

Analysis of Offshore Wind Turbine Towers with Different Designs by Finite Elements Method

¹M. Ensari Yigit

Celal Bayar University, Civil Engineering Department
Manisa, Turkey
ensar.yigit@cbu.edu.tr

^{2*}Anil Ozdemir

Gazi University, Civil Engineering Department
Ankara, Turkey
anilozdemir@gazi.edu.tr

³Fethi Sermet

Ege University, Civil Engineering Department
İzmir, Turkey
fethi.sermet@ege.edu.tr

⁴Murat Pinarlik

Gazi University, Civil Engineering Department
Ankara, Turkey
muratpinarlik@gazi.edu.tr

Abstract— It is known that the use of renewable energy has an increasing trend in whole world. Wind energy is one of the renewable energy types, as well is among the cleanest and most economical energy sources. Nowadays, in order to provide much more energy from wind, turbine towers are being built higher and the turbine blades have begun to be manufactured longer. Due to these applications, tower and turbine weights are continuously increasing. For this reason, it is necessary to optimize the materials used as well as the dimensions of the turbine towers. In the present study, behavior of TLP floating wind turbine towers with three different designs under wave, hydrostatic and static loads were investigated. In order to clarify the effect of these loads, turbine designs were analyzed in the ratio of 1/5 using finite elements method. Steel, reinforced concrete and hybrid (reinforced concrete and steel) wind turbine towers tied to sea floor at a depth of 10 meters rigidly by TLP floating method. In this context, 10-meter-high turbine towers having three different designs which static analyzed previously were used for investigate effects of wave and hydrostatic loads. Turbine structures analyzed with ABAQUS finite elements model. The deformations and stress values of underwater turbine structures were obtained and compared with each other. As it can be seen from analysis results, compared to the reinforced concrete design, the displacement of steel tower design decreased 77.84%. It is seen that the torsion effect was dominant in the steel tower design. However, the decreasing displacement value for steel design was recorded as 44.43% compared to the hybrid tower design.

Index Terms—Offshore Wind Turbine, Wind Turbine Tower, TLP Floating, Fluid–Structure Interaction, ABAQUS FEM.