A plastic-damage model for stress-strain behavior of soils

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Abstract: This paper presents a constitutive model for soil, which combines elements of plasticity with damage mechanics to simulate the stress-strain behavior. The model is primarily suitable for soil types that exhibit a postpeak strain-softening behavior, such as dense sand and stiff clay. The postpeak stress drop is captured by the elasto-damage formulation, while the plasticity is superimposed beyond the elastic range. The total strain increment is composed of an elasto-damage strain increment and a plastic strain increment. The elasto-damage strain increment is found using the elasto-damage formulation, while the plastic strain increment is found using either the Drucker-Prager classical plasticity model or as a function of damage strain. To implement this model, an experimental program was conducted on local cohesive and cohesionless soils. Various physical and mechanical properties of these soils were determined. Both triaxial tests and hydrostatic tests were performed under different confining pressures, in order to obtain the model parameters. These parameters were used to calibrate the model, which was coded in computer programs to simulate the stress-strain behavior of soils. The model was verified and found to be a good predictor of the geomaterial response for the selected stress path.