion that in turn comprises a lattice work and/or a truss system (not shown).

Moreover, it should be noted that although the embodiments of the conduit balcony 22 that have been described hereinabove comprises a support portion 24 that in turn comprises panels 27', 27'', it is also envisaged that the embodiments of the conduit balcony 22 comprises a support portion 24 that in turn comprises a lattice work and/or a truss system (not shown).

10 Fig. 6 illustrates a portion of a floating unit 10. The Fig. 6 floating unit 10 comprises a plurality of conduit balconies 22. The floating unit 10 has a length L_{unit} in the longitudinal direction L (i.e. the length between perpendiculars of the floating unit 10).

A conduit balcony 22 preferably has a length L_{RB} in the longitudinal direction L that is less than 20%, preferably less than 6%, of the floating unit's length L_{unit} . Purely by way of example, a floating unit 10 may comprise a plurality of rise balconies each one of which having a length that is less than 20%, preferably less than 6%, of the floating unit's length L_{unit} .

20 Finally, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. For instance, although an FPSO has been used as an example of a floating unit in the description presented hereinabove, a conduit balcony could also be attached to another type of floating unit, such as a semi-submersible unit, a barge, a tension leg platform, a SPAR buoy, a ship or the like. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

30 DESCRIPTION OF TEST METHODS

DETERMINATION OF THE SECOND ELONGATION OF THE INNER SUPPORT PORTION

Fig. 7 illustrates a method for determining the second elongation of the inner support portion when the first connection portion is subjected to a first prescribed elongation.

Firstly, a finite element (FE) model is generated for the conduit balcony 22. The FE model should be generated so as to model the shape and material of the parts constituting the conduit balcony 22.

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When the FE model has been generated, the FE nodes of the first connection portion 26' are identified. As has previously been discussed, the first connection portion 26' is adapted to be attached to the floating unit (not shown in Fig. 7).

- 10 The nodes of the inner support portion 24' that are located at the first and second longitudinal ends 48, 50 of the conduit balcony 22 are determined. Moreover, the longitudinal distance L_{s1} between nodes at the first and second longitudinal ends 48, 50 of the inner support portion 24' is determined before any portion of the conduit balcony 22 has been subjected to any displacement.

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- A magnitude of the first prescribed elongation Δ_1 is determined. The magnitude of the first prescribed elongation Δ_1 should be relatively small such that substantially only elastic deformations occur in the conduit balcony, be it that some local plastic deformation inevitably may occur. Moreover, the first prescribed elongation Δ_1 is distributed along the longitudinal direction L such that the displacement is zero at the first longitudinal end 26'a of the first connection portion 26' and the longitudinal displacement equals Δ_1 at the second longitudinal end 26'b of the first connection portion 26'. As such, each node of the first connection portion 26' that is included in the first longitudinal end 26'a is locked from displacement in all three translational displacement directions, i.e. the longitudinal, transversal and vertical directions and also locked from rotation around axis parallel to the longitudinal, transversal and vertical directions.

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The longitudinal displacement d of a node of the first connection portion, wherein the node is located at a position x from 26'a in the longitudinal direction L, equals:

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$$d(x) = \Delta_1 \frac{x}{L_{RB}}$$

Eq. 1

Wherein L_{RB} equals the distance, in the longitudinal direction L, between 26'a and 26'b before the elongation of 26'.

Each one of the FE nodes of the first connection portion 26' is subjected to a longitudinal displacement corresponding to the longitudinal position of the node in accordance with Eq. 1 hereinabove. Each node, except for the one(s) located at 26'a, is locked in the remaining 5 degrees of freedom.

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Thereafter, the resulting displacement of the conduit balcony 22 is determined using an FE analysis software.

The longitudinal distance L_{s2} between the nodes at the first and second longitudinal ends 48, 50 is determined after the first connection portion 26' has been subjected to the above discussed displacements. If the FE model comprises a plurality of nodes each one of which being located at the first and second longitudinal end, end 48 and 50, but on different vertical position, the average position of these nodes at each end is used to determine the value of the distances L_{s1} , L_{s2} between the first and second longitudinal ends 48, 50.

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Thereafter, the second elongation Δ_2 is determined by:

$$\Delta_2 = L_{s2} - L_{s1}$$

Eq. 2

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DETERMINATION OF LOAD TRANSFER THROUGH A LONGITUDINAL LOAD TRANSMITTING PANEL

Fig. 8 illustrates a method for determining the load transfer through a conduit balcony.

25 Firstly, a finite element (FE) model is generated for the conduit balcony 22. The FE model should be generated so as to model the shape and material of the parts constituting the conduit balcony 22.

When the FE model has been generated, the FE nodes of the first connection portion are 30 identified. As has previously been discussed, the first connection portion 26' is adapted to be attached to the floating unit (not shown in Fig. 8). Each node that is included in the first connection portion 26' is locked from displacement in all three translational displacement directions, i.e. the longitudinal, transversal and vertical directions and locked from rotation around axis parallel to the longitudinal, transversal and vertical directions

A magnitude of a longitudinal load F_L is determined. The magnitude of the first prescribed elongation F_L should be relatively small such that substantially only elastic deformations occur in the conduit balcony, be it that some local plastic deformation inevitably may
5 occur.

The longitudinal load F_L is applied to the support portion 24 of the conduit balcony 22. To this end, half the longitudinal load $F_L/2$ is applied to the transversal centre 40 of support portion 24 at its aftmost longitudinal end 41 and half the longitudinal load $F_L/2$ is applied
10 at the foremost longitudinal end 42.

