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A Bounding Surface Viscoplasticity Model for Creep and Strain-Rate-Dependent Behaviour of Soils

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The time-dependent behaviour of geomaterials is of concern in many geotechnical engineering projects. These include the analyses of long-term settlement and creep-induced failure of infrastructure founded on soft soils, stability of natural and excavated soil slopes, strain-rate-dependent response of earth-structures subjected to dynamic loads, the construction of tunnels in squeezing grounds, and the design of geological nuclear waste disposal facilities. In this paper, a viscoplastic constitutive model is presented for the time-dependent behaviour of soils with particular reference to capturing drained and undrained creep-induced failure in clayey soils. The model is developed within the context of the bounding surface plasticity using the critical state theory and the consistency viscoplastic framework. Unlike the overstress models, the model meets the consistency condition and allows a smooth transition from rate-independent plasticity to rate-dependent viscoplasticity. The strain rate dependency of the material response is represented through defining the bounding surface as a function of the viscoplastic volumetric strain as well as the viscoplastic volumetric strain rate. A non-associated flow rule is defined to generalise the application of the model to a wide range of soils. Simulation results and comparisons with experimental data are presented to highlight the capabilities of the model.

Participation

In-Person

References

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