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Effect of Particle Shape on Monotonic and Cyclic Biaxial Behaviour of Sand Using Discrete Element Method

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Abstract : This study proposes a Discrete Element Method (DEM) simulation using a commercial software PFC 2D (2019) for quantitatively simulating the monotonic and cyclic behaviour of sand using irregular shapes of sand grains. A preliminary analysis of the number of particles for optimal Representative Element Volume (REV) simulation of dimension 35mm x 35mm x 70mm using the scaled Grain Size Distribution (GSD) of sand is carried out. Subsequently, the effect of particle shape on the performance of sand during monotonic and cyclic bi-axial tests is assessed using numerical simulation. The validation of the numerical simulation for one case is carried out using the test results from the literature. Further numerical studies are performed in which the particles in REV are simulated by mixing round discs with irregular clumps (100% round disc, 75% round disc 25% irregular clump, 50% round disc 50% irregular clump, 25% round disc 75% irregular clump, 100% irregular clump) in different proportions using Dry Deposition (DD) method. The macro response for monotonic loading shows that irregular sand has a higher strength than round particles and that the Mohr-Coulomb failure envelope depends on the shape of the grains. During cyclic loading, it is observed that the liquefaction resistance curve (Cyclic Stress Ratio (CSR)-Number of cycles (N)) of sand is dependent on the combination of particle shapes with different proportions.

Keywords : biaxial test, particle shape, monotonic, cyclic
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