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The Examination of Cement Effect on Isotropic Sands during Static, Dynamic, Melting and Freezing Cycles

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Abstract : The consolidation of loose substrates as well as substrate layers through promoting stabilizing materials is one of the most commonly used road construction techniques. Cement, lime, and flax, as well as asphalt emulsion, are common materials used for soil stabilization to enhance the soil's strength and durability properties. Cement could be simply used to stabilize permeable materials such as sand in a relatively short time threshold. In this research, typical Portland cement is selected for the stabilization of isotropic sand; the effect of static and cyclic loading on the behavior of these soils has been examined with various percentages of Portland cement. Thus, firstly, a soil's general features are investigated, and then static tests, including direct cutting, density and single axis tests, and California Bearing Ratio, are performed on the samples. After that, the dynamic behavior of cement on silica sand with the same grain size is analyzed. These experiments are conducted on cement samples of 3, 6, and 9 of the same rates and ineffective limiting pressures of 0 to 1200 kPa with 200 kPa steps of the face according to American Society for Testing and Materials D 3999 standards. Also, to test the effect of temperature on molds and frost samples, 0, 5, 10, and 20 are carried out during 0, 5, 10, and 20-second periods. Results of the static tests showed that increasing the cement percentage increases the soil density and shear strength. The single-axis compressive strength increase is higher for samples with higher cement content and lower densities. The results also illustrate the relationship between single-axial compressive strength and cement weight parameters. Results of the dynamic experiments indicate that increasing the number of loading cycles and melting and freezing cycles enhances permeability and decreases the applied pressure. According to the results of this research, it could be stated that samples containing 9% cement have the highest amount of shear modulus and, therefore, decrease the permeability of soil. This amount could be considered as the optimal amount. Also, the enhancement of effective limited pressure from 400 to 800kPa increased the shear modulus of the sample by an average of 20 to 30 percent in small strains.

Keywords : cement, isotropic sands, static load, three-axis cycle, melting and freezing cycles
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