World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:16, No:05, 2022

Conceptual Design of Gravity Anchor Focusing on Anchor Towing and Lowering

Authors : Vinay Kumar Vanjakula, Frank Adam, Nils Goseberg

Abstract : 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, 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 from the oil and gas industry. The unfolding of Universal heavyweight gravity anchor (UGA) for floating based foundation for floating Tension Leg Platform (TLP) sub-structures is developed in this research work. It is funded by the German Federal Ministry of Education and Research) for a three-year (2019-2022) research program called “Offshore Wind Solutions Plus (OWSplus) - Floating Offshore Wind Solutions Mecklenburg-Vorpommern.” It’s a group consists of German institutions (Universities, laboratories, and consulting companies). The part of the project is focused on the numerical modeling of gravity anchor that involves to analyze and solve fluid flow problems. Compared to gravity-based torpedo anchors, these UGA will be towed and lowered via controlled machines (tug boats) at lower speeds. This kind of installation of UGA are new to the offshore wind industry, particularly for TLP, and very few research works have been carried out in recent years. Conventional methods for transporting the anchor requires a large transportation crane vessel which involves a greater cost. This conceptual UGA anchors consists of ballasting chambers which utilizes the concept of buoyancy forces; the inside chambers are filled with the required amount of water in a way that they can float on the water for towing. After reaching the installation site, those chambers are ballasted with water for lowering. After it’s lifetime, these UGA can be unballasted (for erection or replacement) results in self-rising to the sea surface; buoyancy chambers give an advantage for using an UGA without the need of heavy machinery. However, while lowering/rising the UGA towards/away from the seabed, it experiences difficult, harsh marine environments due to the interaction of waves and currents. This leads to drifting of the anchor from the desired installation position and damage to the lowering machines. To overcome such harsh environments problems, a numerical model is built to investigate the influences of different outer contours and other fluid governing shapes that can be installed on the UGA to overcome the turbulence and drifting. The presentation will highlight the importance of the Computational Fluid Dynamics (CFD) numerical model in OpenFOAM, which is open-source programming software.

Keywords : anchor lowering, towing, waves, currrents, computational fluid dynamics
Conference Title : ICCSCE 2022 : International Conference on Coastal Structures and Civil Engineering
Conference Location : Berlin, Germany
Conference Dates : May 23-24, 2022