

INVESTIGATING THE BIO-HYDRO-MECHANICAL BEHAVIOUR OF PEATS

Cristina Jommi

Department of Geoscience and Engineering
Delft University of Technology, The Netherlands
e-mail: c.jommi@tudelft.nl

Keywords: Peats, Bio-hydro-mechanical behaviour, Laboratory testing, Constitutive modelling.

Summary. An extensive experimental programme has been designed at TUDelft, aimed to provide a comprehensive framework for deeper understanding, characterisation and modelling of peats in the engineering practice. Conventional tests have been performed on natural and reconstituted samples of various peats, having different organic and fibres content. Unconventional tests have been designed to study the result of in-situ oxidation, drying and production of biogenic gas on the hydro-mechanical behaviour of peats. Simple hydro-mechanical models have been developed in the framework of generalised hardening elastic-plasticity to help in the interpretation of the experimental results, as well as to provide the conceptual basis for more advanced and comprehensive constitutive approaches.

1 BACKGROUND AND MOTIVATION

Peats are soils with a relevant percentage of organic matter, which govern their hydro-mechanical response in time. Non decomposed fibres of various sizes and partly decomposed organics constitute the soil skeleton, which has very high void ratios, is anisotropic and very compressible, but shows high strength as well. Peats are partially saturated in nature due to biochemical degradation of the organic fraction, which is the source of the biogenic gases (CO₂, H₂S and CH₄) observed in peat layers. The gases produced by organic decomposition tend to saturate the pore water, eventually resulting in gas expansion and exsolution. Moreover, degradation affects the physical and chemical properties of the organic matter, which in turn modify the fabric of the soil and its hydro-mechanical response. All the previous aspects are investigated at Delft University of Technology, by means of an extensive experimental programme aimed at providing a comprehensive framework for deeper understanding, characterisation and modelling of peats in the engineering practice.

2 EXPERIMENTAL PROGRAMME

Conventional – oedometer and triaxial – tests have been performed on natural and reconstituted samples of various peats, having different organic and fibres content. Unconventional tests have been designed to study the result of in-situ oxidation and of biogenic gas on the hydro-mechanical behaviour of peats. In a series of test, a controlled amount

of gas was generated inside the samples before the start of deviatoric compression, to evaluate explicitly the role of biogenic gas on shear stiffness and strength. The effects of drying and oxidation on the compression behaviour of peat were investigated on samples at increasing degradation level. In situ oxidation revealed that increased compressibility is mostly a consequence of changes in fabric and water retention capacity.

3 CONSTITUTIVE MODELLING

To help in the interpretation of the experimental results a simple model is proposed, based on the superposition of a strain hardening elastic-plastic constitutive law for the diffused fibrous matrix with a pure tensile contribution of larger fibres. Despite its simplicity and the reduced number of parameters needed for calibration, the model allows reproducing the observed results accurately in various stress-strain planes, as shown in Figure 1. Generalised hardening is being developed to account for degradation and biogenic gas effects.

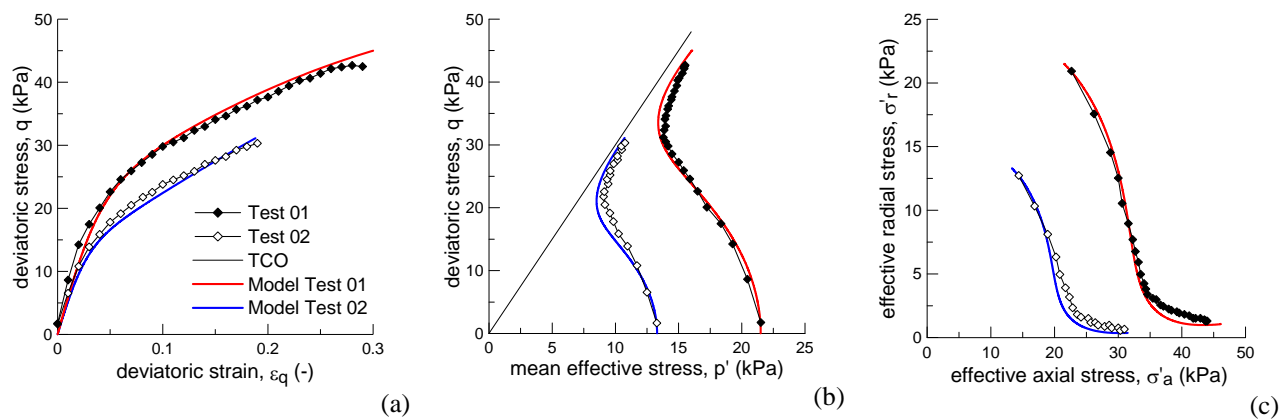


Figure 1. Comparison between experimental data and model simulations of undrained shear in a triaxial test: (a) stress-strain curves; (b) stress-path in the meridian plane; (c) radial vs axial stress.

REFERENCES

- [1] H. Yamaguchi, Y. Ohira, K. Kogure and S. Mori. Undrained shear characteristics of normally consolidated peat under triaxial compression and extension conditions, *Soils and Foundations*, 25 (3), 1985, 1–18.
- [2] E.J. Den Haan & G.A.M. Kruse. Characterisation and engineering properties of Dutch peats. In *Characterisation and Engineering Properties of Natural Soils*, (Phoon, Hight, Leroueil & Tan, Eds.). Proc.2nd Intern. Workshop on Characterisation and Engineering Properties of Natural Soils, Singapore, 2006, 2101-2133.