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The Value of Model Testing in Understanding the Behavior of Offshore Anchors: Towards New Generation Anchors

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Abstract

This paper introduces the model testing of drag embedment anchors under laboratory and offshore conditions. As the anchors form the foundation of a floating unit (both permanent and temporary), the model tests help in designing new generation anchors with higher performance and reliability. Furthermore the physical models are used to test and simulate the anchor handling/installation procedures, and serve as powerful teaching aids for operating personnel offshore.

The new directions in psychical model testing of offshore drag anchors are highlighted. The benefits of well controlled testing and the ability of measuring new anchor-ground interaction variables are discussed. It is shown that the new model testing programs will increase our current understanding of the anchor behavior and performance in operational and storm loading conditions.

Introduction

A special category of drag embedment anchors is a commonly used foundation option for offshore mooring of floating units (i.e. MODU, SPM, FPU, FSO, FPSO, etc.). The anchors in this category are labeled as High Holding Power (HHP) anchors owing to their very high efficiencies or performance ratios. The old generation drag anchors had efficiencies (i.e. the ratio of Ultimate Holding Capacity - UHC to dry dead weight of anchor) as low as 3, and had suffered from penetration and stability problems in slightly challenging seabed soil conditions. Today, the modern HHP anchors have reached efficiencies over 65 by overcoming the penetration and stability issues thus presenting a reliable as well as practical and economical foundation solution in challenging soil conditions. This development would not be possible without continues testing of scaled model anchors in laboratory, in centrifuge, and under actual field conditions.

This paper presents the model testing of both fluke (e.g. Stevpris – Stevshark series) and plate (e.g. Stevmanta VLA series) anchors (Figure 1) of drag embedment type. The drag embedment fluke anchors are commonly used in catenary mooring systems whereas the drag embedment plate anchors (i.e. Vertically Loaded Anchors – VLAs) are commonly chosen for semi-taut or taut-leg mooring systems. Both anchor types are installed by lowering the anchor to the seabed first and then by applying a pull load from a surface vessel (Vryhof 2005).

The quantities given in this text, unless otherwise referenced in the text, refer to the in-house testing database and track record of the company that the author is affiliated with.

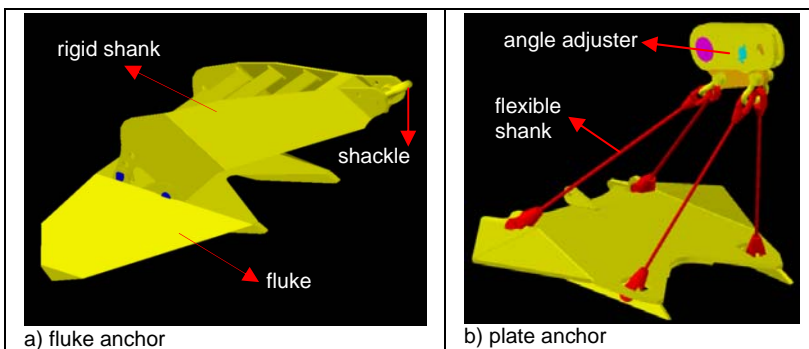


Figure 1: The simplified solid drawings of drag embedment fluke (a) and plate (b) anchors