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Simulation of Soil-Pile Interaction of Steel Batter Piles Penetrated in Sandy Soil Subjected to Pull-Out Loads

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Abstract : Superstructures like offshore platforms, tall buildings, transition towers, skyscrapers and bridges are normally designed to resist compression, uplift and lateral forces from wind waves, negative skin friction, ship impact and other applied loads. Better understanding and the precise simulation of the response of batter piles under the action of independent uplift loads is a vital topic and an area of active research in the field of geotechnical engineering. This paper investigates the use of finite element code (FEC) to examine the behaviour of model batter piles penetrated in dense sand, subjected to pull-out pressure by means of numerical modelling. The concept of the Winkler Model (beam on elastic foundation) has been used in which the interaction between the pile embedded depth and adjacent soil in the bearing zone is simulated by nonlinear p-y curves. The analysis was conducted on different pile slenderness ratios (lc⁄d) ranging from 7.5, 15.22 and 30 respectively. In addition, the optimum batter angle for a model steel pile penetrated in dense sand has been chosen to be 20° as this is the best angle for this simulation as demonstrated by other researcher published in literature. In this numerical analysis, the soil response is idealized as elasto-plastic and the model piles are described as elastic materials for the purpose of simulation. The results revealed that the applied loads affect the pullout pile capacity as well as the lateral pile response for dense sand together with varying shear strength parameters linked to the pile critical depth. Furthermore, the pile pull-out capacity increases with increasing the pile aspect ratios.

Keywords : slenderness ratio, soil-pile interaction, winkler model (beam on elastic foundation), pull-out capacity
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