



# Jack-up Rigs - Geotechnical Analysis



At Cathie, our approach optimises jack-up foundation decisions, maximises operability, increases the safety and reliability of rig moves and is proven over 3,000 individual locations. We have also developed our own specialist leg penetration software, JACA. Working closely with our naval architect partner Global Maritime, we offer a holistic jack-up consultancy solution and have delivered over 1,500 location specific Leg Penetration Assessment (LPA) / Site Specific Assessment (SSA) studies.

## **Jack-up Operations - Geotechnical Risk**

Foundation related problems with jack-up vessels are one of the major sources of accidents in the offshore industry. More than 25 serious accidents caused by geotechnical issues have been reported since 2000<sup>1</sup>. Therefore it's vital to undertake a geotechnical assessment to reduce the risk and potential consequences of events such as spud leg punch-through or lateral leg sliding.

Our approach delivers strongly on safe operations but also goes beyond this, seeking to maximise operability on marginal locations through enhanced understanding of geotechnical phenomena relating to jack-up operations.

## Data Review and Initial Site Evaluation

In order to evaluate risks and identify data gaps, we'll perform an integrated review of available site information including geological, geophysical and geotechnical data. This process can provide a risk register to manage risks, and provide a rationale for the gathering of additional data, addressing operability concerns or amending rig move decisions.

## Leg Penetration

The ISO19905 and SNAME 2002 codes detail several methods for assessing leg penetration for various spudcan geometries in differing ground conditions. Our specialist in-house software JACA accommodates all of the published methods, in addition to our own unique insights. With our experienced engineers and JACA we can rapidly undertake iterative sensitivity studies and provide value-adding outcomes for our clients.

## In-place stability

Proper understanding of the soil stiffness response and stability envelope, going beyond published methods, can avoid unnecessary conservatism in the site stability assessment. At marginal locations, this can contribute significantly to the increase in the operability limit for the vessel.

Our engineers are also experienced in assessing the potential interaction effects between spud legs and existing infrastructure such as platform foundation piles, and seabed features such as existing spud holes, pock marks and sand waves.

Jack-up vessels often operate alongside existing infrastructure. We carry out analytical checks of potential interaction effects alongside foundation structures, quaysides and subsea pipelines to ensure safe operations. Where interaction effects are a concern, our team utilise 2D and 3D finite element modelling approaches to further investigate and quantify the risk, leading to clear guidance for vessel operators.

## Leg extraction

Leg extraction difficulties can lead to significant operational delays, damage to spud-legs and potentially even to the loss of the vessel. Therefore, understanding the potential pull-out resistance and mitigation techniques can prove vital. Our engineers determine areas of potential risk and use the latest research, including phenomena such as partial drainage in soils, to evaluate extraction forces and recommend potential mitigation techniques.

## Risk evaluation and mitigation recommendations

Our proven and systematic approach provides a clear evaluation of the potential risks and how they can be mitigated. Our expert team work closely with the marine warranty surveyor easing the approval process, and substantially reducing the risk of an accident or operational delays, whilst increasing the productivity and operability of the vessel.

**Sources:** <sup>1</sup> Jack et al 2007, 2013.