

Editorial

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Welcome to this themed issue of *Bridge Engineering* on the subject of assessing the capacity of existing bridge structures.

Many parts of the world continue to provide opportunities for major new bridge construction. These include the massive investment in infrastructure in China and the Far East; the urban metro schemes in India and the Middle East; and the high-speed rail lines in Europe and the USA.

However, many countries now have extensive stocks of mature bridge assets. A typical example is provided by the paper in this issue by McKoy (2016) on London Underground, which has a stock of approximately 8000 bridges and other assets, of which nearly half were constructed before 1900.

Assessment is a key tool for the management of existing bridges. Assessments may be undertaken to check that bridges are safe under the loads they are already experiencing. In addition, increasing traffic capacities and loading often require the evaluation of the carrying capacity of existing structures. Changes to structures, such as modifications or external damage or deterioration, may need to be assessed.

Bridge assessment, although a challenging subject, can also be a rich field that offers opportunities for research, innovation and the development of technical expertise. The rewards can also be significant: analytical approaches are generally less costly than structural strengthening, so there can be many benefits in progressing sophisticated investigation and analysis methods to justify the strength of structures.

This issue of *Bridge Engineering* includes five papers from across this full range of endeavours. Papers include a discussion of an asset owner's assessment programme spanning three decades; a methodology for evaluating the potential benefit of installing structural monitoring systems; techniques for controlling proof test loading using acoustic emission; development and calibration of a finite-element approach to service-level assessment of masonry arch bridges; and a case study of a project to assess a 620m-long steel-composite box girder viaduct by deploying Eurocode methods.

Olaszek *et al.* (2016) consider the on-site assessment of bridges supported by acoustic emission. In situ tests show that sometimes bridges have a reserve strength that is not accounted for in design codes of standard assessment methods, since the

codes may conservatively neglect contributory mechanisms. Full-scale load testing can demonstrate these reserves of strength. However, proof load testing up to the design load may have risks of inducing cracking or damage in the structure if it is not properly performed and controlled, owing to the high level of load in the bridge.

Acoustic emission has been identified as a useful technique to stop the load increase before any damage can be inflicted on the bridge. The paper presents tests on a three-span bridge at Barcza, Poland, and shows that monitoring with acoustic emission sensors made it possible to evaluate the cracking limits of the concrete members and stop the load increase prior to the onset of plastic behaviour.

The second paper by Gibbons and Fanning (2016) considers progressive cracking of masonry arch bridges. The paper presents non-linear 3D finite element models that consider progressive damage in masonry arch bridges. This allows for the investigation of damage and crack propagation at service level loads, in contrast to traditional methods that only consider the ultimate capacity state of masonry arch bridges.

McKoy (2016) reports on the successful outcome of the bridge assessment programme by London Underground. The paper presents the bridge assessment programmes over three decades, including the development of loading and assessment standards, the management and technical approval processes and approaches to managing the risk of non-compliant assets. It includes descriptions of common issues with historic bridges across the asset base.

Vardanega *et al.* (2016) present a methodology to assess the potential value of bridge monitoring systems. Structural health monitoring can produce valuable data-sets that can aid with key decisions on current performance, margins of safety, actual loading, stress history, extent of deterioration and residual life. However, the collection of data is of little value unless it can be used to inform and influence decision making.

A methodology is presented to facilitate formal discussions between key stakeholders before any deployment is specified, to ensure that scarce resources are not wasted in the pursuit of data as opposed to information. The approach is based around a questionnaire to be completed in partnership between the asset manager, structural engineer and monitoring engineer.

The approach can be used to determine if there is a case for specifying monitoring on a project and assess the potential value of any information that may be obtained. It has been trialled against five historical monitoring case studies.

Finally, West (2016) presents the assessment of the Tame Valley Viaduct. This is a project case study of an assessment of a 620 m-long 21-span steel-composite box girder bridge in the West Midlands highway network, UK, dating from 1969. Key objectives aims of the assessment were to exploit opportunities to improve the assessed capacity of the viaduct, but also to minimise the extent of strengthening required by identifying elements that were adequate.

Studies using non-linear-finite element models were used to demonstrate the adequacy of web stiffeners and longitudinal stiffeners. The approach considered the development of adequate post-buckling capacity to be used with the Eurocodes effective-area approach to calculating the resistance of plated structures. The desire to optimise the strengthening works led to the creation of a structural information model and bespoke software tool to automate the assessment process rather than conservatively selecting critical panels.

This paper concludes with an indication of the value of bridge assessment work: it shows how an investment at assessment stage can leverage major savings in construction, by significantly reducing the quantity of strengthening required. The earlier papers show some of the more advanced techniques that are being considered in research and testing, and how together these can deliver the required management outcomes for asset owners.

We hope that you find these papers valuable. In order to allow contributions to be available as soon as possible, the journal now publishes papers online ahead-of-print. There are currently 15 papers available to subscribers on the ICE Virtual Library website (<http://www.icevirtuallibrary.com/toc/jbren/0/0>).

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