

Coupled damage-creep analysis of nuclear irradiated concrete

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Abstract:

For concrete material under long-term nuclear irradiation, damage and creep occur concurrently. The damage is resulted from nuclear irradiations such as neutron irradiation, and the creep is due to mechanical and environmental loadings. ABAQUS cannot handle coupled damage-creep analysis through built-in viscoelastic models and damage models. In this study, a coupled damage-creep model of nuclear irradiated concrete was developed by combining the isotropic scalar damage model and generalized Maxwell model together, and the coupled model was implemented in ABAQUS. Two independent damage processes are considered: the mechanical damage is obtained through Mazars' damage model, and the damage due to neutron irradiation were characterized by a multiphase and multiscale model. In each time step, the damage due to neutron irradiation will feed the coupled damage and creep analysis in ABAQUS as inputs. The performance of the coupled creep-damage model was examined through a numerical example for a concrete specimen under mechanical loadings and neutron irradiation.