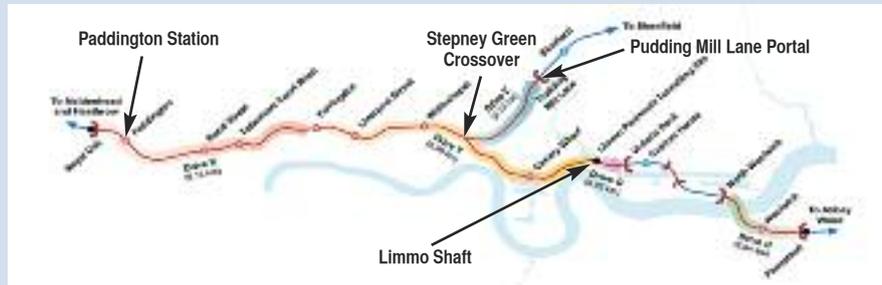


Case study

Transforming construction: innovative fibre optics sensors deployed on a variety of Crossrail sites



CISC fibre optics installations on Crossrail shafts and retaining walls

Location

Paddington Station, Stepney Green Crossover, Pudding Mill Lane, Limmo Shaft.

Working with

Crossrail

Context

- working closely with two Knowledge Transfer Partnership (KTP) Associates (employed by Cambridge University and funded by both Crossrail and TSB) CSIC has led the development and installation of optical fibre and conventional monitoring instrumentation on four major Crossrail sites

Challenges

- to provide new insights into the behaviour of the shaft linings and retaining walls, and adjacent ground movements, during construction
- to develop a robust method for installing fibre optic sensors during construction

Project details

- CSIC has been actively involved on four key sites during construction of Crossrail, principally in the implementation of fibre optic sensing to measure the performance of shafts and deep excavations
- CSIC has successfully installed optical fibre sensors on the diaphragm wall reinforcement cages at the Crossrail sites, with the fibre optic cable being unrolled from drums and fixed to the cage at intervals as it is lowered into the deep trench in the ground
- tunnelling machines were launched from the 40m deep Limmo Shaft
- a novel wireless sensor network has also been installed in the deep excavation for Paddington Station

Achievements

- the monitoring data has provided completely new insights into the

behaviour of the shaft lining and ground movements adjacent to the shaft during construction

- the information has highlighted the conservative nature of the design of the shafts and retaining walls – only very small wall strains and deflections were recorded by the fibre optics. The monitoring has also shown much smaller ground movements than predicted
- many lessons have been learned on the complexities of installing fibre optic sensors in diaphragm walls on the Crossrail sites, including the important challenges of working under difficult construction site conditions. Robust installation techniques for achieving reliable measurements have been developed

Transformative benefits to the infrastructure and construction industries

- informed decision making: the fibre optics monitoring on these sites has demonstrated that potential economic benefits can be achieved with refined designs. Rationalisation of the design approach for shafts and retaining walls will benefit the wider construction industry
- cost saving: a more efficient design approach should result in reduced amounts of material used and a faster construction process

Going forward

- further plans have been developed by CSIC with Crossrail for monitoring the behaviour of tunnel lining segments in the tunnels to be constructed beneath the River Thames: fibre optic sensors have been installed in the segments when they were cast in the factory
- the behaviour of a sprayed concrete Crossrail platform tunnel during construction of a cross-passage tunnel will also be monitored with fibre optics



Above: installation of reinforcement cage for diaphragm wall with fibre optic sensors attached. Below: diagram showing detail

