



Project

- Vallirana Bypass Tunnel Connection
- Part of western connection between road N-340 and highway A-2 to Barcelona
- Twin tube of length of 1,380 metres
- Contractor: JV of FCC & Serviá Cantó

Duration

- 2010 - 2011 / 2015 - 2016

Task

- Forecast of potential existence of mining operations, e.g. cavities or galleries of unknown geometry and dimensions in an urban environment

Challenges

- Uncertain possible mining voids ahead of tunnel face
- Changing ground conditions

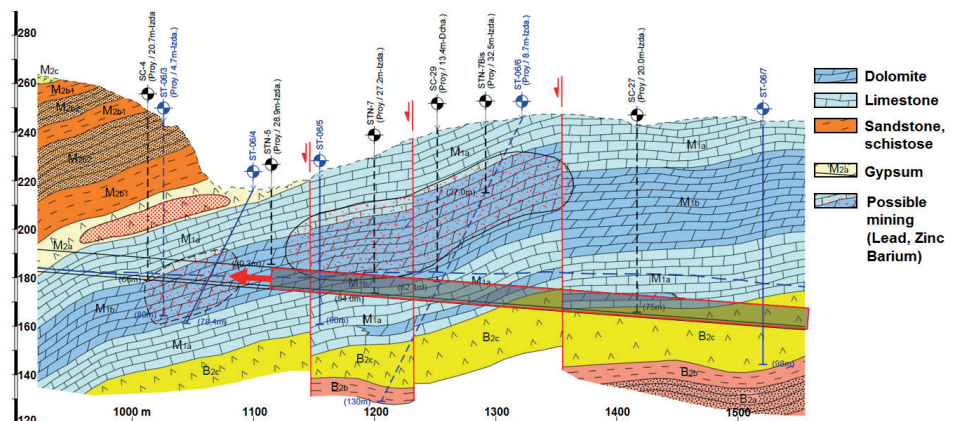
Products Used

- TSP 203 Plus system equipped with four receivers
- Two shot lines one along right and left tunnel wall each
- Amberg TSP Plus 3D-software analysis

Secure excavation in a sensitive urban area

The Vallirana tunnel is part of the western connection between road N-340 and highway A-2 to Barcelona. The tunnel consists of a twin tube of 1,380 metres in length and forms the bypass of the town of Vallirana.

The road header excavation of the Vallirana tunnel was facing a tricky stage at low overburden combined with possible existence of cavities or galleries of unknown geometry from abandoned mining operations. Moreover, the seriousness of the situation in the urban environment increased with the near presence of houses being above, which limited access for any investigations from the surface.





«The use of the TSP 303 system from Amberg allowed us to investigate a particularly worrying geologi-

