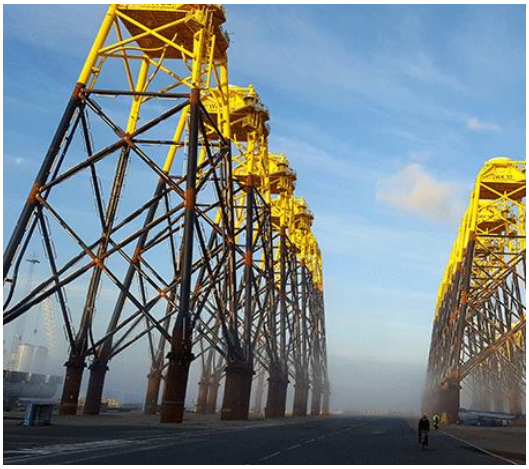
Offshore & Dredging Engineering

Technische Universiteit Delft

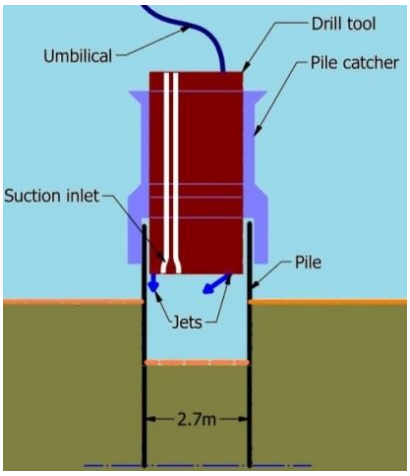
Subsea pile-top drilling tool – An experimental and numerical investigation

Offshore windfarms are becoming an increasingly popular method for governments to reduce their dependence of fossil fuels and fulfil environmental goals. The Wikinger project, located in the Baltic Sea, is currently one of the larger windfarms under construction.



Boskalis has been awarded the contract for the transport and installation of seventy wind turbine foundations. The windmills are supported by jacket structures (depicted on the left), each of which has four foundation piles.
For the installation of these piles a dedicated drilling tool has been developed. The main function of the tool is dredging up to a few meters of soil from the pile to allow for jacket installation. Next to this it is also suited for the drilling of refusal piles, which cannot be driven to the full depth in one effort.
The tool relies on a combination of low and high pressure jets and a suction system to excavate material. The high pressure jets are capable of cutting away soft rock. The main purpose of the low pressure jets is to transport material towards the suction inlet.

Though a smaller scale version of the drilling tool was previously used, there are some concerns about the capability of the scaled up version to extract loosened material from underneath its shield. Therefor the main research question was to analyze the suction behavior of the drill tool. A secondary research question was whether this tool could be designed using a CFD-DEM approach.



The research is subdivided into a literature study followed by an experimental research. In order to investigate the performance of the drill tool and to gain better insight into the occurring processes physical tests are performed in the laboratory. A scale model of the drill tool is built in which different combinations of suction flow rates, jet pressures and jet arrangements are tested on gravel fragments.

The presence of the low pressure jets proves to be critical for achieving higher productions. Positioning the low pressure jets at an angle proves particularly effective at transporting material towards the suction inlet. A further improvement is achieved by introducing an adapted nozzle design. Based on the laboratory tests it is concluded that the extraction of loosened material is not expected to be a limiting factor for production.

Following the experiments a numerical CFD-DEM study is conducted. The purpose of this study is to investigate whether such a numerical model can be a practical aid during the design of the drill tool. The focus is aimed at the erosion process, in specific the initiation of movement of a particle located on a bed. Although there are still some practical shortcomings in the model, using the numerical model the Shields curve was successfully reproduced for one grain size.

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at 10:00 AM
Room K, Faculty 3mE

Sponsor

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