

Tunnel Construction Monitoring for the U5 Metro Line Extension in Germany

Country

Germany

Project type:

Tunnel construction monitoring

Sector:

Construction

Main product:

Monitoring Solution

Challenge

The U5 Stadtbahn Europaviertel is a metro line extension project that aims to provide public transport for a new city district with commercial areas, a park, 3,800 households and 30,000 people working there. The underground section of the U5 metro line is constructed by a tunnel boring machine (TBM) that bores 2 tunnels with a total length of 1,720 m (860 m for each tunnel). Considering the fragile infrastructure surrounding the site as well as the risky tunnel excavation, PORR AG, the building contractor of SBEV GmbH who was in charge of the project, needed monitoring equipment to be installed without impacting the construction work or disrupting city traffic.

For a metro line extension project in Frankfurt Worldsensing data loggers and gateways were selected to perform geodetic and geotechnical monitoring to manage construction-related risks around the city center.

Solution

In order to address the project requirements, ANGERMEIER INGENIEURE GmbH installed around 100 geotechnical sensors and 400 geodetic monitoring points. Among the sensors installed are multi-point extensometers located at several measuring points along the tunnel route that is built under public areas and roadways.

To automate data acquisition without installing long and expensive cables, the extensometers are connected to Worldsensing vibrating wire 5-channel data loggers. A wireless biaxial tiltmeter, which serves as a sensor and node in one, is also installed to monitor the tilt of the surrounding structures. For connectivity, Worldsensing uses LoRa: a long-range, low-power wireless technology used by IoT networks worldwide. Features of the system include:

- **Radio:** Worldsensing has radio signals up to 32 times stronger than other wireless monitoring systems which can penetrate through metallic manholes.
- **Range:** The monitoring system uses a star network topology that can cover a range of up to 2.5 miles / 4 km in a tunnel without any repeaters.
- **Batteries:** The nodes are extremely low-power and can last for up to 10 years or until the project completion around the year 2025.

"The Worldsensing set-up and installation with the sensors were extremely simple. The measured data could be immediately transferred to the existing evaluation and visualization system. Its main advantage is its ability to send radio signals from under the manholes and over a long distance."

Dr.-Ing. Andreas Wagner,

Project manager

ANGERMEIER INGENIEURE GmbH

Benefits

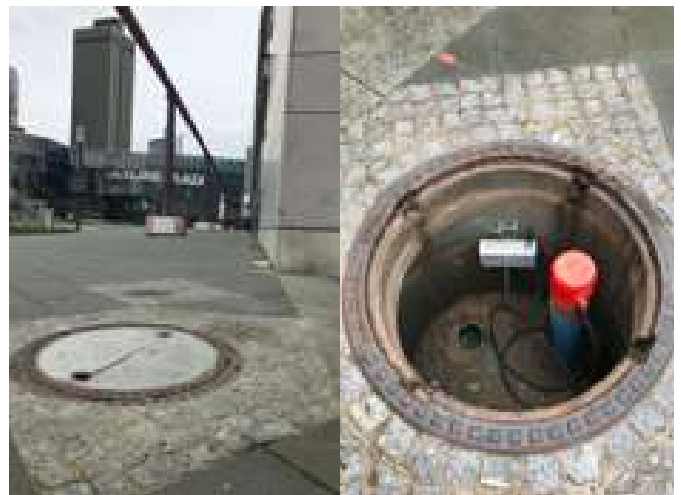
Using Worldsensing, which allows collecting monitoring data wirelessly, eliminates the need for expensive cabling that could disrupt traffic and construction work. While setting up the system is simple, data can be acquired even from sensors inside manholes. Ultimately, the monitoring system helps to ensure that the environment is safe not only for workers on site but also for people who live and work in the city center.



Photo courtesy of SBEV GmbH/Klaus Helbig

Advantages

- Strong radio signals that can pass through manholes and reach long distances
- Less intrusive and vandalism-protected monitoring equipment and power supply in public areas



The battery-powered nodes, installed in a covered manhole to prevent vandalism, successfully send data wirelessly to a gateway, installed on top of a temporary office building on site, which in turn immediately transmits the data to an evaluation and visualization system.

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