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Estimation of rock mass deformation modulus using distinct element method incorporating finite size fractures

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Estimation of rock mass strength and deformability is important in engineering geology, civil, mining and petroleum disciplines related to deep seated underground facilities. The rock mass deformation modulus is one of key parameters to analyze thermo-hydro-mechanical behaviors of the rock masses around tunnels and underground spaces. Deformation modulus for fractured rock masses has been estimated by either direct or indirect methods. The direct measurements consist of laboratory and field tests that have a limitation to consider the scale effect. Indirect methods are based on empirical relations with rock mass classifications and numerical analyses such as finite element method (FEM) and distinct element method (DEM). The DEM has an advantage over FEM in considering the geometry of a fracture network system. A case study of estimating deformation modulus for unit cubes having different stochastic 3-D discrete fracture network (DFN) system was addressed in this presentation. Fracture entities were treated as finite size square planes in the DFN cubes. Fictitious fractures having the characteristics of intact rock properties were systematically generated and combined with finite size fracture to create polyhedral blocks in the DFN cubes. Directional deformation modulus in 3-D were estimated for the DFN cubes under true triaxial in-situ stress condition. Finally, the effect of fracture geometry parameters on estimated anisotropic deformation modulus was discussed in a comprehensive manner. The results obtained from this study clearly showed that the generated polyhedra composed of the combination of finite size real and fictitious fractures in the 3-D DFN systems were found to effective in estimating more realistic deformation modulus of the fractured rock masses based on the distinct element method.