Cite this article

Cooke R and Collings D (2018)

Editorial.

Proceedings of the Institution of Civil Engineers – Bridge Engineering **171**(3): 141–142,
<https://doi.org/10.1680/jbren.2018.171.3.141>

Editorial

ICE Publishing: All rights reserved

Bridge Engineering

ice publishing

Editorial

1 Richard Cooke BA Hons (Oxon), CEng, MICE, MStructE
Consultant, Richard Cooke Concepts Ltd, Norton Lindsey, UK

2 David Collings BSc, CEng, FICE
Technical Director, Arcadis and Researcher, University of Surrey, UK

Thirty years ago, the publication of *A Survey of 200 Highway Bridges* by Wallbank (1989) marked a milestone in the UK's approach to bridge design and maintenance strategy. The report confirmed the widespread poor performance of many bridges. Six main causes of deterioration were investigated: chloride attack, alkali–silica reaction (ASR), carbonation, frost action, sulfate attack and high-alumina cement. The results showed that the most serious and widespread form of deterioration was corrosion of reinforcement arising from contamination by chlorides from de-icing salts typically penetrating through failed movement joints and affecting abutment and pier supports. Recommendations for improved construction and maintenance were proposed, primarily the use of integral construction, encouraging structural continuity and eliminating the use of movement joints and bearings where appropriate.

In 1995, UK government agencies issued new requirements requiring all designers to adopt these recommendations and this guidance was updated by the Highways Agency (HA, 2001a, 2001b). Guidance for the design of integral bridges was previously given in BA 42/96 (HA, 2003) but this has been withdrawn and is replaced by PD 6694-1 (BSI, 2011).

Elsewhere, other national or state agencies had already recognised the benefits of integral construction. Innovative solutions have developed using a mixture of testing, experience and analytical methods. This was particularly evident in North America, and further research was undertaken by Nicholson *et al.* (1997). This study confirmed that many different methods of designing and constructing integral bridges were being adopted and feedback on performance was collected.

This themed issue invited topics covering methods of integral bridge construction, use of innovative materials, research into soil–structure interaction, application beyond design standards, forms of semi-integral construction, feedback on the in-service performance of integral bridges, innovation leading to improvements in performance and novel choice of construction

methods to satisfy design criteria. The papers featured in this issue of *Bridge Engineering* illustrate many of these topics with descriptions of current practice in the UK, South Africa and New Zealand demonstrating international experience.

The paper by Al-Ani *et al.* (2018) discusses the key issues for consideration in the design of integral bridges in non-seismic and seismic regions adopted in New Zealand, based on recent research and application. Integral bridges are suitable for use in seismic regions but with increased significance of the effects of soil–structure interaction. The paper concludes with a case study describing the performance of a bridge subjected to earthquake actions.

Banks and Bloodworth (2018) describe recent research into the progressive increase in earth pressures behind abutments arising from cyclic thermal movements. Their research helps to justify whether current practice using computational techniques represent actual behaviour and whether current UK design recommendations are accurate or conservative.

Measurement of the in-service behaviour of a new 90 m long integral bridge in South Africa is described by Skorpen *et al.* (2018). The observed behaviour to date – before the bridge deck was surfaced – indicates that it is operating within the scope of design standard recommendations, but monitoring is continuing to confirm longer-term effects due to temperature and shrinkage. This is necessary as earth pressures and forces are expected to progressively increase behind the abutments over a number of annual cycles.

Caristo *et al.* (2018) have used numerical modelling to investigate the progressive change in earth pressure under a large number of thermal cycles for two model abutment conditions. Practical application of this approach is then illustrated with a description of the design of the new 133 m long Pont Brewit Viaduct in north Wales. This bridge is also outlined in a recent *Bridge Engineering* issue by Barnes and Gill (2018).

The four following papers each describe the design and construction of new bridges with various site or construction constraints leading to different structural solutions. They demonstrate that practical and effective layouts can be implemented that take into account the predicted movements, pressures and forces inherent in integral behaviour.

