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Modeling of Internal Erosion in Water-Saturated Materials Subjected to Dynamic Loading

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ABSTRACT

Internal erosion in porous materials is modelled by use of the Porous Media Theory, which is applied to a ternary phase system consisting of a solid phase (solid skeleton), an abrasion phase (fluidized solid particles), and a fluid phase (pore water). The erosion is modelled as mass transfer from the solid to the abrasion phase. Dynamics effects are included, but small strain kinematics is assumed in this paper. The deformation response of the solid phase and the seepage of the two fluid(ized) phases are modelled by suitable generalizations of the classical Hookes law and Darcy's law, respectively, accounting for the finite change of total porosity. A novel variational format is proposed that includes three globally coupled fields (displacement, pore pressure and concentration of abrasive) and two local fields (seepage velocity and porosity). This setting represents an extension of that proposed in [1] for the biphasic situation. Numerical results are obtained for some elementary experimental setups as well for a full-scale problem representing the so-called immersion wheel-tracking test due to moving loads on a bitumen-based top layer of a road structure.

REFERENCES

[1] B. Lenhof, P. Kettil, F.Larsson and K. Runesson. A two-field variational format for fully saturated porous media subjected to dynamic loading. Submitted for publication.