Case study

Integration of sensing technologies in the London Bridge Station Redevelopment Project

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The project

The London Bridge Station Redevelopment Project (LBSR) is part of the Thameslink upgrade which will increase the capacity of the north-south routes through London. The main objective of the redevelopment is to increase the number of through-tracks and extend the capacity of the platforms, which required demolition of several historic vault structures and the construction of new viaducts and a new concourse. CSIC developed new monitoring techniques to tackle construction challenges on the project. The station, the fourth busiest in the UK, is being kept operational during the construction works, providing CSIC the opportunity to demonstrate the value of new sensing technologies on a real site, including innovative monitoring of masonry vaults and passenger flow.

Engineers on the project, led by CSIC Research Associate Sinan Açıkgöz, were faced with the task of predicting the response of historic brick vaults under the active platforms to piling induced settlements. Using traditional instrumentation, it is difficult to quantify the response of these viaducts to settlements and evaluate their safety. In order to ensure safe operation of the vaults and the tracks above, CSIC utilised two novel distributed sensing technologies to investigate the vault response to settlements in unprecedented detail. The distributed fibre optic sensor system, which employs Brillouin Optical Time Domain Reflectometry (BOTDR), was used to examine the strain development at several sections along the vault. This highlighted the location and magnitude of emerging cracks. The second system utilised laser scanners to generate georeferenced 3D point clouds, before and after piling, which were compared to provide global deformation estimations for all visible surfaces. The rich information led to the development of more efficient damage assessment techniques for evaluating settlement-induced damage on masonry vaults.

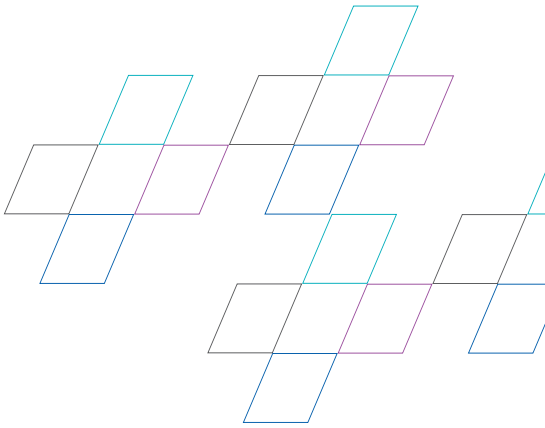
In parallel, CSIC tested low-cost infrared sensors and cameras to monitor pedestrian flow around a platform of the new station. This exercise allowed researchers to evaluate the accuracy of these low-cost sensors and to determine how the pedestrian flows change as the station is being constructed. This information was linked with pedestrian prediction models which run faster than real time. By combining the modelling and sensing information, CSIC aims to develop a technology which can identify imminent congestions and help station managers identify issues concerning pedestrian flows and respond effectively.

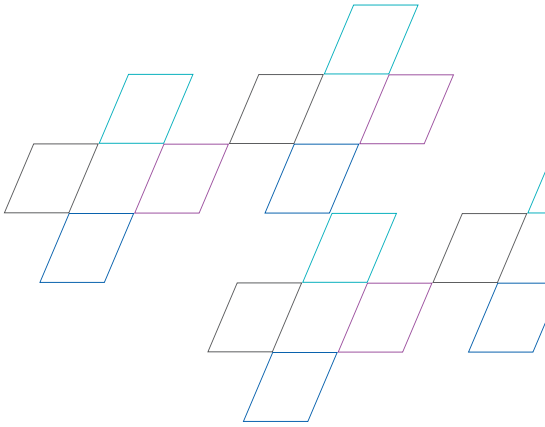
The innovations

- new cloud comparison techniques were developed to detect the 3D structural movements with high accuracy from laser scan data
- the pioneering use of fibre optic sensing in masonry vaults led to the critical identification of crack locations and magnitudes and effective quantification of damage
- effective linking of modelling and sensing tools enables a better understanding of the performance of our assets
- the rich data provided by the cheap and efficient sensing techniques holds the key to improving the efficiency of our asset assessment and management techniques.

Impact and value

- development of new data analysis techniques to retrieve critical engineering information from sensing data
- provide efficient methods to use the data to improve asset assessment and management
- reduce risks due to uncertainties (e.g. concerning the ground settlements and passenger flows) by providing cheap and/or distributed monitoring techniques
- improved fundamental understanding of the mechanical behaviour of masonry assets and their long term behaviour.





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