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Application of Particle Image Velocimetry in the Analysis of Scale Effects in Granular Soil

Authors : Zuhair Kadhim Jahanger, S. Joseph Antony

Abstract : The available studies in the literature which dealt with the scale effects of strip footings on different sand packing systematically still remain scarce. In this research, the variation of ultimate bearing capacity and deformation pattern of soil beneath strip footings of different widths under plane-strain condition on the surface of loose, medium-dense and dense sand have been systematically studied using experimental and noninvasive methods for measuring microscopic deformations. The presented analyses are based on model scale compression test analysed using Particle Image Velocimetry (PIV) technique. Upper bound analysis of the current study shows that the maximum vertical displacement of the sand under the ultimate load increases for an increase in the width of footing, but at a decreasing rate with relative density of sand, whereas the relative vertical displacement in the sand decreases for an increase in the width of the footing. A well agreement is observed between experimental results for different footing widths and relative densities. The experimental analyses have shown that there exists pronounced scale effect for strip surface footing. The bearing capacity factors Nγ rapidly decrease up to footing widths B=0.25 m, 0.35 m, and 0.65 m for loose, medium-dense and dense sand respectively, after that there is no significant decrease in Nγ. The deformation modes of the soil as well as the ultimate bearing capacity values have been affected by the footing widths. The obtained results could be used to improve settlement calculation of the foundation interacting with granular soil.

Keywords : DPIV, granular mechanics, scale effect, upper bound analysis
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