

Implementation of a Modified Anisotropic Creep Model with Structure for Soft Soils with the use of Physics Builder

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Introduction: Time-dependent behaviour in clays constitutes an engineering challenge in construction areas with deep soft clay deposits. The need for constitutive models that could capture many of the important features of soft soil behaviours is of great importance.

Results: Fig. 3 shows the simulations of K_0 CUC and K_0 CUE triaxial tests. The simulation results are in good agreement with the laboratory results. Fig. 4 presents a practical example of an embankment on soft clay reinforced with lime cement columns.

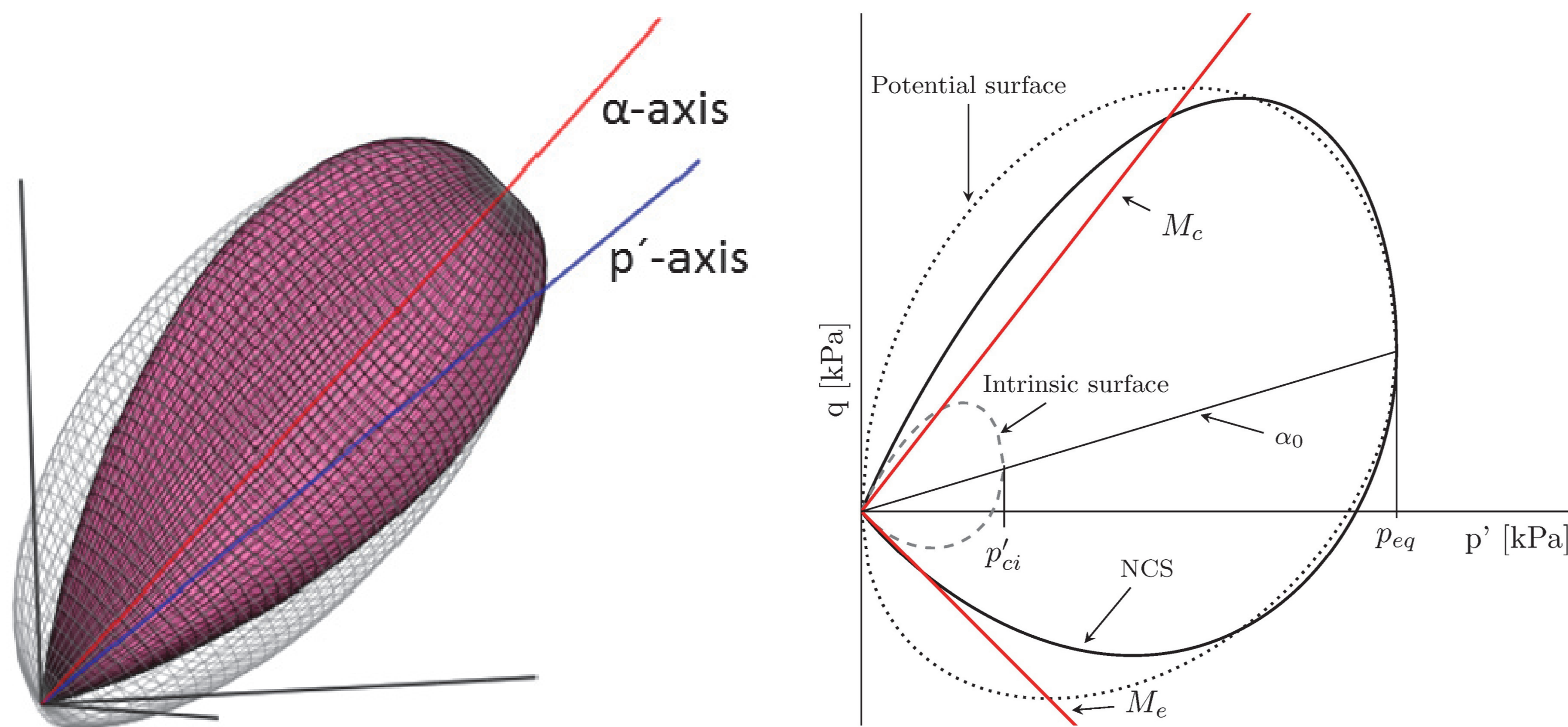


Figure 1. Visualization of both the reference and creep potential surface in 3D stress space.

