

Optimization of Pile Installation through Scour protection (OPIS)

Publieke samenvatting / Public summary

Aanleiding

Offshore Wind Turbine (OWT) foundations are often subject to scour erosion processes. If the risk of scour is considered to be significant, pre-installed scour protection systems may be incorporated during the foundation installation. In such cases, a layer of rocks is placed on the seafloor around the MonoPile (MP). In the North Sea, many scour protections for monopile foundations are double graded, consisting of a filter layer of smaller rocks and an armour layer of larger rocks on top. Current practice consists of placing the scour protection layers in two separate operations. The so-called 3-step scour protection construction approach consists of: (1) placing the filter layer, (2) installing the monopile through the filter layer and (3) placing the armour layer. Consequently, the Rock Dumping Vessel (RDV) for installing the scour protection needs to visit each wind turbine location two times.

Doelstelling

The proposed project is called Optimizing Pile Installation through Scour Protection (OPIS). The overarching aim of OPIS is the development of a deeper understanding of pile penetration through scour protection to enable optimization of the installation operation. This will be achieved by realizing the following set of objectives: - To gain an accurate understanding of the driving mechanism and response of the scour protection layer under a range of different conditions (e.g. subsoil conditions, rock size, shape, dimensions of the MP, and properties of the scour protection). - To develop a

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calculation model that predicts the maximum force required to penetrate through the scour protection layer, and thus whether a successful pile penetration for a given scour protection design (e.g. grading and thickness) can be obtained. - In case of unsuccessful SWP, to understand the impact of pile driving (vibro, impact) on the scour protection and the integrity of the pile. - To explore innovative solutions that ease pile penetration during installation.

Korte omschrijving

This study will use scaled experiments, data analysis, and numerical analyses to achieve project objectives and answer research questions. The approach will be to first execute a series of small-scale laboratory tests that focus on improving the understanding of an object penetrating a granular medium under various conditions. Then, laboratory tests at medium-scale will be executed. Thirdly, numerical analyses will be carried out using the discrete element method (DEM) and finite element method (FEM). The results of small and medium-scale tests will be used to calibrate and verify the numerical models. The combination of scaled laboratory tests and numerical modelling will allow for a deeper understanding of the pile penetration process and investigation into potential optimization measures.

Resultaat

The main outcomes/results of the project are anticipated to be: - Data sets and information from field experience with pile penetration through scour protection. This will be obtained from experiences of the consortium partners. - Data sets from small and medium scale experiments up to scale 1:4 (scaled to a monopile of 8 m outer-diameter). - An empirical/analytical model that predicts the maximum penetration force required for self-weight pile penetration for a given scour protection layout (e.g. grading and thickness). This will be delivered in the form of an Excel spreadsheet or a (Python) script. - A validated simulation environment in order to explore design and operational scenarios for optimizing the pile penetration process. This is

based on Discrete Element Method (DEM) and Finite Element Method (FEM) numerical analyses. - A structured database with selected data from the laboratory experiments. - Factual and final reports.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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