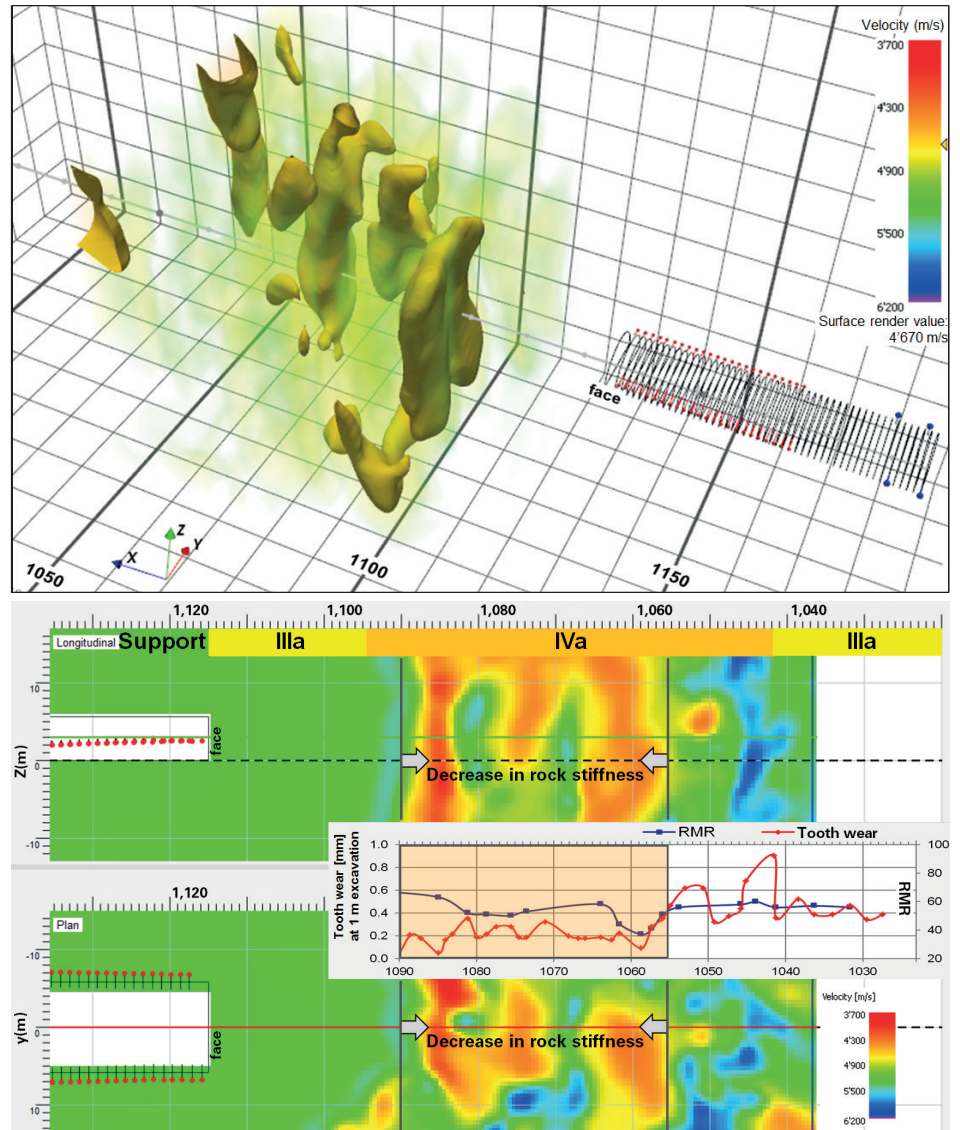
cal uncertainty which we could not handle from the surface due to the presence of houses.

The prediction results have matched quite accurately with what we have later encountered during excavation. Even though we haven't found any significant mining voids, the ground strength decreasing in the left tunnel as per TSP prediction complied with the cutter head bit consumption of our road header.

The 3D result presentation is quite attractive and allows a clear understanding to any party involved.»

Ignacio Piedra Morales
Senior Geologist advisory to the work site technical team of the JV

The Vallirana tunnel is being excavated in a geological environment consisting of carbonate units, sandstone, mudstone and gypsum of Triassic, Muschelkalk age. As per the geological project section, both carbonated and gypseous clay units have been reported to exhibit possible presence of abandoned mining works of lead, zinc, barium and gypsum. The overburden is reduced to less than 30 meters along a 150 meters long stretch, which particularly represents a hazardous zone in a densely populated area. The objective of four TSP measurements – two in each twin tunnel – was the detection of karst cavities, possible mining galleries and lithological changes some 60 to 80 meters ahead of the tunnel face and before the heading reaches any of the described uncertainties.



The upper image of the 3D P-wave velocity distribution emphasizes areas ahead of left tunnel face at 1,115 m, where values below 4,670 m/s have been surface rendered. The lower illustrated 2D sections of the same segment compare the seismic P-wave velocities with both the logged RMR values and the cutter head tooth wear of the road header machine. The P-velocity is predicted to drop from 5,400 m/s to 3,660 m/s after 25 m ahead of face and continues to be low ahead to chainage 1,055 m. It is in very good agreement with the tooth wear that declines at same places where velocity drops. Accordingly, rock support was being shifted from class IIIa to IVa and back again to IIIa when rock mass returned to more solid conditions.

Conclusion

The tunnel seismic prediction ahead revealed a change from sound rock mass to a soft rock with potential small voids in the left tunnel, whereas the TSP surveys in the right tunnel didn't detect any major changes. Abandoned mining structures haven't been forecasted and a riskless excavation could take place.

Contact

Amberg Technologies AG
Trockenloostrasse 21
8105 Regensdorf-Watt
Switzerland
Phone +41 44 870 92 22
geophysics@amberg.ch
www.amberg.ch/at