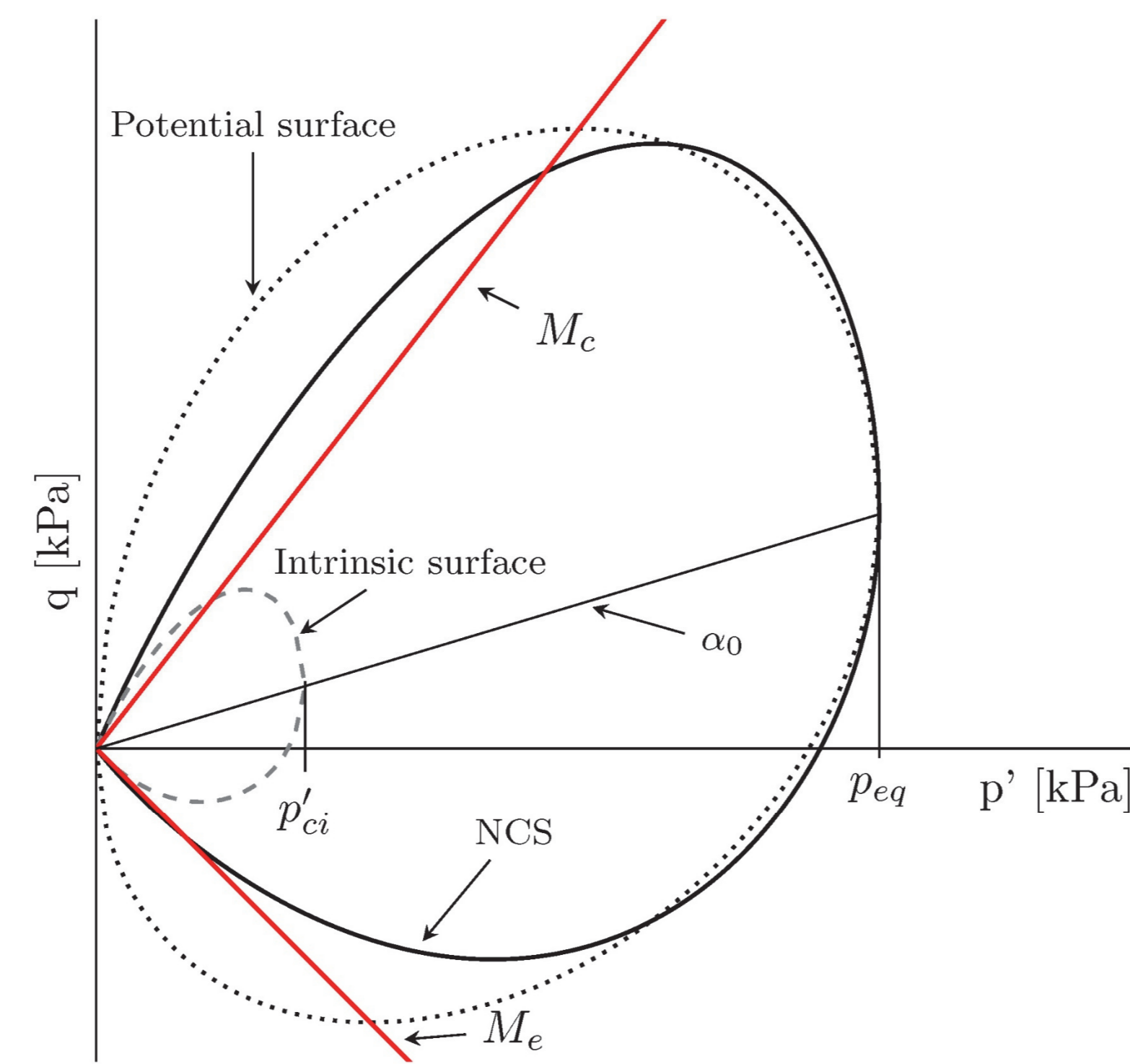


Figure 2. Visualization of both the reference and creep potential surface in p' - q stress space.

