Scale Effects of Shallow Foundations on Granular Material

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A number of studies have suggested that there is a scale effect for shallow foundations on granular soils. These studies indicate that the bearing capacity factor N_γ is dependent on the absolute footing width, B, and is also influenced by mean grain size. In order to evaluate this phenomenon further, model scale square and circular footing tests were performed on two compacted sands having different characteristics; Brown Mortar Sand (G_s=2.69, ρ_{min}=1.41 Mg/m^3, ρ_{max} = 1.70 Mg/m^3, D_{50} = 0.6 mm) and Winter Sand (G_s=2.69, ρ_{min}=1.61 Mg/m^3, ρ_{max} = 1.96 Mg/m^3, D_{50} = 1.6 mm). Test beds were prepared at three different relative densities for each sand.

The model footing tests were performed in a 0.762 m X 0.762 m X 0.305 m steel box with a concrete base. All tests were performed under saturated conditions with the footing resting on the sand surface (D_f = 0). The dimensions of the model footings used were 25.4, 50.8 and 101.6 mm. The footings were given a rough base and were loaded at a constant rate of 0.001 cm/sec until a settlement of 0.1 B occurred. The failure modes for each of the footings varied depending on the sand type and density. The ultimate bearing capacity was defined at a relative settlement s, of s/B = 0.1 and the bearing capacity factor, N_γ was back calculated from the load at failure. The results of the tests show that values of N_γ for both sands decrease with footing size and increase with increasing relative density. The results also show that relative density may have a more pronounced influence on N_γ than grain size.

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