

Accepted Manuscript

Stabilized mixed finite elements for deformable porous media with double porosity

Jinhyun Choo, Ronaldo I. Borja

PII: S0045-7825(15)00133-4

DOI: <http://dx.doi.org/10.1016/j.cma.2015.03.023>

Reference: CMA 10597

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 28 July 2014

Revised date: 26 March 2015

Accepted date: 27 March 2015

Please cite this article as: J. Choo, R.I. Borja, Stabilized mixed finite elements for deformable porous media with double porosity, *Comput. Methods Appl. Mech. Engrg.* (2015), <http://dx.doi.org/10.1016/j.cma.2015.03.023>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Stabilized mixed finite elements for deformable porous media with double porosity

Jinhyun Choo · Ronaldo I. Borja*

Department of Civil and Environmental Engineering, Stanford University,
Stanford, CA 94305, USA.

*Corresponding author, E-mail: borja@stanford.edu

Summary. Natural geomaterials such as fissured rocks and aggregated soils often exhibit a pore size distribution with two dominant pore scales, usually termed macropores and micropores. High-fidelity descriptions of these materials require an explicit treatment of the two pore regions as double porosity. We develop a finite element framework for coupled solid deformation and fluid diffusion in double porosity media that employs a thermodynamically consistent effective stress. Mixed finite elements that interpolate the solid displacement and pore pressures in the macropores and micropores are used for this purpose. In the limit of undrained deformation, the incompressibility constraint causes unstable behavior in the form of spurious pressure oscillation at the two pore scales. To circumvent this instability we develop a variant of the polynomial pressure projection technique for a twofold saddle point problem. The proposed stabilization allows the use of equal-order (linear) interpolations of the displacement and two pore pressure variables throughout the entire range of drainage condition.

Keywords: coupled problem · double porosity · effective stress · mixture theory · stabilized finite elements · twofold saddle point problem

1 Introduction

Natural geomaterials often exhibit a pore size distribution with two dominant pore scales. Examples include fissured rocks and aggregated soils. In fissured rocks the two pore scales are the fissures and matrix pores, whereas in aggregated soils they are the inter-aggregate and intra-aggregate pores. Due to the significant difference in pore sizes, the two pore regions exhibit highly contrasting hydromechanical responses. For example, fissures in rocks serve as conduits for fluid flow that can significantly influence the preferential flow patterns, whereas the pores in the matrix can also provide substantial space

Download English Version:

<https://daneshyari.com/en/article/6916870>

Download Persian Version:

<https://daneshyari.com/article/6916870>

[Daneshyari.com](https://daneshyari.com)