



The Royal Mail Tunnel – Liverpool Street

CSIC with industry partner Crossrail

The project

To develop monitoring and data-collecting systems which demonstrate the effects of Crossrail's excavation on existing infrastructure. CSIC technologies have been installed at a number of sites across Crossrail's £15 billion subterranean rail link, Europe's largest civil engineering project, which is creating 26 miles of new tunnels underneath Greater London and is due to open in 2018.

The challenge

The Crossrail project at Liverpool Street station presented a challenge to engineers; never before had a tunnel been dug in London in such close proximity and parallel to a pre-existing tunnel over such a long distance. There was considerable uncertainty about the likely mode and levels of deformation to the existing tunnel network meaning contractors were forced to introduce a number of costly safeguards and temporary works based on predicted worst-case scenarios.

The approach

CSIC deployed a team of researchers to install four different pioneering monitoring devices inside a 40-metre stretch of the disused, 100 year-old Royal Mail Post Office railway tunnel. These included Wireless Sensor Network (WSN) displacement transducers, fibre optic strain sensors and photogrammetric monitoring. CSIC's combined instrumentation created the

world's first smart tunnel capable of measuring and monitoring the structural performance and stress levels of the older tunnel as the new, giant Crossrail tunnel was excavated below.

The benefits

CSIC's ground-breaking technologies are quick and cost-effective to install and provide contractors with answers to complex engineering questions. Combined, the sensors can detect movements as small as one-hundredth of a millimetre, allowing potential problems to be spotted and corrected well before they represent any risk.

The data collected from the instrumentation, in sync with the construction programme, gave detailed information about the deformation of the Royal Mail Post Office tunnel, offering a better understanding of the temporary work requirements for such tunnels. A unified dashboard system was specifically developed by CSIC for this project to collate, filter, process and present information from the various sensor deployments allowing engineers to make well-informed and timely decisions in difficult construction settings.

CSIC's method is an industry first; installing low-cost, robust and efficient sensor technologies to feedback data in near real-time will provide a complete picture of the entire tunnel deformation previously unavailable. In

this case, the use of CSIC's array of innovative instrumentation offered our industry partner Crossrail, an opportunity to make significant savings on future projects by more accurate planning of the required monitoring systems and the design of the temporary works.

The response

"CSIC's work on Crossrail and other related projects is cutting edge. Optic fibre strain gauges to measure the performance of our tunnel sections and asset management systems that detect changes in the condition of infrastructure over its life cycle are firsts anywhere in the world. Both these projects are being developed for us by CSIC to understand better how our structures and assets behave and how we can save money through more economic design and reduced life cycle costs."

Andrew Wolstenholme, CEO of Crossrail