Leg Penetration Analysis of Jack-up Rig Installation over Existing Footprints

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ABSTRACT

The paper discusses a case study of a jack-up rig revisit to a site offshore Southeast Asia. With the original ground being disturbed by previous rig visits, the current state of the site has been modified, featuring footprints and change in soil stratigraphy and properties. It is technically challenging to incorporate these features into the leg penetration assessment of the rig which was going to be installed partially into the disturbed ground. Through the case study, the paper illustrates how these design challenges were overcome.

KEY WORDS: Jack-up rig; revisit; footprint; soil stratigraphy; leg penetration assessment.

INTRODUCTION

In 2009, a MSC-CJ50 design jack-up rig was contracted to drill additional well(s) for an existing platform offshore Southeast Asia. The site was deposited by fluvial materials with alternate sand and clay/silt strata. The rig, referred to as ‘Rig B’ herein, has three independent truss legs in which each leg is supported by a spudcan with equivalent diameter of 13.4 m, area of 140 m², and average tip height to widest section of 2 m. The designed maximum preload is 61.7 MN (or equivalent pressure of 440 kPa).

Prior to the installation of Rig B, the site has previously been visited by another jack-up rig, referred to as ‘Rig A’, in 2005 (1st visit) and 2006 (2nd visit). Rig A is a Levingston III C design with spudcan equivalent diameter of 14.6 m, area of 140 m², and average tip height to widest section of 2.4 m. During the 2nd visit, Rig A was re-positioned to a slightly different rig heading. Even then, the Starboard (SB2) and Port (P2) legs were still partially overlapped with the seabed depressions, also known as ‘footprints’, created during the 1st rig visit (see Figure 1).

The measured final leg penetrations of Rig A during the 1st and 2nd visits are summarized in Table 1. Note that the spudcan reaction under preload condition during both visits are of similar magnitude i.e. 49.4 MN (or equivalent bearing pressure of 294 kPa). Referring to Table 1, it is observed that each spudcan during the 2nd rig visit penetrated to a lesser depth as compared to that of the 1st visit despite that part of the P2 and SB2 legs were penetrated into disturbed ground. The observation seems to imply that the disturbed ground has somehow become stronger than the originally undisturbed. Site investigation was not carried out prior to the 2nd visit of Rig A, and therefore the actual reason(s) leading to this unusual penetration behaviour cannot be confirmed.

As the above mentioned observations might occur during future rig installation, these issues were studied when performing geotechnical assessment for the spudcan foundations of Rig B. The insights gained from the assessment in relation to the field measurement are summarized in this paper.

Figure 1. Diagram of platform and rig locations