World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:16, No:09, 2022

Investigation of Fluid-Structure-Seabed Interaction of Gravity Anchor Under Scour, and Anchor Transportation and Installation (T&I)

Authors : Vinay Kumar Vanjakula, Frank Adam

Abstract : The generation of electricity through wind power is one of the leading renewable energy generation methods. Due to abundant higher wind speeds far away from shore, the construction of offshore wind turbines began in the last decades. However, the installation of offshore foundation-based (monopiles) wind turbines in deep waters are often associated with technical and financial challenges. To overcome such challenges, the concept of floating wind turbines is expanded as the basis of the oil and gas industry. For such a floating system, stabilization in harsh conditions is a challenging task. For that, a robust heavy-weight gravity anchor is needed. Transportation of such anchor requires a heavy vessel that increases the cost. To lower the cost, the gravity anchor is designed with ballast chambers that allow the anchor to float while towing and filled with water when lowering to the planned seabed location. The presence of such a large structure may influence the flow field around it. The changes in the flow field include, formation of vortices, turbulence generation, waves or currents flow breaking and pressure differentials around the seabed sediment. These changes influence the installation process. Also, after installation and under operating conditions, the flow around the anchor may allow the local seabed sediment to be carried off and results in Scour (erosion). These are a threat to the structure's stability. In recent decades, rapid developments of research work and the knowledge of scouring on fixed structures (bridges and monopiles) in rivers and oceans have been carried out, and very limited research work on scouring around a bluff-shaped gravity anchor. The objective of this study involves the application of different numerical models to simulate the anchor towing under waves and calm water conditions. Anchor lowering involves the investigation of anchor movements at certain water depths under wave/current. The motions of anchor drift, heave, and pitch is of special focus. The further study involves anchor scour, where the anchor is installed in the seabed; the flow of underwater current around the anchor induces vortices mainly at the front and corners that develop soil erosion. The study of scouring on a submerged gravity anchor is an interesting research question since the flow not only passes around the anchor but also over the structure that forms different flow vortices. The achieved results and the numerical model will be a basis for the development of other designs and concepts for marine structures. The Computational Fluid Dynamics (CFD) numerical model will build in OpenFOAM and other similar software.

Keywords : anchor lowering, anchor towing, gravity anchor, computational fluid dynamics, scour
Conference Title : ICMGE 2022 : International Conference on Coastal and Marine Geotechnical Engineering
Conference Location : Lisbon, Portugal
Conference Dates : September 20-21, 2022