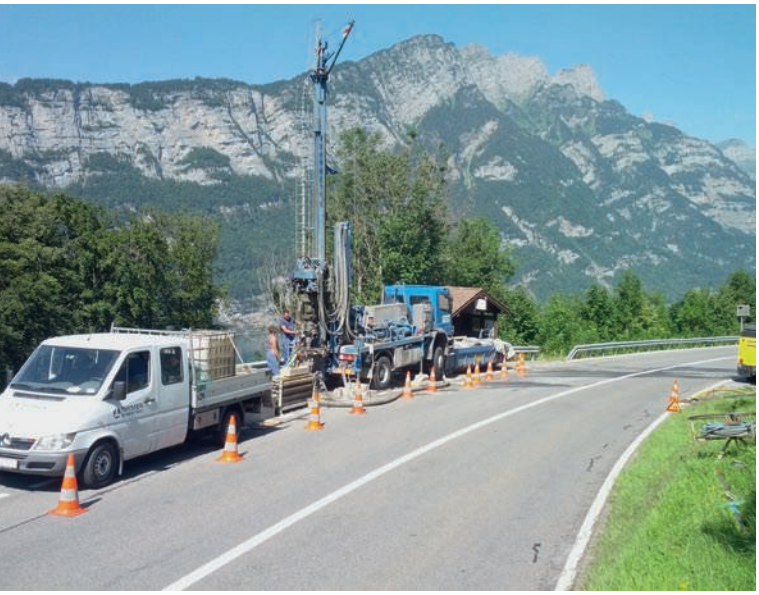
Drilling site for the 300 m-deep exploration hole in difficult terrain

Breaking new ground!

The Graz branch of THYSSEN SCHACHTBAU has been active in Austria and the neighbouring regions since 2010 and the office in Macedonia and other Balkans-based activities are also run from there. The branch has recently completed a conventional shaft sinking project and this paper will present and describe two other interesting commissions undertaken by the Graz-based engineering team.



Drilling on a motorway access road

Exploratory drilling for a safety gallery to serve an existing motorway tunnel in Switzerland

In March 2012 the Austrian branch was awarded the contract to act as general contractor for an extensive programme of exploratory drilling work in Switzerland. For THYSSEN SCHACHTBAU this was to mean a challenging agenda of geotechnical survey work.

Work commenced in June 2012. During the preparatory phase the company invested in two new drilling machines (a Wirth Eco1 driller and an Ellettari EK400 crawler-mounted rig) so that the work could be undertaken according to the required methods and guidelines. New drilling tools were also procured for large-calibre dry core holes (DN 278).

Some 36 individual exploratory holes were drilled out from the existing road tunnel and along the motorway for the full length of the new tunnel route, of which 10 km or more runs under residential and farming land. Because of the proximity to dwellings the drilling team had to comply with strict noise and emission regulations. All the diesel powered equipment was fitted with the latest particulate filters. During the drilling period a total of six machines were needed in order to meet the various operating requirements and strict deadline conditions.

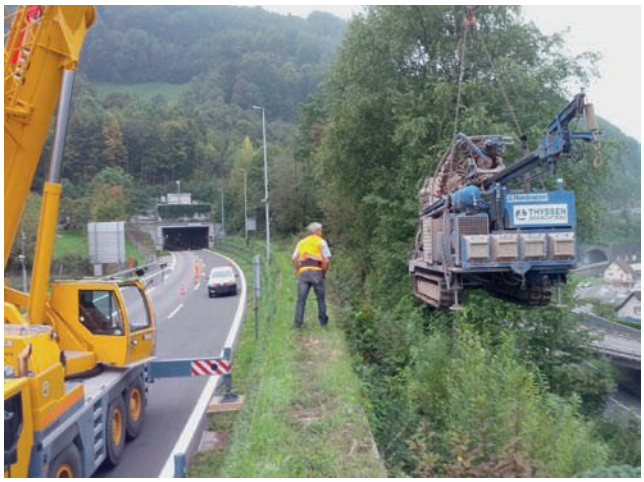
In the tunnel portal zones ram core drilling was used for the large-diameter dry core holes. The drilling diameter was 278 mm and the holes were drilled to a depth of up to 40 m. The drilled holes were then lined as wells or fitted with sliding micrometers.

