Offshore & Dredging Engineering

Technische Universiteit Delft

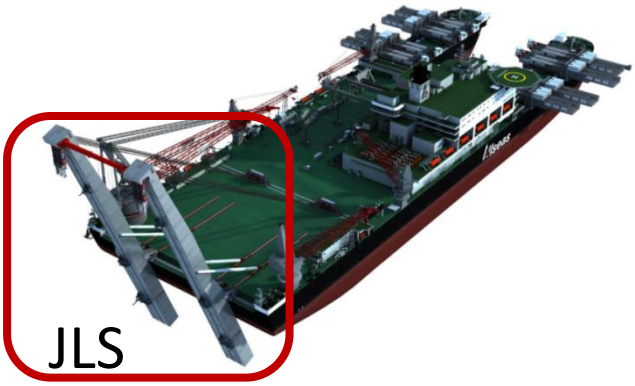
Design options study: Investigation into the design of a steel substructure for installation with the Pioneering Spirit's jacket lift system

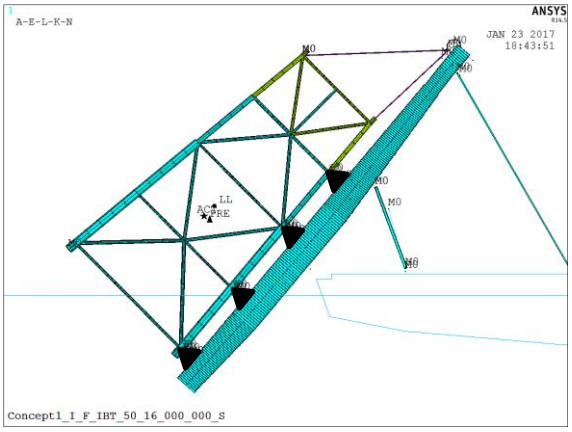
In 1967, BP began production from the West Sole 'A' platform, which was the first fixed steel piled jacket to be installed in the North Sea region. Since then, a total of 556 steel piled substructures have been installed across the region. Of those, 480 are lift-installed substructures installed by heavy lift crane vessels. The remaining substructures exceed available conventional heavy lift crane vessel capacities. 70 substructures are installed by way of launching from a launch-barge and 6 are self-floaters.

With the Pioneering Spirit, Allseas provides the possibility to lift-install substructures that were otherwise restricted to installation by launch or self-floating methods. Design of conventional installed substructures contain large amounts of temporary steel during installation which is not needed during their remaining lifetime. Installation with the Pioneering Spirit's jacket lift system (JLS) minimizes the need for temporary steel. It is expected that a substructure designed for installation with the Pioneering Spirit has a weight similar to a conventional lift jacket. Such jackets are typically significantly lighter than jackets designed for launching. This results in large substructure steel saving.

The main objective of this research is to design an optimized steel substructure for installation with the Pioneering Spirit's jacket lift system. To investigate this, a benchmark platform has been chosen for comparison. The benchmark platform will be installed in Norwegian waters. This substructure is designed to be launched. The comparison of structural steel of the benchmark substructure and the final concept design resulted in a quantifiable answer to the question on how many (temporary) structural steel can be saved with installation by the Pioneering Spirt. During this study all design steps and boundary conditions were mapped, lessons learned are documented in the form of design guidelines.

- The final concept fulfills all requirements for operation at the installation location and can carry the same topside as the benchmark substructure. The final concept is compatible for installation with the jacket lift system and also performs better than the benchmark substructure during in-place conditions. Due to the high lift capacity of the jacket lift system launching is unnecessary, therefore certain design constraints no longer apply. This leads to a more square shaped design that experiences less lateral loading in similar environmental conditions.
- The jacket lift system makes it possible to install the substructure in one single lift. This results in a transparent final concept with an operational weight of 13962 tonnes, saving 5769 tonnes which is 29% less than the benchmark substructure operational weight and an installation weight of 12947 tonnes, saving 6797 tonnes which is 31% less than the benchmark substructure installation weight. This does not include weight saving of flotation tanks and piles.





Student
Youp van Krevelen
February 22nd, 2017

Sponsor
Allseas Engineering B.V.

Thesis committee
Prof.dr. A. Metrikine
Ir. P.G.F. Sliggers
Ir. J.S. Hoving
Dr. F. Pisanó
Ir. M. Dijk
Ir. A.M. Brugma