Keynote lecture

Plasticity for crushable granular materials via DEM

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ABSTRACT

The mechanical behavior of granular materials is characterized by strong non-linearity and irreversibility. These properties have been described by a variety of constitutive models, a large proportion of them are developed within an elasto-plastic framework. On top of the usual grain rearrangement mechanism, the presence of crushable grains adds one extra source of irreversibility to granular materials, a source that is frequently associated with instabilities. In his context, it is very instructive to obtain incremental responses of crushable granular materials but the experimental difficulties are formidable [1]. This contribution describes a procedure to obtain incremental responses of this type of materials using the discrete element method [2].

The DEM model is calibrated to represent Fontaineblau sand. The resulting granular assembly is incrementally tested starting from an initial oedometric (no lateral deformation) condition. The incremental behavior of the numerical models is studied by performing axisymmetric stress probes of equal magnitude but varying direction. Recent advances to enhance the efficiency of the numerical procedure are adopted [3]. The cascading nature of crushing events complicates stress probe control but damping is effectively used to overcome this problem.

The contribution of grain crushing to the incremental irreversible strain is identified and separately measured. Three components of the incremental strains are distinguished: elastic, plastic-unbreakable and plastic-crushing. Particular focus is placed on the effects of crushing on the direction of plastic flow. Examination of the results provides important information concerning the appropriate way to model this type of materials using elastoplastic models.

REFERENCES

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