JACKUP RIG AND LEG PENETRATION ANALYSIS

Since the early 1950s, self-elevating platforms or “jackups”, which are mobile units, have been essentially used for exploratory drilling. Jackups rest on the seabed during operations, with the aid of spud cans or a mat, through vertically-moving legs. The jackup floats on its hull with the legs raised. It is imperative that the jackup meets the requirements governing the safety of floating structures. The choice of a jackup depends on the following criteria:

- The conformity of the drilling rig to the specifications of the petroleum operator.
- The conformity of the structure to the requirements of the local authorities for the site concerned.
- The availability of the structure in the region or the cost of its transport.

The jackup units are divided into two main categories according to leg and the foundation:

a) Independent lattice-leg jackup units that are supported on spud cans.

b) Mat-supported jackups that rest on a mat footing which connects all the legs together.

The equivalent diameter of the spud cans routinely varies from 10 to 20 metre and the maximum typical legloads range between 20 and 50MN and they induce an average stress ranging from of 200 to 400kPa.

When a jackup is installed, the penetration of the spud cans or of the mat continues until the unit bearing capacity of the soil equals the unit load due to the weight of the structure and to the preload applied.

Hence, a load penetration curve is determined for the calculation of the soil penetration of the spud cans or the mat of a jackup. Before installation of any jackup structure, an accurate estimate of spud can or mat penetration is required for the following reasons:

- Occurrence of excessive spud can penetration in soft soils.
- Too little penetration of the spud can in dense sands may result in sliding and instability.
- Penetration of the mat greater than its height, increases the risks of instability due to partial covering of the mat, which could lead to excessive stresses in the legs on retrieval.

In the case of deep penetration of the spud can into a soft soil, modified Skempton equation is used to arrive at the bearing capacity (Clarom, 1993):

\[ q_u = 6C_u \left( 1 + 0.2 \frac{D}{B} \right) + \gamma' \frac{V}{A} \]

Where: 
- \( C_u \): Average undrained shear strength of the soil;
- \( \gamma' \): submerged unit weight of the soil;
- \( B \): diameter of the maximum cross section of the spud can;
- \( D \): penetration in the soil of the widest cross-section of the spudcan;
- \( A \): area of the widest cross section of the spudcan;
- \( V \): volume of the soil displaced by the spudcan.

In the case of penetration of spud cans in sands, the bearing capacity is given by the following equation (McClelland et al, 1981):

\[ q_u = 0.3 \gamma'B_1 N_\gamma + \sigma'_v N_q + \gamma' \frac{V_1}{A_1} \]

Where:
- \( \gamma' \): submerged unit weight of the soil;
- \( B_1 \): diameter of the maximum cross sectio of the spud can;
- \( \sigma'_v \): effective overburden pressure below the cross-section of the spudcan;
- \( A_1 \): area of the cross section of the spudcan;
- \( V_1 \): volume of the soil displaced by the spudcan;
- \( N_q, N_\gamma \): dimensionless factors.
“Perfection is achieved, not when there is nothing more to add, but when there is nothing left to take away.”
—Antoine de Saint-Exupéry

Fig. Leg Penetration Analysis of Jackup Rig

Leg penetration analysis (LPA) of Jackup rigs with risk assessment (punch through potential) is one of the key core competences of SGES. We have performed assessment on several projects in India, South East Asia and Middle East to estimate spud can penetrations.

IMPORTANCE OF GEOTECHNICAL PARAMETER ASSESSMENT FOR TALL BUILDINGS

High rise buildings have many a times posed a challenge to structural and geotechnical engineers. Knowing and understanding the ground conditions is necessary for evaluating geotechnical parameters and developing cost-effective foundation solutions. Systematic geological and geotechnical investigations provide us with information required for assessment of soil properties and geological features that may influence the parameters considered for analysis and foundation design. The geotechnical investigation and site characterization should also capture information about the bedrock types encountered at the site as it will aid in the analysis for deciding the type of foundation if the structure could be founded on bedrock.

In-situ testing coupled with laboratory testing form an integral part in characterizing the ground conditions. Apart from these tests, geophysical investigation is gaining popularity and being implemented to obtain the subsurface profile data. These tests assist in discerning the existing ground conditions between the boreholes and identifying any irregularities (e.g. cavities, loose soil deposits etc.). Aside from conventional laboratory testing such as classification tests, unconfined compression tests, consolidation tests, and direct shear test, it is necessary to carry out advanced testing to evaluate soil and rock parameters. Establishing an accurate knowledge of the ground conditions is essential in the development of economical foundation systems which perform to expectations.
EVENTS IN 2016 (1st AND 2nd Quarter)


3. **SGES Engineers, Ms.Meera Jacob** and **Ms.Pratibha Ramesh** attended Tunneling Workshop, organized by **Dr Manoj Verman** in March 2016, Delhi.

AWARDS AND RECOGNITIONS:-

- **Quality Excellence Award for Fastest Growing Company** awarded to **SGES**, by **World Quality Congress**, February 2016, Mumbai.

- **Emerging Professional of the Year** awarded to **Dr.CR.Parthasarathy** by **World Quality Congress** February 2016, Mumbai.

- **International Quality Award for Excellence in Geotechnical Engineering Services in Offshore and Onshore Industries** awarded to **SGES**, February 2016, Goa.

- **Gold Star Award For Excellence in Geotechnical Engineering Services** by **Global Achievers Foundation** awarded to **SGES**, February 2016, Bangalore.

- **Achievement in Geotechnical Engineering Services** by **ABS** awarded to **SGES**, February 2016, Bangalore.

- **Best Geotechnical Service Provider in Offshore and Onland Construction in South India** awarded to **SGES** at the Asia Service Quality Awards, April 2016, Mumbai.

- **International Quality Summit Award** awarded to **SGES** at International BID Quality Convention, May 2016, New York.
“The greatest obstacle to discovery is not ignorance; it is the illusion of knowledge”

— Daniel J. Boorstin