Computational Methods: The constitutive model MAC-s (Olsson, 2013) implemented in the Physics Builder in COMSOL is based on the n-SAC model by Grimstad & Degago (2010). In Fig. 2 overview of the model appearance in COMSOL is shown for one of the features implemented in the model.

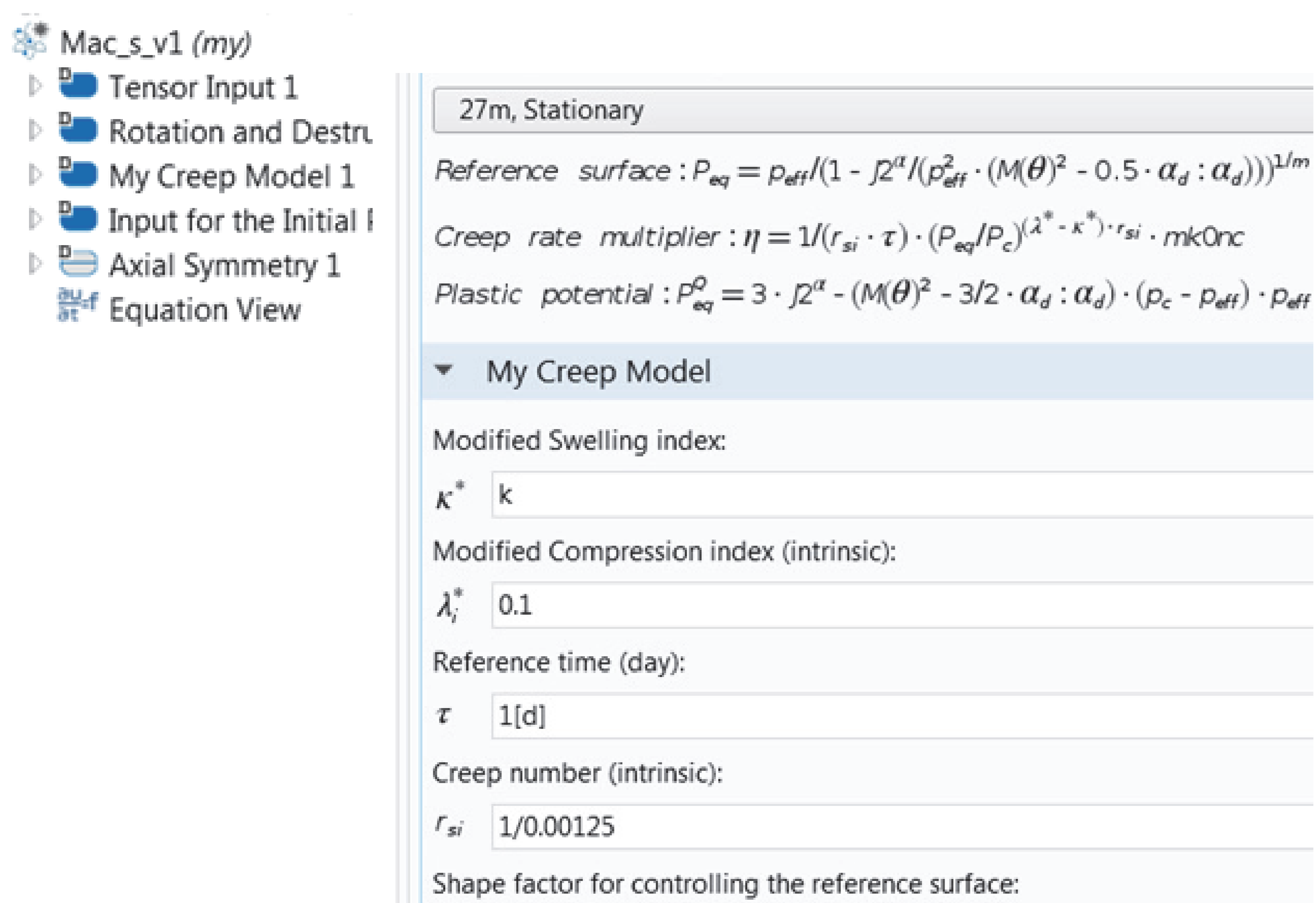


Figure 2. Overview of the implemented model.

