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Coupled solid-fluid response of deep tunnels excavated in saturated rock masses with a time-dependent plastic behaviour. (English) Zbl 1481.74162

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Summary: This article provides a general numerical approach for modelling the response of deep tunnels excavated in saturated time-dependent plastic rock masses, considering a coupled solid-fluid interaction and time-dependent plastic behaviour. In order to do that, a Burgers-viscoplastic strain-softening model has been developed and implemented into the finite element method software `CODE_BRIGHT`, and a coupled solid-fluid model is used to simulate the interaction between solid deformations and fluid flow. Parametric analyses are then performed to analyse the influence on the tunnelling response of different time-dependent models, different standstill times and different excavation rates. It has been observed that the time-dependent model selection is crucial to simulate the response of underground excavations. Additionally, the coupled solid-fluid results are significantly different from the purely mechanical ones. The liquid pressure build-up in the vicinity of the tunnel face and the overpressure dissipation with time due consolidation can be accounted for. Moreover, the higher the excavation rate, the larger build-up of liquid pressures occurs.

MSC:

74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)

74L10 Soil and rock mechanics

Keywords:

hydro-mechanical modelling; viscoelasticity; viscoplasticity; post-failure; underground excavation; `CODE_BRIGHT`

Software:

CodeBright; *FLAC3D*

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