

Railway Bridge Upgrade

How wireless monitoring has supported challenging bridge improvement works

Challenge

The team planning modifications to a bridge in Yorkshire, UK faced the challenge of adding a walkway for pedestrians and cyclists. They had to consider the impact of additional loading on the existing structure, as well as how to minimise disruption during the works. They needed information on the behaviour of the structure, but had to gather data with minimal impact on the construction programme and on road traffic carried by the bridge as well as rail traffic using the electrified double-track railway below.

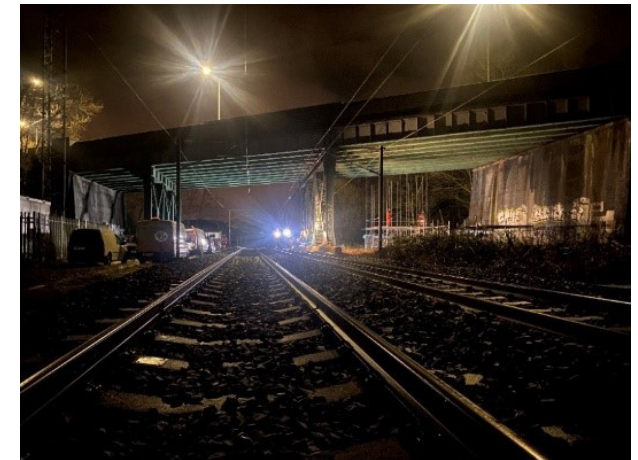
Monitoring specialist GEO-Instruments UK was tasked with providing a monitoring solution that would provide their client with the required data. The monitoring scheme required the measurement of vertical displacement of the bridge at various points as well as horizontal displacement across the jack arches forming the underside of the bridge. They chose a wireless monitoring solution using Senceive technology.

Solution

The adopted solution used Optical Displacement Sensor (ODS) nodes installed in pairs at multiple positions across three spans of the bridge. The ODS nodes comprise a triaxial tilt sensor and a laser distance meter - enabling measurement of rotational movement of the structure the node is mounted to, as well as changes in the distance to a target object. By evaluating changes in these values over time, it is possible to build a detailed understanding of the movements and deformation of the structure.

Each pair of nodes comprised a node directed horizontally to monitor movement of the outermost jack arches and edge girders, and another directed vertically at the track below to monitor vertical displacement.

Where necessary, reflective targets for the ODS nodes were installed to provide more accurate distance measurements. Several of the vertical sensors could not be aimed directly down at the tracks where it was not possible to install targets. In these cases, the sensors were aimed diagonally down, with vertical displacement calculated using tilt angle measurements.



Installation was restricted by track access, which could only be achieved during overnight possessions. Nodes were fixed to the masonry structure and, as a further precaution to mitigate the risk of items falling on the tracks, were secured to the structure using lanyards.

Because of the duration of the project it was necessary to selectively clear vegetation to prevent obstruction of the path between the sensors and the target.

Key advantages:

- Near real-time movement data transmitted to third-party visualisation software
- High frequency reporting and automated alerts in the event of threshold exceedance
- Improved safety and reduced rail traffic interruption

Outcome

Following installation, the system transmitted tilt and displacement data from the ODS nodes to a cellular gateway. Data was relayed to WebMonitor™, Senceive's cloud platform, where any necessary calculations could be applied. The system was configured to allow the client to view data in GEO-Instruments' online portal QuickView. This features project displays, triggers, alarm systems and reporting features -all set-up to meet client specifications.

Providing high frequency reporting and near real-time alerts in the event of threshold exceedance, the monitoring programme has enabled the construction team to work more efficiently and with fewer site visits.



Data from the Optical Displacement Sensor Nodes was transmitted via cellular Gateway to WebMonitor™, Senceive's cloud platform, and on to GEO-Instruments' online portal QuickView.

Data from WebMonitor™