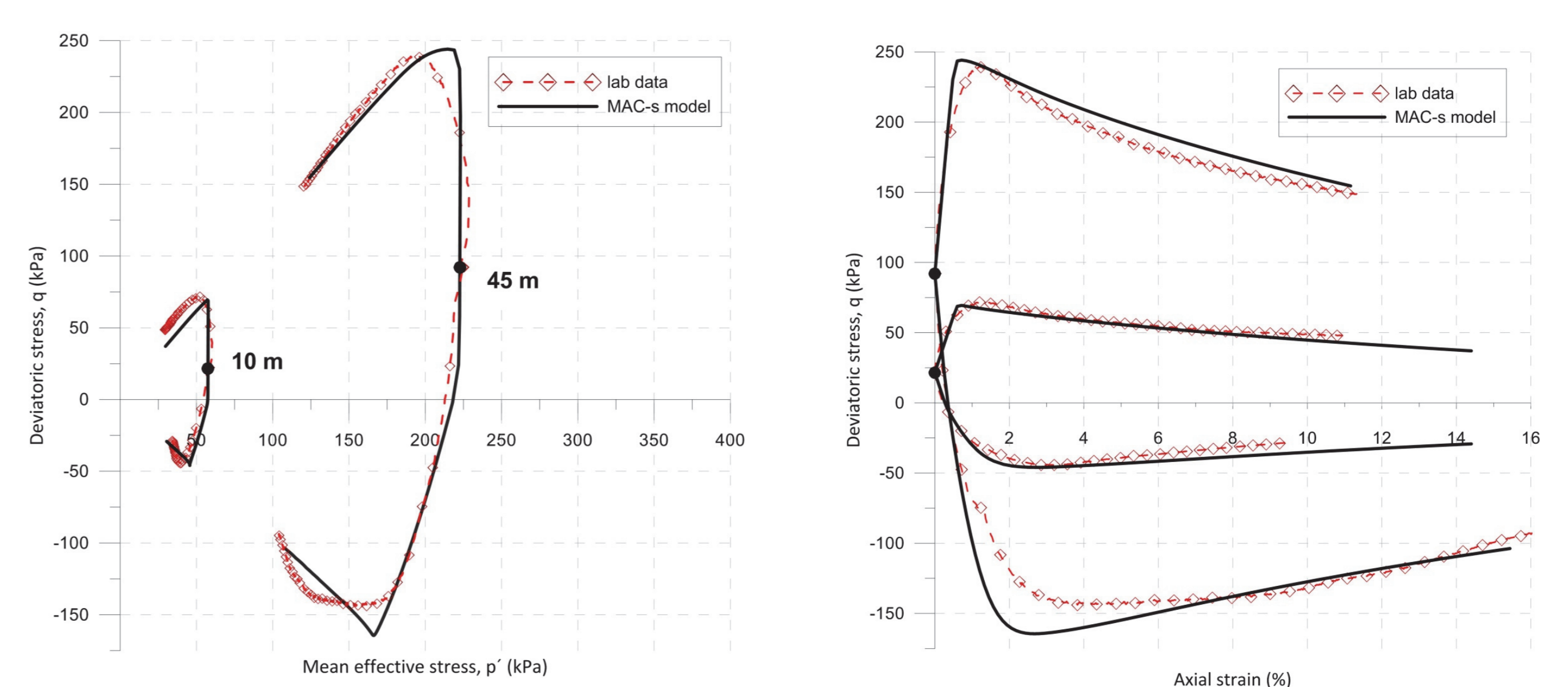


Figure 3. Comparison between simulations and laboratory results for undrained triaxial tests.

