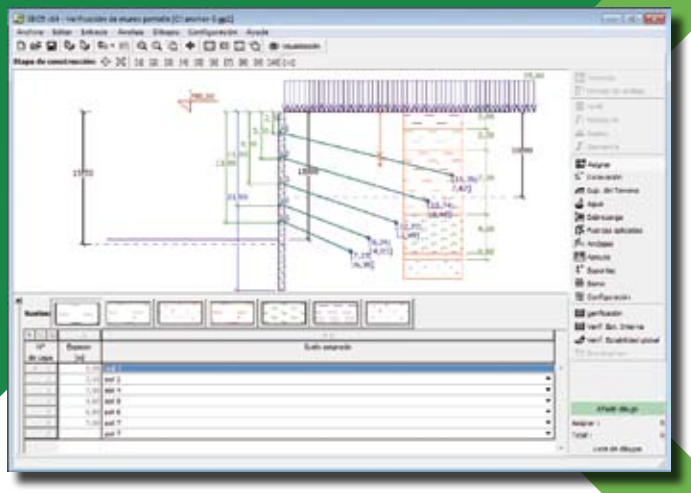
GEO5

Fine Project Gallery



Location: Prague - Ládví - Letňany, Czech Republic

Construction period: 2004–2008

Designer: METROPROJEKT Praha, a. s.,
Ing. Jaroslav Kopečný

Software: GEO5 Sheeting check

Open pit for the cut-and-cover tunnels
between the Střížkov and Prosek stations

Prosek station - open pit

Prosek station - before completion

Prague Metro line C

About project

Operational section IV. C2 of the Prague Metro line C provides higher speed of public transport services for large housing developments of the North Town, especially in relation to the city center. The section IV. C2 has 4.6km of tunnels ; mined tunnels make up a length of 2.36 km (mostly double-track) and contain three cut-and-cover stations, i.e. Střížkov, Prosek and Letňany. The final design developed METROPROJEKT Praha a. s. The construction operations started in May 2004 and the the line was opened to the public in May 2008. Construction lot 11 covers cut-and-cover tunnels between the Střížkov and Prosek stations. The total length of this lot is 772 m. The cut-and-cover Prosek station (construction lot 12) is 205 m long in total. The magnitude of the earthwork operations on the Operational section IV. C of the Metro line C – 2nd phase corresponds to the size of the project. About 1,138,000 m3 of spoil were transported from the open pit excavations and tunnels.

The construction site

We are focused on the Construction lot 12 – cut and cover Prosek station. This station was built in the construction trench supported by sheet pile walls. The structure of the station proper is designed from cast-in-situ reinforced concrete, forming three basic levels, i.e. the under platform, platform and concourse levels (underground).

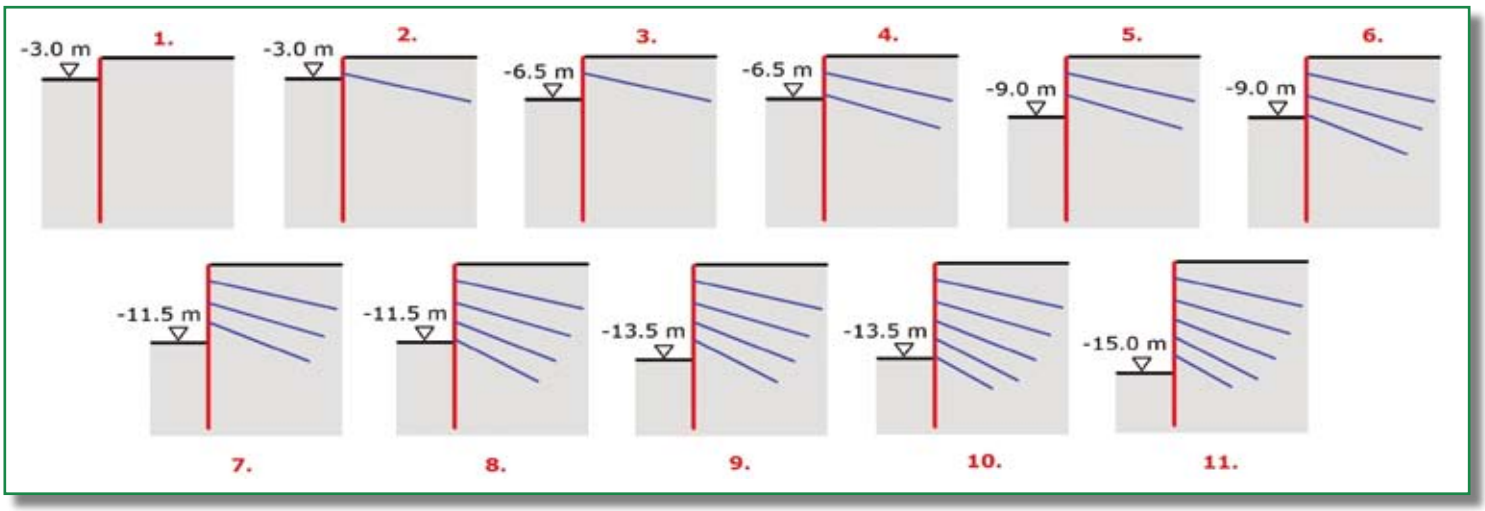
GEO5 Sheeting Check program was selected for the design of the sheet piling. The reason for this decision was the fact, that this software offers the use of the dependent pressure method (elasto-plastic soil model). This method allows a quick change of the geometry and properties of the structural members (in comparisson to finite element method) and simulates real deformations of structure during construction.

