TU Delft

Offshore & Dredging Engineering

Technische Universiteit Delft

Monopile upending workability and techniques

To respond to the growing offshore industry Jumbo Maritime has designed a new vessel to expand its offshore fleet: The Stella Synergy. The vessel will be able to install monopiles for the offshore wind and oil and gas industry. The main objective of this thesis is: Making a model that is able to predict the motions of the vessel as well as the forces induced by the monopile on the vessel during the monopile installation process. First the most suitable upending technique has been chosen for the Stella Synergy. The upending of a monopile can be seen in figure 1. The different techniques are analysed in a multi criteria analysis. Upending with the gripper turned out to be the best choice. The gripper design has been chosen the same way. The two rotating arm gripper and linear four arm gripper score highest but have almost the same score, therefor one of these two grippers is advised.

The hydrodynamic parameters of the vessel are obtained using AQWA, then a model of the vessel is made in Matlab to decide on the best location for the gripper with the least severe motions. The calculated RAOs are compared with the measured RAOs by Marin and are almost similar. When the crane hoisting curve is taken into account only two possible upending locations remain: x = 42m and x = 70m. Both locations are on the starboard side of the vessel. At the location x = 70m the motions are far less severe, so the dynamic forces will be less high. A disadvantage of this location is that only monopiles up to 100 m can be placed into the gripper without coming to close to the secondary crane.

The forces on the crane and gripper during upending and the workability of upending have been examined using a model in Matlab, the upending process is split up in six phases. Because the monopile is partly under water during four of the six phases the wave forces, added mass and damping that act on the monopile are calculated using AQWA. The viscous damping is calculated using the drag coefficient of a cylinder. The dynamic forces are the biggest during phase 3, where the monopile is only submerged with a small part far away from the vessel. The static forces during phase 1 to 5 are really low, therefor the workability of upending in phase six is computed, the workability is 34.3%. The workability of the vessel while it is hoisting a monopile from a barge onto the gripper is investigated using a ten degree of freedom model. The natural frequencies of the model are calculated and compared with the RAO plots. The total workability for a hoisting cable length of 64m is 29.9% and for 80m is 27.9%. Increasing the offlead angle from one to two degrees will increase the workability to 44.0% for 80m and 36.7% for 64m. It is advised to look into increasing the maximum offlead angle of the crane.

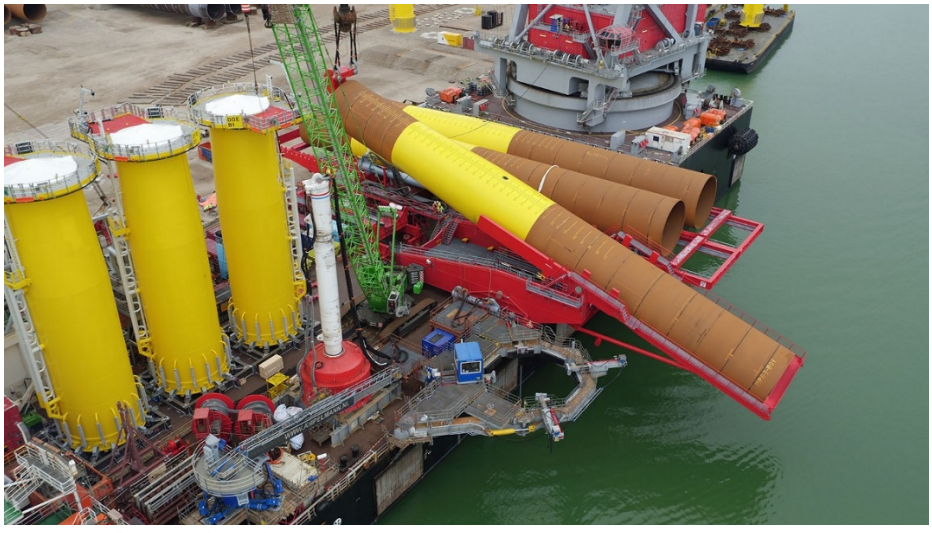

Figure 1: The upending of a monopile

Student
Gerard van der Veen
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Sponsor
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Thesis committee
Prof.dr. A. Metrikine
Dr.ir. A. Jarquin Laguna
Dr.ir. K.N. van Dalen
Ir. K. van der Heiden