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Numerical Analysis for Soil Compaction and Plastic Points Extension in Pile Drivability

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Abstract : A numerical analysis of drivability of piles in different geometry is presented. In this paper, a three-dimensional finite difference analysis for plastic point extension and soil compaction in the effect of pile driving is analyzed. Four pile configurations such as cylindrical pile, fully tapered pile, T-C pile consists of a top tapered segment and a lower cylindrical segment and C-T pile has a top cylindrical part followed by a tapered part are investigated. All piles which driven up to a total penetration depth of 16 m have the same length with equivalent surface area and approximately with identical material volumes. An idealization for pile-soil system in pile driving is considered for this approach. A linear elastic material is assumed to model the vertical pile behaviors and the soil obeys the elasto-plastic constitutive low and its failure is controlled by the Mohr-Coulomb failure criterion. A slip which occurred at the pile-soil contact surfaces along the shaft and the toe in pile driving procedures is simulated with interface elements. All initial and boundary conditions are the same in all analyses. Quiet boundaries are used to prevent wave reflection in the lateral and vertical directions for the soil. The results obtained from numerical analyses were compared with available other numerical data and laboratory tests, indicating a satisfactory agreement. It will be shown that with increasing the angle of taper, the permanent piles toe settlement increase and therefore, the extension of plastic points increase. These are interesting phenomena in pile driving and are on the safe side for driven piles.

Keywords : pile driving, finite difference method, non-uniform piles, pile geometry, pile set, plastic points, soil compaction
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