Particle Scale Assessment of Strain Localization in Sheared Sand

Mohammed Elnur[1], Khalid Alshibli[2]

[1]The University of Tennessee, Knoxville, Tennessee, U.S.A; melnur@vols.utk.edu; https://orcid.org/0000-0002-2444-4162
[2] The University of Tennessee, Knoxville, Tennessee, U.S.A; alshibli@utk.edu; https://orcid.org/0000-0001-5351-1670

Abstract: Triaxial testing of sand typically results in shear strain localization in zones of intensive shearing known known as a shear bands. Strain localization in sand is influenced by many factors including specimen density, particle morphology, gradation, boundary conditions, and stress path. Conventional triaxial measurements such as volume change and axial deformation measure the global response and fail to accurately quantify localized deformation. Synchrotron micro-computed tomography (SMT) technique was used to acquire 3D images of the experiments to measure particle kinematics allowing for localized strain quantification at the particle scale in addition to the specimen's global deformation. Three mini-triaxial compression experiments were conducted using GS#40 Columbia uniform angular sand under axisymmetric triaxial loading conditions. The specimens' dimensions are approximately 10 mm in diameter and 20 mm in height. The experiments were performed under dry, drained, and undrained saturated conditions to investigate the role of pore water pressure on strain localization. Saturated experiments were conducted at an effective cell pressure of 50 kPa. Sand particles' contact and morphology was characterized based on the 3D images, and the concept of translation gradient was applied to track the relative movement of sand particles to highlight shear strain localization. The presentation will discuss how the pore water distribution change as the specimen dilates how they affect the onset of shear bands.