Ashworth *et al.* (2018) describe the requirements of a 220 m long railway viaduct with semi-integral abutments, which show that longer bridges that notably exceed the typical length covered by design recommendations can also be considered.

An innovative method of using a redundant arch as temporary support for a new integral bridge is described by Mitchell *et al.* (2018). This approach minimised disruption to the existing transport routes and the utility services carried by the bridge.

Stroscio *et al.* (2018) present the alternative solution for a new flat-arch integral bridge built over the River Nene in the UK. The end result is an elegant span that optimises the benefits of integral performance with complex site and geotechnical conditions.

Finally, Sandberg *et al.* (2018) describe the various abutment layouts adopted for the new bridges that form part of the A14 improvement scheme. In developing these schemes, recommendations have been made to improve the current design standards adopted in the UK. This demonstrates the need for continuous improvement and better understanding of how designers can approach the analysis of integral bridges.

We hope you enjoy reading these informative papers and would encourage readers to submit discussion pieces to the Journal Editor describing their own experiences.

REFERENCES

- Al-Ani M, Murashev A, Palermo A *et al.* (2018) Criteria and guidance for the design of integral bridges. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 143–154, <https://doi.org/10.1680/jbren.17.00014>.
- Ashworth T and Young C (2018) Design and construction of Loughor railway viaduct with semi-integral abutments. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 191–200, <https://doi.org/10.1680/jbren.17.00012>.
- Barnes JN and Gill JC (2018) The design and construction of the Pont Brewit Viaduct, UK. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(2): 80–90, <https://doi.org/10.1680/jbren.16.00034>.
- Banks JR and Bloodworth AG (2018) Lateral stress profiles on integral bridge abutments. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 155–168, <https://doi.org/10.1680/jbren.17.00017>.
- BSI (2011) PD 6694-1:2011: Recommendations for the design of structures subject to traffic loading to BS EN 1997-1:2004. BSI, London, UK.
- Caristo A, Barnes J and Mitoulis SA (2018) Numerical modelling of integral abutment bridges under seasonal thermal cycles. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 179–190, <https://doi.org/10.1680/jbren.17.00025>.
- HA (Highways Agency) (2001a) BA 57/01: Design for durability. In *Design Manual for Roads and Bridges, Volume 1 – Highway Structures: Approval Procedures and General Design, Section 3, Part 8*. HA, Guildford, UK.
- HA (2001b) BD 57/01: Design for durability. In *Design Manual for Roads and Bridges, Volume 1 – Highway Structures: Approval Procedures and General Design, Section 3, Part 7*. HA, Guildford, UK.
- HA (2003) BA 42/96: Design of integral bridges. In *Design Manual for Roads and Bridges, Volume 1 – Highway Structures: Approval Procedures and General Design, Section 3, Part 12*. HA, Guildford, UK.
- Mitchell A and Warrior D (2018) Farm Road, UK: a new ‘top-down’ integral bridge using an existing arch as falsework. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 201–209, <https://doi.org/10.1680/jbren.17.00013>.
- Nicholson BA, Barr JM, Cooke RS *et al.* (1997) *Integral Bridges – Report of a Study Tour to North America. Technical Guide No. 1*. Concrete Bridge Development Group, Camberley, UK.
- Sandberg J, Argyle T, Petty R, Nowak P and Patel B (2018) The design of integral bridges with bankseat, half-height and full-height abutments on the A14, UK. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 222–234, <https://doi.org/10.1680/jbren.17.00018>.
- Skorpen SA, Kearsley EP and Kruger EJ (2018) Measured temperature and shrinkage effects on a 90 m long integral bridge in South Africa. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 169–178, <https://doi.org/10.1680/jbren.17.00019>.
- Stroscio R, Lake N, Toms C and Pettifer S (2018) An integral flat arch bridge. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **171**(3): 210–221, <https://doi.org/10.1680/jbren.17.00033>.
- Wallbank EJ (1989) *The Performance of Concrete in Bridges: A Survey of 200 Highway Bridges*. Her Majesty's Stationery Office, London, UK.