SmartMeasures

Tough projects call for smart measures.

AmbergSeismics

GeoMecca Eng. Co., Ltd.
Hyundai Engineering & Construction Co., Ltd.
Boryong-Taean National Highway Construction Project, South Korea

Project

- Boryong-Taean national highway construction project
- Section between Sinheuk, Boryong and Gonam, Taean
- 14.1 km total project length including 6.92 km undersea tunnel
- The longest NATM undersea tunnel in South Korea

Contractor

- Contractor: Hyundai Engineering & Construction Co., Ltd.
- TSP Survey: GeoMecca Eng. Co., Ltd.

Duration

- 2010.12 - 2018.12

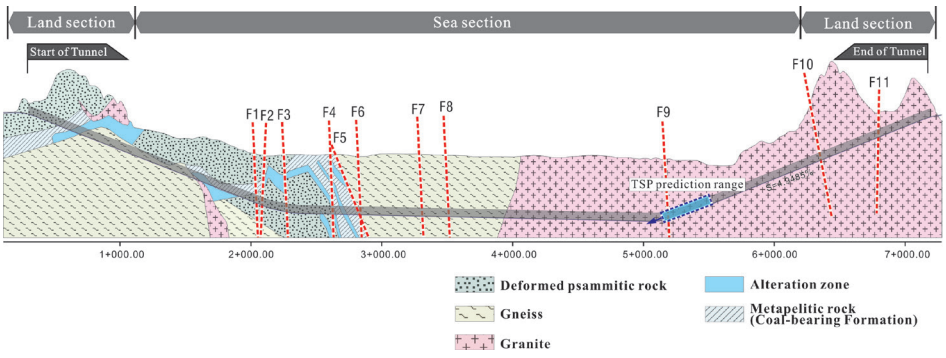
Task

- Detection of geological and hydrological conditions ahead of the tunnel face including fault zones, weak rock zones, water bearing bodies, heavily jointed zones

The longest undersea tunnelling in Korea: Slope matters!

The Boryong Tunnel is an extended section of the Route 77 connecting Daecheon Port and Wonsando Island, and has a total length of 7.985 km. It is initially planned to facilitate the development of tourist attractions and to improve the living environment of the nearby island residents. Furthermore, it is also expected to improve the development of local area and accompanying traffic congestions.

The Boryong Tunnel (L=6,927 m), which is the first excavated submarine road tunnel in South Korea, is a two lane tunnel. The length of the undersea section is 5.1 km with a maximum water depth of 37 m in this area. The overburden thickness lies between 30 m and 55 m, where the rock mass thickness is around 25 m.



AMBERG TECHNOLOGIES

«Our company introduced the latest TSP technology – the TSP 303 Plus system – for the first time in South Korea. Since then we have applied it in various tunnel construction projects for roadways, railways and waterways, etc.

With TSP 303 Plus, the geologic conditions and heterogeneities such as the fault/fractured zones and water bearing formations ahead of tunnel face are predicted within a short time. Thus, it provides basic data for the tunnel construction. The accuracy of the TSP survey is usually confirmed by comparing with the horizontal probe drilling and face mapping.»

Hwi Young Chae
Doctor fo Engineering /
Professional Engineer Geology and Geotechnics
GeoMecca Eng. Co., Ltd.

Challenges

- Comparison of the TSP survey results with and without tunnel non-linearity and slope correction

