An innovative numerical approach to overcome end restraint effects from standard undrained triaxial tests on peats

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ABSTRACT

Constitutive models for soils are traditionally validated against experimental tests assuming these represent single (infinitesimal) element tests. However, the boundary conditions imposed to the sample with standard laboratory equipments induce non negligeable stresses and strains non–uniformities. As a result, the observed sample behaviour differs from the true material response. As an interesting example of the misconceptions introduced by end restraint effects on the observed soil behaviour, a series of undrained triaxial compression tests on reconstituted peat samples is presented in this work. The experimental results indicate dramatic end restraint effects in the apparent shear strength of the tested samples. Moreover, the diffuse fibrous networks present in the peat matrix seem to magnify the severity of the end restraint effects, as compared to previous studies on traditional inorganic soils, by introducing a characteristic length in the hydro–mechanical response of the material. Starting from the experimental evidence, the triaxial test results have been simulated with a coupled hydro–mechanical FE–IGA formulation, incorporating an advanced model for the soil, enriched with a second–gradient formulation capable of providing an internal length scale to the material [1]. The numerical results show the capability of the model to capture the end restraint effects on the deviatoric stress–strain response and the development of excess pore water pressures within the specimen. The introduction of a second gradient formulation allows reproducing correctly the length scale effects observed for samples with different height to diameter ratio. More importantly, the results suggest the possibility to link the magnitude of the second gradient stiffness coefficient to the characteristic length of the fibrous network in the peat fabric.

REFERENCES

[1] Plúa, C. (2018). *Développement d'une stratégie d'implémentation numérique pour milieu continu poreux de 2nd gradient basée sur les éléments finis isogéométriques, application à un milieu partiellement saturé.* PhD Thesis, Communauté Université Grenoble Alpes and the Consortium of the Universities of Firenze, Pisa and Perugia.