World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:11, No:03, 2017

Finite Element Modelling of Mechanical Connector in Steel Helical Piles

Authors : Ramon Omar Rosales-Espinoza

Abstract : Pile-to-pile mechanical connections are used if the depth of the soil layers with sufficient bearing strength exceeds the original ("leading") pile length, with the additional pile segment being termed "extension" pile. Mechanical connectors permit a safe transmission of forces from leading to extension pile while meeting strength and serviceability requirements. Common types of connectors consist of an assembly of sleeve-type external couplers, bolts, pins, and other mechanical interlock devices that ensure the transmission of compressive, tensile, torsional and bending stresses between leading and extension pile segments. While welded connections allow for a relatively simple structural design, mechanical connections are advantageous over welded connections because they lead to shorter installation times and significant cost reductions since specialized workmanship and inspection activities are not required. However, common practices followed to design mechanical connectors neglect important aspects of the assembly response, such as stress concentration around pin/bolt holes, torsional stresses from the installation process, and interaction between the forces at the installation (torsion), service (compression/tension-bending), and removal stages (torsion). This translates into potentially unsatisfactory designs in terms of the ultimate and service limit states, exhibiting either reduced strength or excessive deformations. In this study, the experimental response under compressive forces of a type of mechanical connector is presented, in terms of strength, deformation and failure modes. The tests revealed that the type of connector used can safely transmit forces from pile to pile. Using the results from the compressive tests, an analysis model was developed using the finite element (FE) method to study the interaction of forces under installation and service stages of a typical mechanical connector. The response of the analysis model is used to identify potential areas for design optimization, including size, gap between leading and extension piles, number of pin/bolts, hole sizes, and material properties. The results show the design of mechanical connectors should take into account the interaction of forces present at every stage of their life cycle, and that the torsional stresses occurring during installation are critical for the safety of the assembly.

Keywords : piles, FEA, steel, mechanical connector
Conference Title : ICCSEE 2017 : International Conference on Civil, Structural and Environmental Engineering
Conference Location : London, United Kingdom
Conference Dates : March 14-15, 2017