Rail Tunnel Survey Leaves No Room for Error

The Trimble TX8 3D Laser Scanner delivers 7-mm accuracy in a railway tunnel survey.

Detailed 3D scan of a tunnel supports railway maintenance program

Trimble technology delivers on accuracy with high-speed laser scanner

Solution

Trimble® TX8 3D Laser Scanner

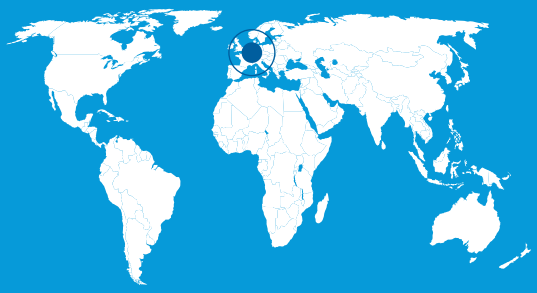
Trimble S7 and S9 Robotic Total Stations

Trimble R10 and R12 GNSS receivers

Trimble RealWorks® Software

overview

Millions of passengers pass through the Schiphol Tunnel every year; it is a vital transportation link between central Amsterdam and Schiphol Airport. To create a 3D model to support essential railway maintenance and upgrades, Trimble technology was used to survey the tunnel and provide measurements. The speed and precision of the laser scanners and total stations enabled the surveying team to meet strict accuracy and delivery requirements.



Location
AMSTERDAM

The Schiphol Tunnel is part of a 17-km passenger train route connecting central Amsterdam and Schiphol Airport, one of the busiest airports in Europe based on passenger volume. There is frequent traffic through the tunnel and any interruption impacts passengers going to and from the airport, as well as trains en route to other cities in the Netherlands, Belgium and France. Safety and reliability are major priorities of the interconnected rail network.

ProRail is the government agency responsible for maintenance and expansion of the Dutch national railway. In 2020, ProRail commissioned GeoNext, a Dutch geodetic engineering firm, to survey the Schiphol Tunnel and build a comprehensive 3D model that could be used to plan repairs and infrastructure upgrades.

A highly accurate model was required to ensure proper alignment of new tracks and adequate clearance for the fast-moving passenger trains. The strict 7-mm or better accuracy requirement meant that GeoNext needed to use top-quality equipment and carefully follow workflow processes for efficient data collection.

Surveying the tunnel presented a combination of several unique challenges, such as the lack of GNSS underground, the 7-mm accuracy requirement, and the need to work around train schedules. Fast scanning was a necessity because access to the Schiphol Tunnel was restricted to pre-scheduled maintenance days.

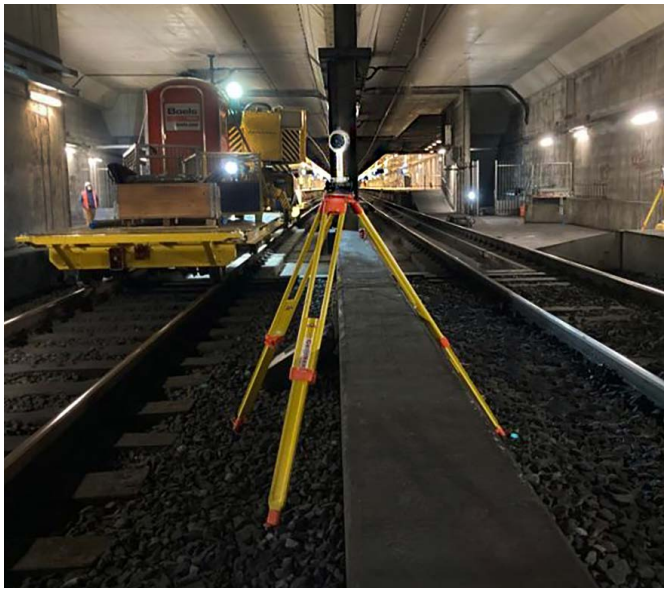
GeoNext has extensive experience with laser scanning and rail surveying and owns several Trimble TX8 scanners, Trimble S Series total stations, and GNSS base and rover systems. The TX8 laser scanner is well suited for fast and accurate surveying. Its powerful laser delivers a high point density and collects one million points per second, a major advantage when faced with strict time constraints. Also, the rugged design of Trimble instruments ensures reliable operations in the challenging environment of a tunnel.

Safety is a high priority for passenger railways that transport millions of people every year.

"The Trimble TX8 is a perfect device to scan more than one track at the same time," explained Daisy Sparla, project leader at GeoNext. "The 360-degree scanner allowed us to set up in between the tracks and collect everything in that specific area. While the scanner was completing its scan, we had time to hang the next targets. It was a highly efficient process.

COORDINATED WORKFLOW

To make up for the lack of GNSS in the tunnel, GeoNext used emergency exits to set GNSS points outside with Trimble R10 and R12 GNSS receivers. They leveled to the Dutch height system NAP and connected the outdoor GNSS points to targets inside the tunnels. For measuring the coordinates of these targets inside the tunnel, GeoNext used the Trimble S7 and S9 total stations with prisms.



The 360-degree laser scanner collects both tracks in the Schiphol Tunnel at the same time. Photo credit: GeoNext.

Working in close cooperation, the GeoNext team collected around 750 scans with the TX8, with a scan every 20 m and overlap of 5—10 m. Close scan station setup spacing and overlap between consecutive scans enabled GeoNext to reach the necessary 7-mm accuracy. The team surveyed the two 6.5-km dual-track tubes in just four weekends.

After scanning was complete, GeoNext utilized Trimble RealWorks to process the scan data. The auto extract feature in RealWorks is helpful for identifying targets and matching the scans. Bentley MicroStation Connect was used to build the complete 3D model of tracks and objects, and the point cloud was delivered in RD-NAP (Dutch coordinate system).

"With dedicated teamwork and detailed planning, we were able to stick to our tight schedule," said Sparla. "We were confident that we could deliver a high-quality 3D model using the Trimble TX8 and Trimble total stations."

GeoNext set GNSS points outside the tunnel (top) and connected to targets inside the tunnel (bottom). Photo credit: GeoNext.

"The speed and accuracy of the TX8 ensures we'll capture everything we need the first time. GeoNext has completed around 200 projects with the TX8, and it never lets us down."

— *Daisy Sparla, Project Leader, GeoNext*

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