Products Used

- One Amberg TSP 303 Plus System

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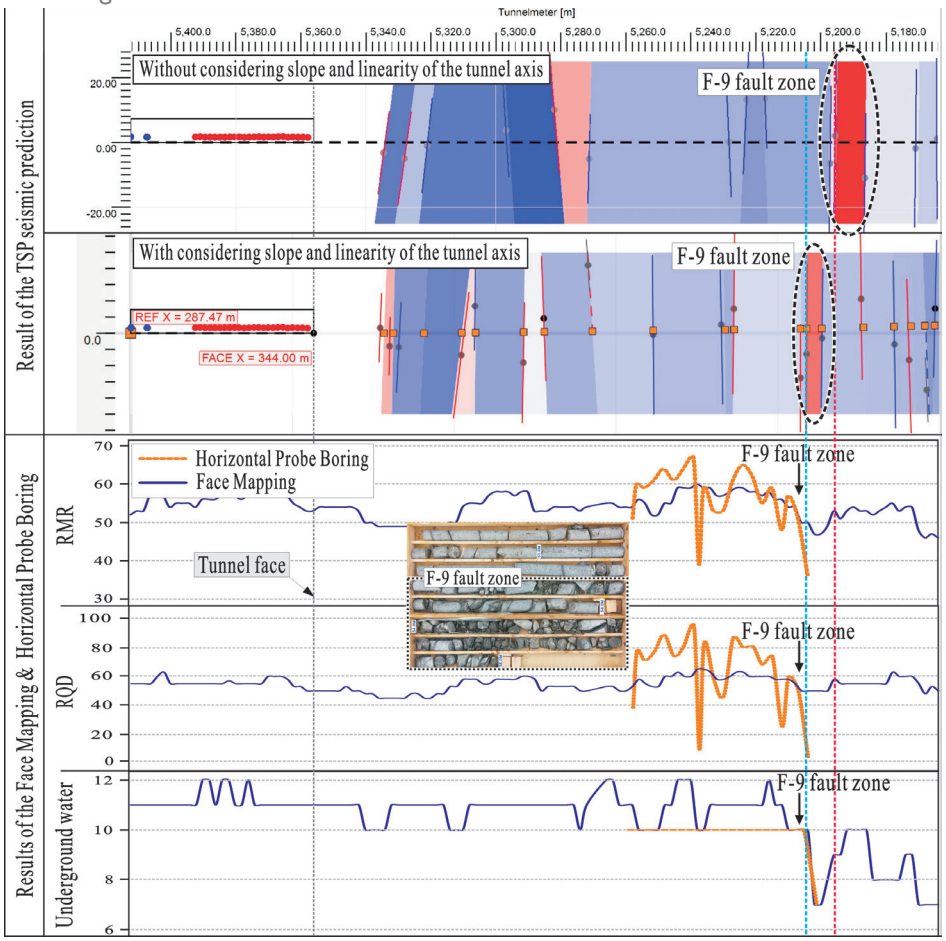
In December 2014, TSP survey was conducted at the end point of the Boryong Tunnel to determine the location and width of the F9 fault zone. The TSP exploration section has downward slope of about 5 %, and is composed mainly of fresh to slightly weathered granite. After analyzing the TSP survey results, it was concluded that the F9 fault zone is located between STA. 5+197.0 and STA. 5+186.0 with a total length of 11 m.



On the other hand, the horizontal probe drilling and surface observation during the tunnel excavation showed that the F9 fault zone already started from STA. 5+207.0, which differs by about 10 m from the TSP results. The main cause of the location error was judged due to the downward excavation, with the slope gradient of 4.95 %.

In December 2015, Amberg Technologies released the Amberg TSP Plus software version, from that on the 3D modeling takes the real slope and curvature of the tunnel axis into account. With this, the TSP data obtained from the F9 fault zone were reanalyzed, and the new results were compared with those from the old version.

After reprocessing with the new 3D version which allows slope and non-linearity of the tunnel axis, the F9 fault zone is analyzed to exist between STA. 5+205.0 and STA. 5+199.0. Even though the reprocessed result still shows 2 m difference from the actual starting point of the fault zone, the accuracy had been increased from 10 m to 2 m just by considering the tunnel slope and curvature.

Conclusion

The updated version of the TSP processing and evaluation system, which allows an inclination and non-linearity of tunnel axis, has been tested at a undersea tunnel in Korea. With this new version, the prediction error of the fault zone location had been substantially decreased, which results in more accurate data needed for tunnel construction.

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