



Box Tunnel Electrification - Structural Monitoring

CLIENT: AECOM / NETWORK RAIL

How a wireless monitoring solution supported major structural changes to a historic rail tunnel as part of Great Western Main Line electrification



Challenge

Network Rail's Great Western Mainline electrification project started in 2014 to improve capacity and reliability. The route passes through the 3 km Box Tunnel, designed by Isambard Kingdom Brunel and completed in 1841. It was bored through four distinct strata and two fault zones and comprises 2 km of brick lined, 350 m of unlined and 450 m of brick arch construction.

In order to achieve clearance for overhead line installation in 2015, there was a need to lower the track by 350 mm. To safeguard the integrity of the tunnel and minimise disruption to train operations there was a need to monitor and control movement.

The challenge was to implement an economical, resilient and precise monitoring solution within a fully operational and congested construction site over the full length of the tunnel. Due to the live network, the system had to be wireless and mains power free.

Solution

Conventional systems were considered impractical due to obstructed lines of sight, absence of power supply, long installation times and risk of damage.

Monitoring experts at AECOM chose to use a Senceive solution to provide near real-time data relating to tunnel distortion that was wireless and did not need mains power.

The AECOM team installed 250 Senceive tilt sensor nodes on a FlatMesh™ platform - providing sufficient coverage to monitor the full length of the tunnel. Data was collected through internal battery powered gateways and sent to users inside and outside the tunnel every 20 minutes to help verify predicted structural movements throughout the works. Additional innovations were made to allow for automatic switch-over to backup gateways in the event of damage or failure.

Outcome

The FlatMesh™ wireless solution met the very challenging requirements of this site, providing a solution where there was really no viable alternative.

The system was delivered and installed in extremely tight timescales, necessitated by the fixed date of the line closure for the works. Additionally, safety was enhanced through the fast and simple installation.

As the system was entirely wireless and mains power free, it was swiftly decommissioned at the end of the project, and the sensors reused, minimising waste, environmental impact, and whole life cost.