The holes along the route of the motorway were drilled both from the surface (in the service lane) and from points below ground (in the emergency escape tunnel). A Diamec 262 rig and a 116-mm double core pipe were used for the underground drilling work in the confined conditions of the escape tunnel. A preventer system was employed to protect the underground boreholes from high-pressure water and gas ingress. As the motorway was to be kept open to traffic during this operation the drilling work not only demanded a significant organisational effort but also had to be carried out in accordance with the strictest safety regulations.

The exploratory drilling along the motorway was undertaken with the road only partially closed and the traffic flow was impeded to a minimal degree with some lanes closed off for certain periods. By removing the crash barriers and taking down the noise-insulation panels the most inaccessible drilling points could easily be reached by mobile crane.

The deeper holes (down to 300 m) were begun as destructive drillings and switched over to wire-line core barrels at 150 m depth. Drilling accuracy was a very high priority and it was essential to survey the holes by gyroscope probe on a continuous basis in order to keep the hole on its specified path. Gas measurements for methane and carbon dioxide (CH_4, CO_2) were also carried out and digitally logged throughout the drilling operation.

Extensive geophysical and geotechnical measurements were made in the survey holes with a view to obtaining the required data. One especially noteworthy aspect of the operation is that crosshole measurements were used – the first time this technique had been deployed at this depth anywhere in the world. An appropriate set of equipment was devised specifically for this project and the measurements were completely successful.



Drilling next to the Kerenzerberg highway

The holes were subsequently to be fitted out with sliding deformeters, inclinometers, piezometers and geothermal probes.

Injection and drilling work for a pressure shaft and hydropower plant

In January 2013 the Austrian office won a contract for a major injection drilling programme. A tunnel construction company had driven a 1,450 m-long inclined shaft, a 2,700 m-long gallery and a 150 m-deep vertical shaft as part of an extension project for a hydropower plant in the Tyrol. The inclined/pressure shaft had also been fitted with a steel-plate lining. In order to ensure a friction-locked connection between the concrete lining and the surrounding strata and at the same time to activate the load-bearing capacity of the rock THYSSEN SCHACHTBAU was called in to undertake strata injection work as the primary means of support and to back this up with a programme of consolidation and contact grouting.

For each stage of the operation it was first necessary to carry out injection tests in order to optimise the grouting parameters. The input data (maximum grouting pressure and injectability of the strata) for the subsequent test injection were then determined from the results of the water permeability test (water pressure test).

Only when the results of the injection tests were available was it possible to proceed with the strata injection work, whose objective was to reduce the permeability of the rock, prevent further water ingress and fill any cracks and fissures present in the rock body. Creating an effective contact

Injection and drilling work for a pressure shaft and hydropower plant

Grouting material being injected through the concrete tubbings in the inclined shaft

between the strata and the shotcrete lining or tubbing support ensures that the rock maintains its load-bearing capacity when subjected to internal water pressure. After the main excavation work had been completed the strata around the pressure shaft was reinforced via borehole injections carried out through the openings in the tubbing. This rock injection process was undertaken at a maximum injection pressure of 20 bar.

A contact injection stage (roof gap injection) was also carried out to fill the gap between the support system and the concrete shell with a cement suspension introduced through pre-fitted injection sleeves. The contact grout was injected at a low pressure of maximum 5 bar.

As many as four injection pumps were used for the grouting operation, this ensuring that the injection pressure could be kept as uniform as possible over the entire grouting profile. The cement-water mixture was processed using a high-performance colloidal mixer that produced a stable suspension that could be injected by high-pressure pump. The entire operation was automatically monitored and logged and supported by an automatic pressure limiter.

The rock injection work was carried out according to a grouting intensity number (GIN). Here the excavation criteria are based on a definition of the specific energy after determining a GIN value. This rules out the simultaneous presence of large quantities of injection medium and high injection pressures and is designed to reduce the risk of fracking (rock fracturation) due to the injection process.

After the injection work had been completed core drillings and water pressure tests were undertaken to determine the permeability of the strata and hence to monitor the success of the grouting operation.

Once again THYSSEN SCHACHTBAU and its associates in the Alpine region were able to demonstrate in-house expertise, flexibility and commitment in the planning, preparation and delivery of challenging assignments to the complete satisfaction of the client.

Since 2010 the Austrian branch of TS has successfully undertaken more than 20 projects involving all kinds of drilling work, supplemented by injection, measurement and documentation activities. The office is currently engaged in a shaft sinking operation, with THYSSEN SCHACHTBAU providing active support.

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