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ABSTRACT:

Part 1: Modelling with Transparent Soil

Enhanced understanding of soil displacement behaviour and soil-structure interaction in geotechnical physical modelling is possible through plane strain modelling with digital imaging and Particle Image Velocimetry analysis. However, limitations persist with this approach such as the influence of interface friction on the measured displacement, geometrical simplification of models, inability to model realistic construction processes (i.e. rotational installation) and failure to detect complex 3 dimensional interactions.

Recent developments in transparent soil technology have produced analogue soil materials that possess visual optical qualities that offer the opportunity to observe and capture internal deformations within a soil volume. High resolution displacement measurements are obtained by tracking tracer particles illuminated by a laser sheet within the model in conjunction with digital image photography and Particle Image Velocimetry (PIV). This represents a significant breakthrough in the ability to assess soil-structure interaction in addition to mitigating boundary effects and associated limitations associated with plane strain modelling. This presentation describes the development of this testing protocol and demonstrates its potential to enhance physical modelling capabilities.

Part 2: Modelling Water Injection to Assist Pile Jacking

Jacked piles remain a desirable niche in geotechnical engineering. Press-in piles require small rigs to hydraulically jack them into the ground - making them ideal for urban sites, or those with limited access. However, very high installation loads are experienced in hard ground, and supplementary techniques, such as complimentary water injection, are required to ensure pile jacking is economical. Scale modelling of water injection-aided piling was completed on the geotechnical centrifuge in University Of Cambridge to investigate the governing mechanism and the effects, if any, on the final pile properties from using water injection.

In this seminar, the centrifuge modelling will be briefly explained, allowing the governing mechanism to be presented. This will be followed by the effects arising from water injection, before commenting on the suitability of using water injection during pile jacking.
SPEAKER BIOGRAPHIES:

**Dr Jonathan Black**

Jonathan completed his PhD studies at Queens University Belfast in 2007 where he investigated the performance of stone column foundations. He was appointed as a Lecturer in Geotechnical Engineering at the University of Sheffield in 2008 where he has extended his research to investigate a wider range of foundation systems including helical screw piles, deep mix columns and press-in piling. One of his major research interests is the use of imaging in Geotechnics. He has continued work at Sheffield on non-intrusive modelling techniques using transparent soil applying this method to investigate soil-structure interaction effects of soil plugging in tubular piles, quantifying soil disturbance during borehole sampling and offshore foundations.

His research has a strong emphasis on physical modelling and he serves as the UK representative on the ISSMGE Technical Committee TC104 on Physical Modelling. During the last 2 years he outlined a vision to establish a geotechnical centrifuge platform at the University of Sheffield which has now been realised with the installation of a 4m diameter 50g-Ton beam centrifuge facility. He established and is the Director for the ‘Centre for Energy & Infrastructure Ground Research’ which houses the centrifuge facility and leads a UK national collaboration network of researchers at 10 partnering universities. To complement the large centrifuge he has also designed a built a small scale 1m diameter 2g-Ton teaching centrifuge undergraduate and project students.

**Dr Paul Shepley**

Paul recently completed his PhD studies at University of Cambridge, titled "Water injection to assist pile jacking". Centrifuge modelling was completed to model the process, in order to investigate the mechanisms governing the process. During his studies, Paul maintained a strong interest in physical modelling, in addition to the instrumentation of geotechnical projects and micro-mechanical behaviour of geo-materials. He has recently been appointed as a lecturer at the University of Sheffield, where he will be aiding the development of their new 50g-Ton centrifuge facility as part of the Centre for Energy and Infrastructure Ground Research.