

Dataset of Simulated CRS Tests for Advanced Soil Parameter Identification

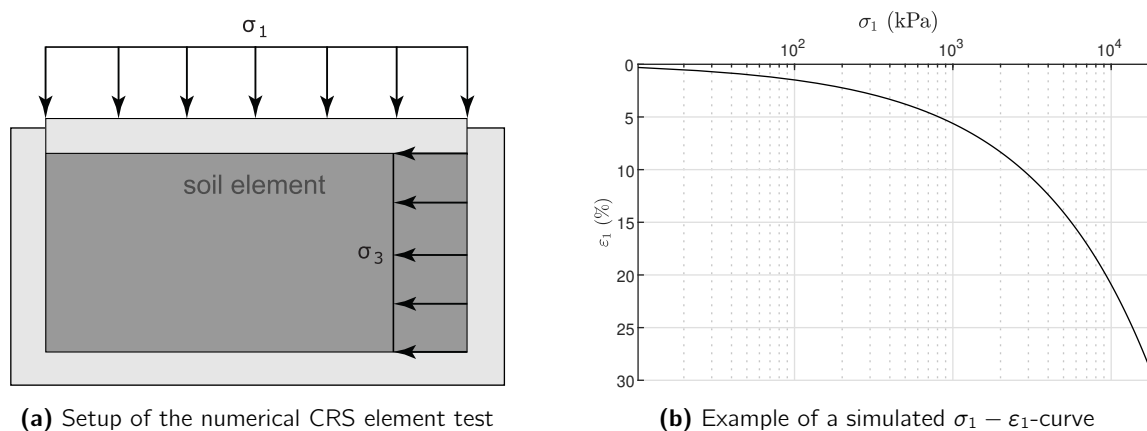
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This extensive dataset contains the results of 30,000 simulated Constant Rate Strain (CRS) tests, comprising three constitutive models with 10,000 simulations each: linear-elastic perfectly-plastic soil model (Mohr-Coulomb), Hardening Soil, and Hypoplasticity with intergranular strain. These simulations are all conducted using the finite element software, Plaxis. Within the simulations, the model parameters were altered in order to generate an extensive data bank with various system responses. The primary purpose of this dataset is to serve as a training foundation for an Artificial Neural Network (ANN). The goal of the ANN is to efficiently and accurately identify suitable parameter sets for the three widely used soil models, based on data sets provided from numerical CRS tests. This identification is critical for enhancing the precision of soil behaviour predictions in numerical structure-soil interaction models.

Numerical Simulation of CRS Tests

In the CRS test (one-dimensional compression test with constant rate of applied strain), a cylindrical soil sample is axially compressed under constant strain rate while preventing radial deformation, and the vertical stresses are measured. The numerical simulations were conducted as 2D compression element tests, using FEM with adequately chosen boundary conditions, see Fig. 1a. Strain was applied at a constant rate on the top surface of a finite element until an axial strain of 30 % was reached, as presented in Fig. 1b.



File Naming and Input Parameters

The naming of the result files is derived from the input parameters of the simulations, with specific formats for each of the constitutive models used:

- **Mohr-Coulomb Model:** Files are named using the varied parameters E_{ref} (kN/m²), φ (°), and c (kN/m²), indicating the modulus of elasticity, the angle of internal friction, and the cohesion of the soil, respectively.
- **Hardening Soil Model:** File names include the varied input parameters of E_{50}^{ref} (kN/m²), $E_{\text{oed}}^{\text{ref}}$ (kN/m²), $E_{\text{ur}}^{\text{ref}}$ (kN/m²), φ (°), and m (-), representing the reference secant stiffness modulus for primary deviatoric loading, the reference tangent stiffness modulus for primary compression,

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Data available at: <https://doi.org/10.15480/882.9435>

the reference stiffness modulus for unloading/reloading, the angle of internal friction, and the exponential power parameter m , respectively. It should be mentioned, that the reference pressure of p^{ref} equal to 100.0 kN/m^2 and the unloading/reloading Poisson's ratio ν_{ur} of 0.2, were used in all conducted simulations for the Hardening Soil Model.

- **Hypoplastic Model:** The naming captures the varied input parameters, including the critical friction angle φ_c ($^\circ$), granular stiffness h_s (kN/m^2), exponent n (-), minimum void ratio e_{d0} (-), maximum void ratio e_{c0} (-), critical void ratio e_0 (-), exponent α (-), exponent β (-), constant R (-), exponent β_R (-), exponent χ (-), factor m_R (-), factor m_T (-), and initial void ratio e_0 (-).

Content Structure of Result Files

Each result file contains a set of columns representing different outcomes of the simulations. The columns are as follows:

- t (min): Time elapsed during the simulation.
- ε_1 (-), ε_3 (-), ε_V (-), ε_q (-): Strain measurements, including axial strain, lateral strain, volumetric strain, and deviatoric strain.
- σ' (kN/m^2), σ'_1 (kN/m^2), σ'_3 (kN/m^2): Effective stress measurements, including total effective stress, effective stress in the axial direction, and effective stress in the radial direction.
- q' (kN/m^2), p' (kN/m^2): Deviatoric stress and mean effective stress.
- τ_{mob} (kN/m^2), p_{excess} (kN/m^2): Mobilized shear strength and excess pore pressure.

List of Files

The data set includes following items:

- CRS test results modeled with Mohr-Coulomb: 10,000 txt-files,
- CRS test results modeled with Hardening Soil: 10,000 txt-files,
- CRS test results modeled with Hypoplasticity: 10,000 txt-files.