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MIXED METHOD OF LIMIT ANALYSIS: VALIDATION AND NEW RESULTS FOR POROUS COULOMB MATERIALS

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The first purpose of this work was to develop efficient upper bound limit analysis tools for axisymmetric limit analysis (LA) problems, together with avoiding the specific singularities of this case of symmetry. The second main purpose concerns assessments and predictions about the macroscopic criterion of a porous material on the basis of the hollow sphere or spheroid model with a frictional matrix, without any smoothing hypothesis of the plasticity criterion.

The starting point of this study is the conic expression of the Coulomb criterion used in a linearized form in [1]. Then, the problem of predicting the plasticity criterion of a porous material with spheroidal cavities is investigated. A similar investigation was conducted with von Mises matrices in the full 3D case [2], resulting in a formulation not easily transposable to Coulomb matrices due to the original expression of this criterion.

To obtain the lower bound results, we have adapted the iterative quadratic static approach defined in [1], with a cone projection formulation leading to a sufficiently robust linear programming code. Unfortunately this was not the case when adapting the classic kinematic approach also presented in this reference. Then, we have developed an original mixed (but rigorously kinematic) approach of the present axisymmetric Coulomb problem. The final problem ends up in a second order conic formulation solved with the efficient code Mosek, and the results are checked as fully admissible by specific post-analysis of the optimal solution fields. Both resulting codes are first tested with comparison to previous results and to the exact solutions of [3]. Then these codes are used to investigate the unexplored problem of the porous Coulomb material; a comparison to the recent corresponding results of [4], with a Drucker-Prager matrix, is also given. Finally, recent extensions to the hollow cylinder problem, considered in generalized plane strain, are presented,

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