Engineering Risk Analysis Group
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MSc thesis

Reliability analysis for tunnel-induced settlements on the adjacent building

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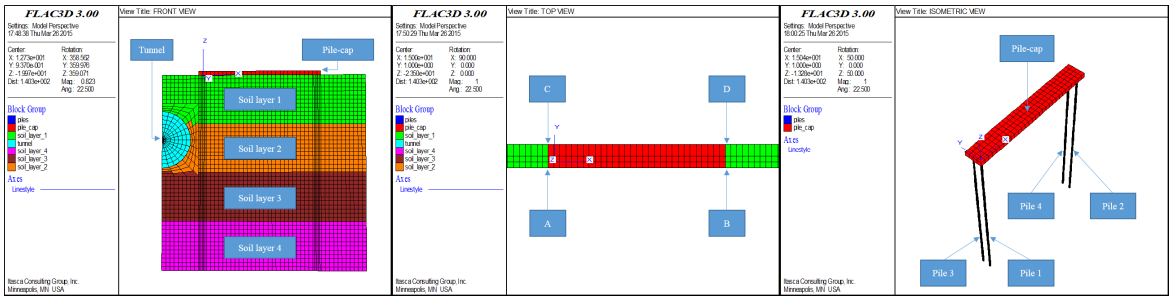
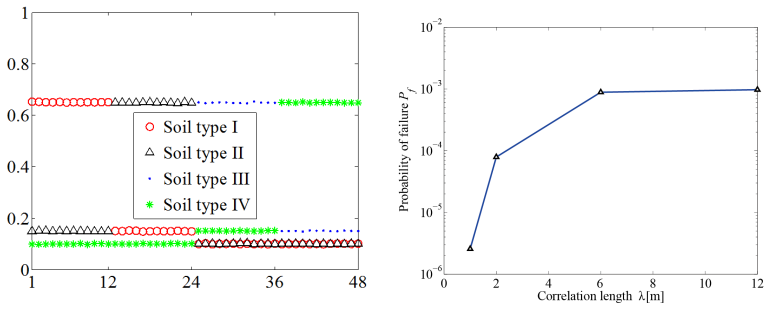
Background

Tunnel excavation often triggers deformations of the surrounding ground, further resulting in endangering the stability of the adjacent buildings and other structures. With limit-collected information from field survey, there are many uncertainties in geological conditions, e.g. the value of cohesion and friction angle of soil layers etc. In the field, the soil layers might follow certain distribution in one profile; however, its occurrence often varies with the tunnel advances.



Profile of the entire model, Top view of the total model, Isometric view of piles and pile-cap



Probability of occurrence of soil types, Probability of failure with respect to different correlation lengths λ

Methodology

The simulation firstly begins with creating a deterministic model in FLAC3D for analyzing the deformation and deflection of the adjacent buildings with piles foundation. The uncertain occurrence of soil layers was modeled as a discrete random field. And the probability of occurrence of soil types and thresholds are predefined to identify the soil types. The reliability analysis of the adjacent buildings is based on the computation results of the deformation. Subsequently, we apply the Subset Simulation method for evaluating the reliability of the adjacent building.

Results

The topsoil layers near the pile-cap are assumed to be weak soil layers whereas the bottom soil layers are assumed to be strong layers. Hence, in cases with smaller correlation length the probability of failure is smaller due to the larger average stiffness of the soil near the pile-cap and it increases fast as increasing the correlation length. The probability of failure in the case with higher correlation length, i.e. four homogeneous soil layers as our assumption, increases slowly while increasing the correlation length.

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