TU Delft

Offshore & Dredging Engineering

Technische Universiteit Delft

Finite element analysis of spudcan penetration in homogeneous and two layered soil deposits

One of the important site specific assessments (SSA) before deploying jack-up units to the project locations is the preload check, which is carried out to predict the load-penetration response. The offshore industry has published guidelines in order to standardize jack-up assessment procedures that adapt the framework used for onshore application following conventional bearing capacity theory to assess spudcan penetration depth.

In practice, a layered system is commonly encountered and the installation process can be hazardous, with the potential of punch-through failure when the spudcan penetrates into strong over weak materials. A better understanding is therefore required since the guidelines are limited in discussing the approach in working in layered soil deposits.

This thesis proposes that an analysis based on numerical modelling can be a one possible alternative in evaluating load-penetration response in the layered system. Press-Replace (PR) Technique, which is based on a small strain geometry update procedure, is employed in a geotechnical software, PLAXIS. Mohr-Coulomb is used as the constitutive soil model. The PR Technique is firstly verified against previous experimental and numerical test data. A parametric study is then conducted to see the influence of normalized soil properties and geometry on the load penetration curves.

The present study shows the capability of the PR Technique to simulate the penetrating spudcan foundations on homogeneous soil (sand and clay) and two layered soil deposits (sand overlying clay). Based on the parametric study, several interesting findings can be identified, such as the stress level effect due to the foundation size, the prominent influence of dilatancy angle on the spudcan penetration in sand, and the difference of soil flow mechanism in clay that leads to the attainment of the limiting bearing capacity factor in deep penetration. In addition, the PR Technique can qualitatively predict the occurrence of punch-through that highly depends on the sand thickness ratio.

Student
Anandro Amellonado
October 21st, 2016

Sponsor
IHC MTI B.V.

Thesis committee
Prof.dr. A. Metrikine
Ir. J.S. Hoving
Dr. F. Pisanó
Dr. M. Alvarez Grima
Ir. T. Wambeke