



Botlek Railway Tunnel - Deformation Monitoring

CLIENT: IV-INFRA B.V. / A-LANES A15

How Senceive technology supported construction and 25-year structural health monitoring

Challenge

The Botlek railway tunnel was the first bored railway tunnel to be built in the Netherlands. It is located near Rotterdam under the Oude Maas river and next to the existing Botlek railway bridge. Designers were concerned about possible ground movement and deformation associated with ongoing infrastructure projects in the area. A robust monitoring programme was therefore required during and after tunnel construction.

A monitoring system was required starting from mid-2017. The system had to be easy to install, as well as accurate, discreet and reliable. The 8.65 m diameter concrete segmental lining tunnel is 1.8 km long. No cellular phone signal or internet access was available. The design team predicted ground movement of up to ± 3 mm.

Dutch survey and monitoring experts Iv-Infra were engaged by the construction team and contacted Senceive to find a solution.

Solution

Iv-Infra installed a total of 434 FlatMesh™ triaxial tilt sensors. These were located at points every 30 m through the tunnel, with nodes fixed to six of the seven segments in each ring. These were set to take readings every 30 minutes. The tilt node triaxial capability meant they could be positioned at any orientation, with no need for time-consuming levelling surveys.

To overcome the lack of internet/cellular connectivity, Iv-Infra used Senceive monitoring hubs positioned 800 m from each portal to receive data from the wireless nodes. The hubs were setup to utilise the tunnel's 220 V power supply and relay data via a 2 km telecommunications cable to a telemetry hub located outside the tunnel. This transmits data through a mobile network to visualisation software.



Fig.1 Cross section showing monitoring arrays on tunnel ring segments

Outcome

Iv-Infra opted to use their own software to read and process the data, however Senceive's WebMonitor software also allowed the support team to remotely check system health.

FlatMesh™ triaxial tilt nodes were the ideal choice, as they could be installed quickly and easily. This reduced man-power requirements, accelerated programme and saved money. Senceive customer support team provided training and advice throughout the project. The extremely reliable and robust system also eliminated the need for any further maintenance or visual checks. For example, when construction works above ground commenced, Iv-Infra requested the reporting rate of the nodes to be increased to 7.5 minutes in certain areas. The system allowed this to be done remotely with no physical intervention.

Monitoring is due to continue for the full 15 year battery life of the nodes. Batteries will be replaced at that point and monitoring will continue for a further 10 years.