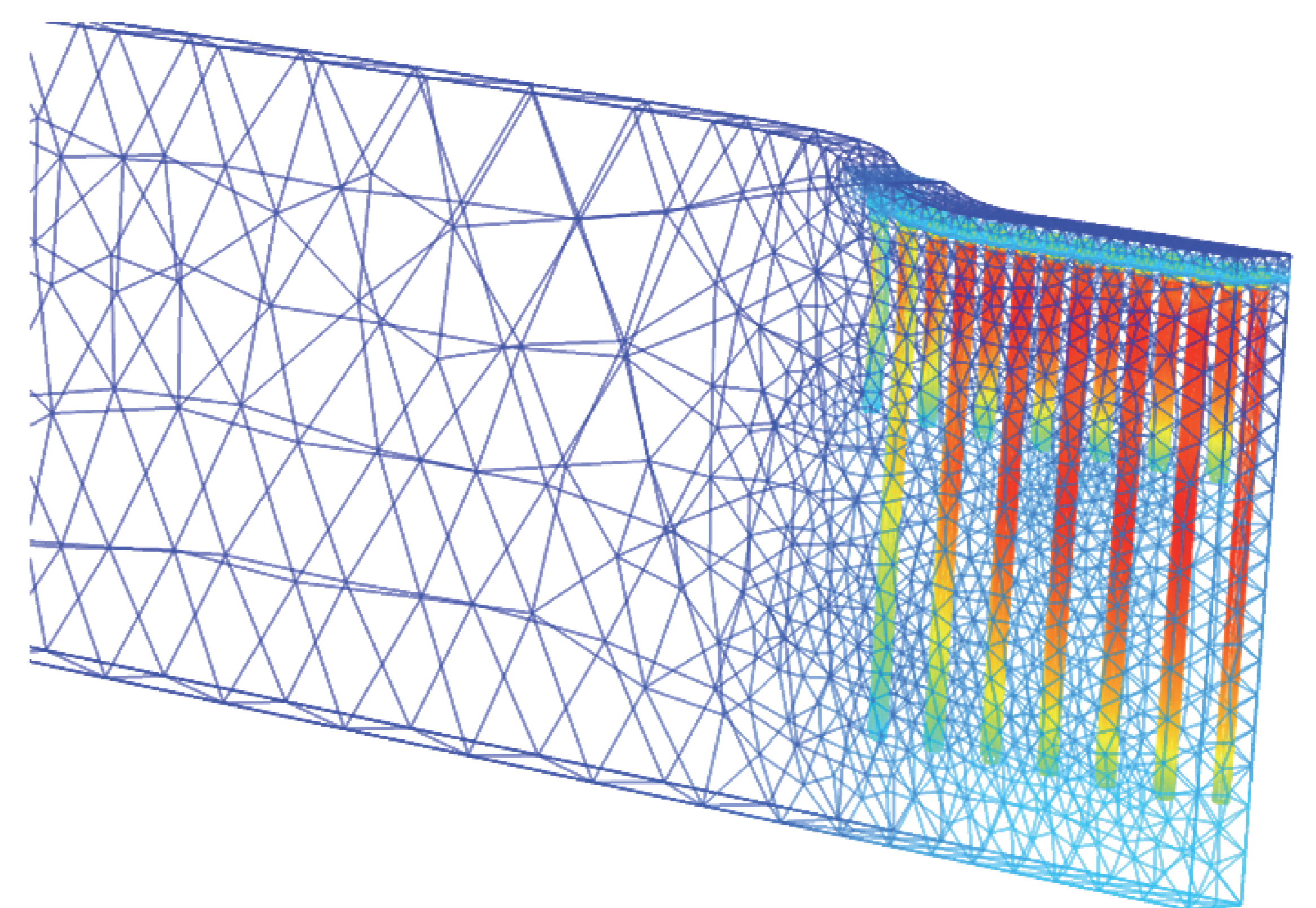


Figure 4. Embankment on soft clay reinforced with lime cement columns. The plot is showing the vertical stress increase due to embankment.

Conclusions: The implemented user-defined MAC-s constitutive model seems to capture many of the important behaviors seen in soft soils.

References:

- Grimstad, G., & Degago, S. (2010). A non-associated creep model for structured anisotropic clay (n-SAC). *Numerical Methods in Geotechnical Engineering: (NUMGE 2010)*,
- Olsson, M. (2013). *On Rate-Dependency of Gothenburg Clay*. (Phd thesis), Chalmers tekniska högskola.