The reaction forces in the longitudinal direction of the nodes belonging to the longitudinal load transmitting panel 32 as well as the first connection portion 26' are determined by means of FE analysis. The sum of these reaction forces is the total load that is transferred
15 by the longitudinal load transmitting panel 32 to the unit 10.

In case of more than one load transmitting panel the reaction forces according to above of all panes shall be added to obtain the total longitudinal load transmitted by the panels to the unit.

The present disclosure relates to a conduit balcony (22) for a floating unit (10). The
20 conduit balcony (22) comprises a support portion (24) adapted to support at least one conduit. The conduit balcony (22) further comprises a connection portion (26) adapted to connect the support portion (24) to the floating unit (10). The conduit balcony (22) extends in a longitudinal direction (L) and a transversal direction (T). The connection portion (26) extends in the transversal direction (T) from a first connection portion (26'), adapted to be
25 attached to the floating unit (10), to a second connection portion (26''), attached to the support portion (24).

The support portion (24) comprises an inner support portion (24') located closest to the first connection portion (26') in the transversal direction (T). The conduit balcony (22) is
30 such that a first prescribed elongation (Δ_1), in the longitudinal direction (L), of the first connection portion (26') results in a second elongation (Δ_2) of the inner support portion (24').

The conduit balcony (22) is configured such that the second elongation (Δ_2) is less than or equal to 30 % of the first elongation (Δ_1).

CLAIMS

1. A conduit balcony (22) for a floating unit (10), said conduit balcony (22) comprising a support portion (24) adapted to support at least one conduit, said conduit balcony (22) further comprising a connection portion (26) adapted to connect said support portion (24) to said floating unit (10), said conduit balcony (22) extending in a longitudinal direction (L) and a transversal direction (T), said connection portion (26) extending in said transversal direction (T) from a first connection portion (26'), adapted to be attached to said floating unit (10), to a second connection portion (26''), attached to said support portion (24), said support portion (24) comprising an inner support portion (24') being located closest to said first connection portion (26') in said transversal direction (T), said conduit balcony (22) being such that a first prescribed elongation (Δ_1), in said longitudinal direction (L), of said first connection portion (26') results in a second elongation (Δ_2) of said inner support portion (24'), characterized in that said conduit balcony (22) is configured such that said second elongation (Δ_2) is less than or equal to 30 % of said first elongation (Δ_1).
2. The conduit balcony (22) according to claim 1, wherein said conduit balcony (22) is configured such that said second elongation (Δ_2) is greater than or equal to 0.01 % of said first elongation (Δ_1).
3. The conduit balcony (22) according to any one of the preceding claims, wherein at least a portion of said conduit balcony (22) is relatively weak in at least said longitudinal direction (L).
4. The conduit balcony (22) according to any one of the preceding claims, wherein a portion of said conduit balcony (22) located more proximally to said first connection portion (26') in said transversal direction (T) than said inner support portion (24') of said support portion (24) has a lower longitudinal stiffness than said inner support portion (24').
5. The conduit balcony (22) according to any one of the preceding claims, wherein said first connection portion (26') further comprises a longitudinal load transmitting means (30) adapted to transmit longitudinal conduit loads from said support portion (24) to said floating unit (10).

6. The conduit balcony (22) according to claim 5, wherein said longitudinal load transmitting means (30) comprises at least one longitudinal load transmitting panel (32, 34).
- 5 7. The conduit balcony (22) according to claim 6, wherein said conduit balcony (22) is configured such that when a longitudinal load (F_L) is applied to said support portion (24), at least 70%, preferably 90%, more preferred 95%, of said load is transferred to said first connection portion (26') via said at least one longitudinal load transmitting panel (32, 34).
- 10 8. The conduit balcony (22) according to any one of the preceding claims, wherein said connection portion (26) comprises a plurality of connection plates (28), each one of which extending at least in said transversal direction (T).
- 15 9. The conduit balcony (22) according to claim 8, wherein said conduit balcony (22) further has an extension in a vertical direction (V), each one of said connection plates (28) further extending substantially in said vertical direction (V).
- 20 10. The conduit balcony (22) according to claim 9, wherein each one of said connection plates (28) has a bending stiffness, around a longitudinal axis parallel to said longitudinal direction (L), which is at least 100 times greater, preferably at least 10000 times greater, than the bending stiffness around a vertical axis parallel to said vertical direction.
- 25 11. The conduit balcony (22) according to any one of claims 8 to 10, when dependent on claim 3, wherein said longitudinal load transmitting means (30) is located between two adjacent connection plates.
- 30 12. The conduit balcony (22) according to claim 11, wherein said conduit balcony (22) comprises a transversal centre line (38) extending in said transversal direction (T), said conduit balcony (22) comprising a distal bracket space (42) between two adjacent connection plates (28), said conduit balcony (22) further comprising a proximal bracket space (44) between two adjacent connection plates (28), said proximal bracket space (44) being located closer, in said longitudinal direction (L),
- 35 to said transversal centre line (38) than said distal bracket space (42), said

longitudinal load transmitting means (30) being located in said proximal bracket space (44).

5 13. A floating unit (10) comprising a conduit balcony (22) according to any one of the preceding claims.

10 14. The floating unit (10) according to claim 13, wherein the length (L_{RB}) in the longitudinal direction (L) of the conduit balcony (22) is less than 20%, preferably less than 6%, of the length (L_{unit}) in the longitudinal direction (L) of the floating unit (10).