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Jackup Foundation Performance in Clay

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Abstract

This paper presents findings of a study of the foundation performance of jackup foundation spud cans in clay. The study was performed for the International Association of Drilling Contractors (IADC). The study findings resulted in significant proposed changes to improve current recommended practice for the site assessment of jackup performance under storm loading.

The work reported here is particularly applicable to sites (such as in the Gulf of Mexico) at which jack-up spud cans have deep penetrations in soft clay. The objective of the study was to produce clay-specific alternatives to the present Bulletin 5-5 recommendations for spud can fixity assessment. Results presented here indicate that fixity assessments can be sufficiently improved to resolve much of the presently existing disparity between favorable field experience and less favorable Bulletin 5-5 fixity recommendations.

Specific changes to SNAME Bulletin 5-5 have been recommended based on the results produced by the work reported in this paper. These recommended changes lie in 5 areas: Rotational Stiffness (via Modulus of Rigidity), Moment Capacity, Yield Interaction, Stiffness Reduction, and Hysteretic Damping

The methods for establishing spud can fixity currently recommended practice (SNAME Bulletin 5-5) can result in unfavorably and unrealistically low fixity estimates. The effect can be costly excess conservatism.

Adoption of the changes based on the work described in this paper could result in site assessments which while remaining demonstrably conservative would be substantially more realistic than current practice, particularly in the case of deep penetrations in normally consolidated clay

Introduction

The present practice for site-specific assessment of the expected performance of jackup rigs under storm loading conditions is established by SNAME Bulletin 5-5A. The methods for establishing spud can foundation performance currently recommended in Bulletin 5-5 can result in unrealistically unfavorable site assessments. These methods involve soil properties, multipliers to obtain spud can capacities and stiffnesses from soil properties, a work hardening yield interaction function and simplified calculation methods to employ the interaction function. All of these elements may suffer from over-conservatism when applied to cohesive soils in general and to deep penetrations in normally consolidated clay in particular. The combined effect can be costly excess conservatism.

This paper presents findings of a study for the International Association of Drilling Contractors on spud can fixity in clay. The study was motivated by a disparity between the recommendations of SNAME Bulletin 5-5 jack-up site assessments in regard to spud can fixity on one hand and the more favorable experience of jack-up rig operators on the other.

Included in the study were a literature survey, continuum finite element analyses, case studies, parametric studies and recommendations for changes to the recommended practice and the demonstration of improved agreement with experience for a particular case of deep penetration in normally consolidated clay. The demonstration of improved agreement with experience is based on comparison to the exposure of the GSF Adriatic III to severe storm conditions during Tropical Storm Josephine. Information from this study has been published by Templeton, Lewis and Brekke (2003) [14] and by Templeton, Brekke and Lewis (2005) [15] and further documented in reports to the IADC. The present paper is a compilation of information from all of those sources

Results presented here indicate that fixity assessments can be sufficiently improved to resolve much of the presently existing disparity between favorable field experience and less favorable Bulletin 5-5 fixity recommendations. The study results are particularly applicable to sites (such as in the Gulf of Mexico) at which jack-up spud cans have deep penetrations in soft clay.