



OTC 19580

## Detailed Geotechnical Investigation Around In-Place Mat Foundation Including T-Bar and Cpt Comparisons

Jean M.E. Audibert, Quest Geo-Technics, Steve Neubecker, Advanced Geomechanics and Stewart, W.P., Stewart Technology Associates

Copyright 2008, Offshore Technology Conference

This paper was prepared for presentation at the 2008 Offshore Technology Conference held in Houston, Texas, U.S.A., 5–8 May 2008.

This paper was selected for presentation by an OTC program committee following review of information contained in an abstract submitted by the author(s). Contents of the paper have not been reviewed by the Offshore Technology Conference and are subject to correction by the author(s). The material does not necessarily reflect any position of the Offshore Technology Conference, its officers, or members. Electronic reproduction, distribution, or storage of any part of this paper without the written consent of the Offshore Technology Conference is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of OTC copyright.

### Abstract

The Maleo Producer is a converted Bethlehem JU250 mat-supported jack-up unit, which was installed in July 2006, on a soft, normally consolidated clay foundation some 40 km (25 mi) south east of Madura Island and approximately 25 km (16 mi) south of Puteran Island, offshore Indonesia. The unit was connected to a wellhead platform, and gas production began in late 2006. An initial site investigation performed in 2003 indicated that the undisturbed soil conditions consisted of a soft normally consolidated clay profile, with an undrained shear strength of 2 kPa (40 psf) at the mudline, linearly increasing with depth at a rate of 1.22 kPa/m (7.83 psf/ft) down to a depth of around 14 m (46 ft), below which a slightly stronger clay was encountered. The issue of on-bottom stability of the unit and its resistance to overturning were questioned by the classification society (ABS) as part of the reclassification of the rig. The behavior of the foundation under extreme storm loads and seismic events could be more reliably predicted by the designer, and more readily accepted by ABS, if new soil data were available. Two types of soil data were required 1) soil data for foundation design and re-analysis under and around the mat and 2) soil data for seismic analysis of the installation. This paper describes the extensive site characterization undertaken to prove the stability of the Maleo Producer facility during both the design storm and seismic events.

### Introduction

The Maleo Field is located in Indonesian waters about 40 km (25 mi) south east of Madura Island and approximately 25 km (16 mi) south of Puteran Island (Figure 1), within the Madura Offshore Production Sharing Contract (PSC) area.

The Maleo Producer is a converted Bethlehem JU250 mat-supported jack-up unit (formerly the CD10) ABS Class Number 7900120. The unit was installed in July 2006, and was connected to a wellhead platform. Gas production began in late 2006 (Figure 2).

### Description of the Installation

The installation is in approximately 57-m (187-feet) water depth. The hull is supported on three cylindrical steel legs, 3.66-m (12-ft) in outer diameter. The legs are supported on an "A" shaped mat (Figure 3) that rests on the seafloor. The mat is 64 m (210 ft) long, 52 m (170 ft) wide and 3-m (10-ft) thick. It has 0.6-m (2-ft) deep skirts (extensions of the mat side walls) that extend along all edges of the mat (around the outside mat edges, inside the slot at the aft end and around the inside edges of the 18 m x 33m (59 ft x 108 ft) cut-out within the three legs beneath the hull (Figure 3).

A 14-in (366-mm)-diameter gas export seafloor pipeline connects the installation (from the starboard side of the mat) to the 26-in. (660-mm) East Java seabed pipeline approximately 7 km (4.3 mi) to the south.

Details of the structure's geometry, preload history, and design load conditions were provided by Stewart Technology Associates (2006 a&b), as documented in Ooley and Stewart (2008).

### Initial Geotechnical Site Investigation

The soil conditions around the Maleo platform site were originally investigated by Fugro in 2003. The site investigation consisted of one 100-m (330-ft) sample hole, one 100-m (330-ft) PCPT hole, four 20-m (66-ft) PCPT holes, and associated static laboratory testing. The results are presented in a log of boring, reproduced in Figure 4.

A report presenting the results of this initial investigation was presented in PTKRS Report No. 03008J-3 Issue 3, dated August 2003. This report characterized the soils as normally consolidated clay, with an undrained shear strength of 2 kPa (40