Non-Linear Dynamic Analyses of Grouted Pile-Sleeve Connection

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Abstract : The focus of this article is to present the experience gained from the design of a grouted pile-sleeve connection and to present simple design expressions which can be used in the preliminary design phase of such connections. The grout pile-sleeve connection serves as a connection between an offshore jacket foundation and pre-installed piles located in the seabed. The jacket foundation supports a wind turbine generator resulting in significant dynamic loads on the connection. The connection is designed with shear keys in order to optimize the overall design but little experience is currently available in the use of shear keys in such connections. It is found that the consequence of introducing shear keys in the design is a very complex stress distribution which requires special attention due to significant fatigue loads. An optimal geometrical shape of the shear keys is introduced in order to avoid large stress concentration factors and a relatively easy fabrication. The connection is analysed in ANSYS Mechanical where the grout is modelled by a non-linear material model which allows for cracking of the grout material and captures the elastic-plastic behaviour of the grout material. Special types of finite elements are used in the interface between the pile sleeve and the grout material to model the slip surface between the grout material and the steel. Based on the performed finite element modelling simple design expressions are introduced.

Keywords : fatigue design, non-linear finite element modelling, structural dynamics, simple design expressions