FOUNDATIONS FOR OFFSHORE STRUCTURES - AN OVERVIEW OF GEOTECHNICAL DESIGN

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Overview

Offshore geotechnical practice has tended to diverge from onshore practice, driven partly by the scale of the foundation elements used, and partly by fundamental differences in construction techniques (Randolph et al., 2005). Knowledge of seabed soils is essential to properly design and build offshore structures, and a major source of uncertainty for any development. Therefore, the first steps to evaluate these risks for an offshore structure is to perform a site investigation.

Site investigations for offshore structures are necessary to acquire data that will facilitate successful foundation design, site or route selection, choice of foundation type, dimensioning, installation and operational integrity of the proposed structure (ISSMGE, 2005). Geotechnical parameters are developed from laboratory tests performed on piston samples or from high quality push soil samples and from in situ test data collected from cone penetration tests with pore pressure measurements or field vane, T-bar and ball probe tests. An overview of the practice of foundation engineering for the offshore structures, including the geotechnical assessment, loading, foundation types and design concepts, is discussed in this presentation.

Offshore Foundations

Offshore structures are generally classified as bottom supported fixed structures or floating structures. The most common form of fixed offshore platforms (jacket structure) may be supported on piled foundations or gravity based structures (GBS) resting on the seabed. Piles are usually tubular, open-ended and driven. Piles are also drilled and grouted in calcareous sediments, and other crushable material, where the shaft friction obtained with driven piles can be extremely low (Randolph et al., 2005). Gravity platforms are steel or concrete structures equipped with skirts that penetrate into the seabed, and frequently ballasted. Jack-up platforms are restricted to shallow waters and are normally installed for a limited duration, and are typically supported on spudcans. The floating structures may be grouped as neutrally buoyant structures (Spars, semi-submersible MODUs and FPSs, ship-shaped FPSOs and drill ships) and positively buoyant structures (TLPs, and buoyant towers) (Chakrabarti, 2005). Anchor systems are used to moor buoyant facilities. Anchors are divided into two types; gravity anchors or embedded anchors (anchor pile, suction caisson, drag anchor, vertically loaded anchor

(VLA), suction embedded plate anchor (SEPLA) and dynamically penetrated anchor (DPA). A comprehensive overview of deep water anchoring systems was provided by Ehlers et al. (2004).

Loads acting on the offshore structures are differentiated as either static or dynamic. Static loads acting on the structures are gravity loads, deck loads, hydrostatic loads and current loads. The dynamic loads originate from wind and waves. In some areas, earthquake imposes high dynamic loads. All these loads are carried by the foundation and hence foundation engineering is a critical element in the design process. Design of offshore foundations generally follows recommendations from various recommended practice documents developed by the American Petroleum Institute (API RP 2GEO, 2011). The following selected references introduce the reader to this broader topic.

References

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