World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:16, No:12, 2022

Investigation of Fluid-Structure-Seabed Interaction of Gravity Anchor under Liquefaction and Scour

Authors : Vinay Kumar Vanjakula, Frank Adam, Nils Goseberg, Christian Windt

Abstract : When a structure is installed on a seabed, the presence of the structure will 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 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 scour On fixed structures (bridges and Monopiles) in rivers and oceans has been carried out, and very limited research work on scour and liquefaction for gravity anchors, particularly for floating Tension Leg Platform (TLP) substructures. Due to its importance and need for enhancement of knowledge in scour and liquefaction around marine structures, the MarTERA funded a three-year (2020-2023) research program called NuLIMAS (Numerical Modeling of Liquefaction Around Marine Structures). It’s a group consists of European institutions (Universities, laboratories, and consulting companies). The objective of this study is to build a numerical model that replicates the reality, which indeed helps to simulate (predict) underwater flow conditions and to study different marine scour and Liquefication situations. It helps to design a heavyweight anchor for the TLP substructure and to minimize the time and expenditure on experiments. And also, the achieved results and the numerical model will be a basis for the development of other design and concepts For marine structures. The Computational Fluid Dynamics (CFD) numerical model will build in OpenFOAM. A conceptual design of heavyweight anchor for TLP substructure is designed through taking considerations of available state-of-the-art knowledge on scour and Liquefication concepts and references to Previous existing designs. These conceptual designs are validated with the available similar experimental benchmark data and also with the CFD numerical benchmark standards (CFD quality assurance study). CFD optimization model/tool is designed as to minimize the effect of fluid flow, scour, and Liquefication. A parameterized model is also developed to automate the calculation process to reduce user interactions. The parameters such as anchor Lowering Process, flow optimized outer contours, seabed interaction study, and FSSI (Fluid-Structure-Seabed Interactions) are investigated and used to carve the model as to build an optimized anchor.

Keywords : gravity anchor, liquefaction, scour, computational fluid dynamics
Conference Title : ICCME 2022 : International Conference on Coastal and Marine Engineering
Conference Location : Amsterdam, Netherlands
Conference Dates : December 02-03, 2022