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Onshore Pile Tests for OWF Dugeon



Background

NGI has been asked by Statoil to plan and execute field tests to evaluate options for reduction of pile driving resistance in a very stiff clay as encountered at the Dudgeon site offshore UK.

The objectives for the field test is to investigate the effect of using different types and combinations of oversized driving shoes (inside and outside) to reduce shaft resistance during driving through such stiff clays. The aim is to demonstrate that the penetration resistance can be reduced to agreed target value without any significant effect on the lateral stiffness of the pile (caused by possible gap created by the driving shoe).

This should include planning for some smaller scale pile driving tests in a similar clay deposit at a convenient site on land. A suitable test site has been found in Rødbyhavn at the Danish side of the planned new fixed link across the Fehmarn straight between Denmark and Germany. This site consists of a very hard stiff silty sandy Clay till (Moræneler) and has been made available for test execution by the owner Femern A/S.

Bilfinger Construction (BMOS) has been awarded the contract for

- delivery of six piles (DU 1220, L=10m, weight 7t) incl. driving shoes (specifications by client)
- design and fabrication of a lateral load test structure
- piling operation
- performing lateral load testing.
- Decommissioning piles (removal).

Contract volume:

~ 0,35 € Mio

Contractor:

Depenbrock Ingenieurwasserbau
Former Bilfinger Marine & Offshore
Systems GmbH

Client:

Norwegian Geotechnical Institute (NGI)

Construction time:

Apr. 2014 – May 2014

Location:

Rødbyhavn

Technical data / main masses:

Pile driving (6 piles)
Lateral Load Testing (5 runs).
Extraction of 6 piles.

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Pile Driving

The six piles are driven into the ground using a hydraulic hammer S200 from IHC (free riding on the pile) suspended from a mobile crane. For pile guidance an excavator Liebherr HS850 incl. frame lead is used.

Pile driving of all six piles to target penetration of 7.5m is done with the same energy settings and monitoring is done using PDA equipment (strain gauges and accelerometers) mounted to the piles and visual blow count measurement (per 25cm). Keeping the rotation of the piles within a given tolerance during piling is important for the following lateral load testing.

Testing

Lateral testing of the piles after installation is done by pulling two piles against each other and measuring the tilt and lateral movement of the piles as well as the strain inside the steel material. During testing the force will be raised stepwise according to a test program (NGI) to the max design force of 4.000 kN.

The lateral load test structure has been designed by Bilfinger Construction and consists of two load bridles (active and passive) attached to the piles with the center at 0.5m above ground. Between the bridles two pairs of tensions rods (GEWI 63.5mm) are running. Each tension rod is mounted and centralized by conical nuts on the far sides of the bridles.

Accurate alignment (both in elevation and cross-line) of the two bridles is required for correct load transfer to the load cells (one on each tension rod). The load cells are mounted between the passive bridle and the conical nuts.

The force is supplied by total of six hydraulic jacks (stroke 300mm, force approx. 1000 kN each) which are mounted between the two parts of the active bridle in a serial circuit, so that the system is self-equalizing.

After successful completion of the testing campaign, additional testing is done on two pairs of piles with the stick-up of one pile per pair being reduced to 3.5m by excavation of a 4m pit around the pile.

The lateral load test was performed on the same height, i.e. at 0.5m above original ground level. In order to compensate for the larger expected tilt of the pile with smaller penetration, passive bridle was monitored such, that the bridle keeps the horizontal if the pile tilts.

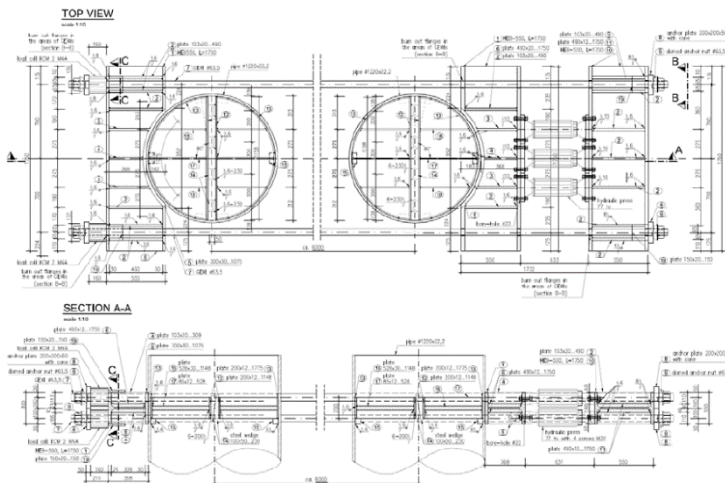




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