NUMERICAL ANALYSIS OF A DEEP EXCAVATION IN SOFT CLAY
APPLICATION OF A MULTILAMINATE MODEL

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SUMMARY
The results of a numerical back-analysis from a deep excavation problem in soft clay are presented. Finite element calculations done with two standard constitutive material models are compared to the results obtained with the newly developed Multilaminate Model for Clay. The latter one accounts for initial anisotropy due to preceding loading and induced anisotropy, inherently, because plastic flow develops independently on several contact planes. Both, the ability of the multilaminate model and the differences with respect to the results of the other models are shown. Furthermore, a comparison of the finite element analyses with geodetic survey measurements is provided.

REFERENCES

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FINITE ELEMENT CALCULATIONS

The finite element mesh used for the simulations is shown in Fig. 4. As the deformation pattern of the underground railway line was of main interest, this structure is fully embedded into the finite element model, whereas the hotel on the right hand side is only partly integrated. Slurry walls and structural elements are modelled by beam elements and interface elements are used to model the interaction between the structures and the soil. For the fill, gravel and sand layers drained conditions are assumed, whereas undrained behaviour is taken into account for the alt and both of the lacustrine clay deposits.

Figure 1: Geometry and geological profile at section B-B

Figure 2: Plan view of the building pit
Fig. 3a & b illustrate some of the intermediate construction stages until the final excavation depth is reached. First of all, the slurry walls at both sides of the excavation pit are installed and the ground water level is lowered in between. Excavation follows down on the right hand side of the pit and struts are installed. Next, the ground water is lowered to its final elevation and the excavation of the core is performed. After this is completed, the foundation slab and the core are build before it is excavated on the left hand side of the pit. In advance of the final excavation, struts between the slurry wall on the left and the core on the right are installed.

Figure 3a: Construction stages following the sequence A, B, C, D

Figure 3b: Final construction stage of the building pit

Figure 4: Finite element mesh for the numerical simulation of the excavation

Figure 5: Simulation results - horizontal displacements at chosen points

Fig. 5 presents the horizontal displacements of the top and bottom point of the right slurry wall of the underground railway line and of the top of both walls of the excavation support. In-situ measurements have been performed in order to control the displacement of the top of the slurry wall from the underground railway line to the left hand side of the excavation. The maximal value of horizontal displacement has been reported to be 7mm. This value compares very well to the results of the numerical back-analyses, where the maximal horizontal displacement varies from about 6 to 8mm, depending on the constitutive model.