The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Implementation of a bounding surface constitutive model for fully coupled dynamic analysis of soil and its validation using dynamic triaxial test

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Keywords: *Constitutive model, Soil dynamics, Fully coupled analysis*

Soil reveals its complex behaviour under dynamic cyclic loading, characterized by closed hysteresis cycles, cyclic shakedown, and degradation[1]. To date, few works in the literature aim at and succeed in capturing these fundamental cyclic aspects. In addition,the development of a fully coupled analysis procedure, incorporating a constitutive model for dynamic behavior of saturated soils, is also limited.

This work presents the implementation of a bounding surface constitutive model into a fully coupled dynamic analysis procedure and its validation using a dynamic triaixl test. First, the fully coupled finite element equations governing the dynamic behavior of saturated soils, with the solid skeleton displacement and the pore water pressure as nodal unknowns, are briefly presented[2]. An user-defined element for the dynamic analysis of saturated porous media is developed in commercial software ABAQUS. The bounding surface model proposed by the authors includes hysteresis in stress-strain curves, cyclic plasticity of the solid skeleton and cyclic degradation. Finally, the analysis procedure is validated using the results from load-controlled dynamic triaxial tests. Comparisons between the numerical and experimental results confirm the goodness of the constitutive approach, capable of correctly capturing and reproducing the key aspects of soil's dynamic behaviour.

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