# The Higher-Order Continuum Model and Its Application for Expansive Soil

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**Abstract:** Due to its double-structure property, the higher-order continuum theory is adopted to study the constitutive behavior of expansive soil. The higher-order strain and scale factor are considered to describe the effect of the microscale structural property on the macroscale behavior, and a higher-order multiscale constitutive model is developed for expansive soil. The effect of the microscale structural property is investigated through the theoretical and experimental studies based on the developed model. In virtue of a representative elementary volume, the double-structure property is better studied for expansive soil. A variational equation is developed with the contribution of the liquid and gas to the total energy after the volumetric strain gradient and deviatoric strain gradient are introduced. The generalized strain and stress is denoted based on the contribution of the higher-order strain and stress to the local deformation, and the fraction of effective porosity change is denoted with the study of the deformation and mass exchange in the representative elementary volume. The relationship between the volume expansion ratio and mean principle stress is incorporate into the equilibrium equation, and the analytical solutions are expected in the cylindrical coordinate system for the solid and hollow higher-order continuum structures. The experiments are carried out to estimate the effect of the microscale structural property on the macroscale behavior of expansive soil.

**Keywords:** Expansive soil; higher-order continuum; microscale effect; scale factor