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A New Energy-Based Elastoplastic Damage Model for Concrete

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In this paper, a new elastoplastic damage model is proposed, in which tensile damage variable and shear damage variable are adopted to describe the degradation of macro-mechanical properties of concrete. Within the framework of continuum damage mechanics, an elegant constitutive law which is the same as the effective stress concept is obtained. The plastic Helmholtz free energy is accounted for the damage growth, and the damage criteria are based on the elastoplastic damage energy release rates, which is consistent with thermodynamics theory. The evolutions of damage variables and plastic strains are established based on the normal rule and the effective stress space plasticity, respectively. Some pertinent computational aspects concerning the numerical algorithm are discussed. The model has been coded into a general finite element program which is capable of predicting the nonlinear behaviours of concrete under different stress states, whose predictive results demonstrate its adequate accuracy for the intended applications.

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