

Role of Matric Suction in Mechanics behind Swelling Characteristics of Expansive Soils

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Abstract : Expansive soils in the unsaturated state are part of vadose zone and encountered in several arid and semi-arid parts of the world. Influence of high temperature, low precipitation and alternate cycles of wetting and drying are responsible for the chemical weathering of rocks, which results in the formation of expansive soils. Shrinkage-swelling (expansive) soils cover a substantial portion of area in India. Damages caused by expansive soils to various geotechnical structures are alarming. Matric suction develops in unsaturated soil due to capillarity and surface tension phenomena. Matric suction influences the geometric arrangement of soil skeleton, which induces the volume change behaviour of expansive soil. In the present study, an attempt has been made to evaluate the role of matric suction in the mechanism behind swelling characteristics of expansive soil. Four different soils have been collected from different parts of India for the current research. Soil sample S1, S2, S3 and S4 were collected from Nagpur, Bharuch, Bharuch-Dahej highway and Ahmedabad respectively. DFSI (Differential Free Swell Index) of these soils samples; S1, S2, S3, and S4; were determined to be 134%, 104%, 70% and 30% respectively. X-ray diffraction analysis of samples exhibited that percentage of Montmorillonite mineral present in the soils reduced with the decrease in DFSI. A series of constant volume swell pressure tests and in-contact filter paper tests were performed to evaluate swelling pressure and matric suction of all four soils at 30% saturation and 1.46 g/cc dry density. Results indicated that soils possessing higher DFSI exhibited higher matric suction as compared to lower DFSI expansive soils. Significant influence of matric suction on swelling pressure of expansive soils was observed with varying DFSI values. Higher matric suction of soil might govern the water uptake in the interlayer spaces of Montmorillonite mineral present in expansive soil leading to crystalline swelling.

Keywords : differential free swell index, expansive soils, matric suction, swelling pressure

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