Description of the open pit

This station was built in the open pit supported by sheet pile walls. This open pit was irregularly-shaped - 205 m long, 7 to 31.5 m the width and 6 to 20 m height. A temporary ramp was situated on the longer side of the open pit during the construction. The geological conditions were following: a 3 to 5 m thick layer of loess (loess loam) and diluvial-eluvial loams covers an 11 m thick layer of considerably fractured and weathered sandy marlstones. There is a continuous layer of virtually impervious clay stone 4 to 5 m thick under the undulated cretaceous marl layer. A continuous layer of glauconitic sandstone about 1 m thick is under the clay stone layer, sitting on a several meters thick layer of weathered clay stones overlaying a competent sandstone bed. The water table is about 11 m under the ground surface.

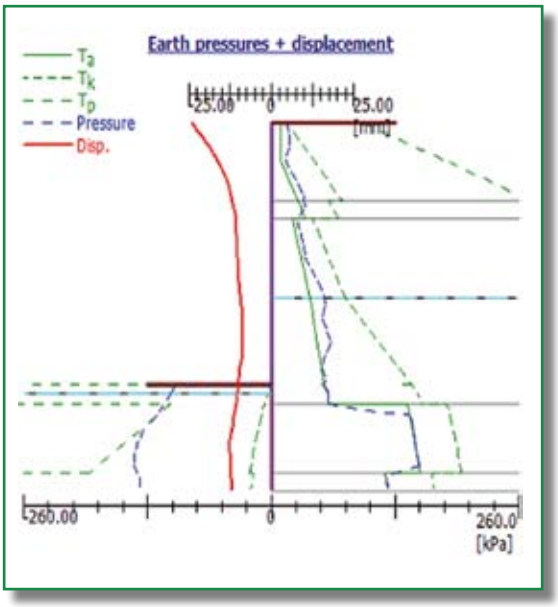
Calculation Assumptions

The sheet pile construction was analyzed with the different heights of the excavations and the number of the anchoring levels including the cases necessary for the metro station structure building. 22 anchor types were reviewed altogether. Types 1 to 4 (multi-level anchoring) were calculated for two geological profiles (occurring in the open pit space). Ground water level was assumed to be 11 m below ground surface. During the excavations it was observed that GWL was approximately 1 m lower.



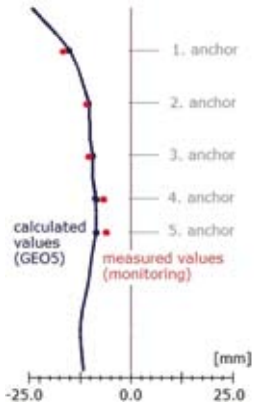
Construction stages of the wall

The sheeting wall is built sequentially by alternating excavations of soil and installation of anchors in various levels. The sequence of construction stages is following: excavation to the depth 3.0 m, installation of 1st level of anchors at the depth 2.5 m, excavation to the depth 6.5 m, installation of 2nd level of anchors at the depth 5.5 m, excavation to the depth 9.0 m, installation of 3rd level of anchors at the depth 8.5 m, excavation to the depth 11.5 m, installation of 4th level of anchors at the depth 11.0 m, excavation to the depth 13.5 m, installation of 5th level of anchors at the depth 13.0 m and excavation to the depth 15.0 m.



Monitoring

The structure deformation (horizontal movements) was measured on the anchor heads in one selected profile (sheeting type 2) during the construction. This profile was choosen in the deepest part of the open pit in geometry type 1. The results of the comparison between calculated and monitored displacement did not show significant variation.



Calculated (blue) and measured (red) deformation of soldier beam

	Deformation	
Anchor	Calculated	Measured
Head Nr.	[mm]	[mm]
1	-15	-17
2	-11	-11
3	-10	-11
4	-9	-7
5	-9	-6

Displacements - comparison of calculated and measured values

Conclusion

This software was selected due to following reasons:

- user friendly
- intuitiveness and transparency
- quality outputs
- easy input of the construction phases
- speed of calculations

The measured deformations proved, that the program gives correct results and that it is an ideal tool for modelling of real behaivour of the retaining walls.

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