# Chapter 9

Modelling Soil Behaviour

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Chapter 9

Modelling Soil Behaviour

9.1 Introduction

Compared to other natural and man-made materials, soils are not as spectacular as, e.g., the mother-of-pearl or liquid crystals. However, in terms of the mathematical description of their mechanical behaviour, soils are probably the most complex materials in the world. For instance, the most important advances in the Theory of Plasticity (originally developed for metals) have been achieved in an attempt to describe the irreversible mechanical behaviour of soils. As has been already mentioned in Chapter 1 of this book, soils are:

- Multiphase (i.e., consist of solids, liquids and gases),
- Granular (i.e., build of particles of different sizes and shapes),
- Non-homogeneous (i.e., their mechanical properties vary in space),
- Anisotropic (their mechanical properties vary with loading direction).

However, even if all the above effects are minimized by special sample preparation and testing procedures, the mechanical behaviour of soils is still rather complex due to the following features:

- non-linearity (in initial loading, unloading and reloading),
- stress path dependency (reaches different strains at the same stress),
- stress level dependency (changes properties with confinement stress),
- irreversibility (produces residual strains in a closed stress cycle),
- material memory (remembers the highest stress before the unloading and follows the initial loading curve after reaching it in reloading),
- dilatancy (changes in volume during shearing),
- hardening (changes in the yield stress with plastic straining),
- rate dependency (different stress-strain curves at various strain rates),
- time dependency (creep, aging, relaxation).

In the Parts II and III of this book it will be shown how these and other features of soil behaviour can be described mathematically. In order to facilitate the explanations, the soil behaviour will be demonstrated and modelled using a simple triaxial test described in Chapter 1.