

## **BRIDGE OWNERS FORUM**

### **MINUTES OF MEETING BOF 54: TUESDAY 31 OCTOBER 2017 AT THE BEVES ROOM, KING'S COLLEGE, CAMBRIDGE**

#### **PRESENT:**

Graham Cole	ADEPT
Rob Dean	Network Rail
Andy Featherby	Canal and River Trust
Richard Fish	Technical Secretary
Jim Hall	CSS Wales
Keith Harwood	ADEPT
Jason Hibbert	Welsh Government
Wayne Hindshaw	Transport Scotland
David List	Big Bridge Group
Neil Loudon	Highways England
John McRobert	Department for Infrastructure - Northern Ireland
Campbell Middleton	Cambridge University Engineering Department (Chairman)
Paul Thomas	Railway Paths Ltd.
Paul Fidler	CUED

#### **Guests** (attending for items 1a) & 2 only):

Kasun Kariyawasam	CUED
Prakash Kripakaran	Exeter University
Jenny Roberts	Gaist Ltd
Steve Roffe*	Network Rail
John Smith	North Yorkshire County Council

\*Attended full meeting

#### **1. a) Welcome, Introductions and Apologies**

The Chairman was warmly welcomed back to BOF having missed a number of meetings due to ill health. He in turn welcomed all to BOF 54 and especially guest presenters who were attending for the morning session dedicated to scour issues. Apologies etc. were deferred until after lunch.

## **2. Scour Issues:**

### **a. Introduction to Presentations**

The Chairman explained the format of the morning: each presentation was limited to no more than 15 minutes and all questions and discussion to take place once all had been delivered. The following accounts are intended only to give a flavour of each presentation with the actual PowerPoints to be uploaded to the BOF website as Action 1 below.

### **b. Highways England and BD97**

Neil Loudon gave an overview of developments since the 2009 Cumbria flood events which had been the trigger for the revision of BA74 to BD97. He noted that the Transport Select Committee had taken evidence and prepared a report but this had never been published due to the 2010 General Election and the change of Government.

Neil also noted more recent flood events and collapses such as in 2016 when Tadcaster, Pooley and Tenbury Wells bridges had collapsed due to scour. He went on to describe various initiatives including the Pitt Review, the updating of the CIRIA report (C551 to C742) and an ongoing review of BA59/94 (The Design of Bridges for Hydraulic Actions). Although Highways England's bridge stock was relatively modern, HE had about 1,100 bridges which were considered to be scour susceptible. In terms of the network, however, some 10% was considered to be vulnerable to flooding with about 1,800 reported incidents per year, all with consequential societal as well as economic impacts.

Other aspects of Neil's presentation included work on fast tracking temporary bridge installation and the link to the Meteorological Office on operational matters as part of the severe weather contingency plan.

### **c. Network Rail Experience**

Steve Roffe presented on the failure of Lamington Viaduct due to scour in January 2016 as a result of Storm Frank. This had led to a national review of Network Rail's bridge scour status and the need for investment. Steve noted that the consequential economic impact of Lamington had been calculated as about £40m. If a similar figure was available for remediation works, it was calculated that all 9,000 at risk bridges could be brought up to an acceptable risk level.

Steve also referred to other scour collapses at Glanrhyd and the River Crane, the latter having been attributed to debris effects. He also noted that RAIB had reported a scour failure rate of one every 2.5 years.

Risk ranking of sites was Network Rail's methodology for prioritising works and the 300 highest risk sites had now been remediated. The risk assessment was

based on document EX2502 which had originated from HR Wallingford. The higher risk (>16) bridges were subject to a more rigorous assessment with 1 or 2-D modelling, usually outsourced, typically to JBA Consulting.

In terms of monitoring, Network Rail commonly use water level closure marks, i.e. the water level which should trigger a bridge closure, but recognise the subjectivity of this method. And, whilst this might inform the decision to shut the bridge, how could one be sure it could be reopened? A dilemma for Network Rail was the balance of cost of technological innovations, and their reliability, against remediation works which could be proved to be effective.

#### **d. Local Authority Perspective**

John Smith of North Yorkshire County Council presented on the flood event that led to the partial collapse of Tadcaster Bridge on Boxing Day 2015. John's presentation also covered the bridge reconstruction at a cost of about £3.9m reopening in February 2017. Apart from a limited bridge widening, DfT fully funded the rebuild which included new piled foundations and underpinning of the remaining arch elements.

JBA Consulting had also modelled hydraulic conditions the led to the failure at Tadcaster and concluded that the scour impact had been exacerbated the river works *downstream* of the bridge.

John went on to describe how NYCC monitored high risk scour sites using divers. He also described a number of other collapses, often delayed, such as at Hawaby in 2005.

#### **e. Debris Effects on Scour (Exeter University EPSRC Project)**

Exeter University's Prakash Kripakaran gave a progress report on this project to better understand the science between fluid and debris interaction and to produce a procedure for evaluating risk alongside the CIRIA report C742, probably proposing a multiplier to risk rankings to deal with the effects of debris. Prakash emphasised that the project was looking at the effects of debris build-up, not impact loading. As well as flume testing, modelling using CFD had also been employed to calibrate the laboratory results.

Early outputs indicated that floating debris, and the level relative to the structure, was the major concern as scour was exacerbated by flows *under* the debris. It was also clear that lower velocities could be considerably worse for scour than high flows.

## **f. Cambridge University Research**

Kasun Kariyawasam presented on his PhD project (funded by the Gates Foundation) which was reviewing recent scour failures (some 500 in the USA) and current methods of monitoring scour. The latter could be split into four categories:

- Devices above water
- Devices in water
- Devices in the river bed
- Devices on the structure

The last of these appeared to have the greatest potential in that it had been shown that scour reduces the global bridge stiffness and hence a consequential reduction in natural frequency. This had also been checked with an FE model and other checks had identified other changes in natural frequency caused by various forms of damage or defect. Kasun noted that bridges in Japan had been monitored by vibration sensors recording changes in frequency for the last 20 years. His next step will be to undertake field trials and he was looking for a suitable bridge site. John Smith invited Kasun to come to North Yorkshire to see if any of his bridges might be suitable.

## **g. BridgeCat Project**

Jenny Roberts of Gaist Solutions Ltd. described this project that had been commissioned by Cumbria County Council with DfT funding following the 2015 floods. The project had started in June of 2017 and trials were about to start using the mobile scour detection equipment on six bridges over a period of six weeks. Trials will be validated by using divers. Following trials, there will be a 12 month deployment plan when the BridgeCat will be on standby for flood events.

The equipment has a sonar device as well as cameras mounted on a Unimog vehicle fitted with a telescopic Hiab crane with a 14.8m reach. Two alternative sonar technologies had been trialled as part of the project development. Although the presentation had shown the vehicle actually on the bridge during monitoring, Jenny pointed out that it could also be sited on a river bank with a reach of over 10 metres.

## **h. Northern Ireland - August 2017**

John McRobert gave a short additional presentation on the impact of an extreme flood event in Northern Ireland in August 2017 in which a considerable amount of top soil and debris, estimated to be some one million tonnes, had been washed off the mountain side into the valleys and caused watercourses to realign as well as significant scour damage to bridges.

## **i. Discussion**

The Chairman thanked all of the morning's presenters and, subject to their confirmation, it was agreed that the presentations could be uploaded to the BOF website.

ACTION 1: Paul Fidler

He then asked if there were any areas of ongoing research that had not been covered: Richard Fish referred to work at Southampton University by Professor Dave Richards; Wayne Hindshaw noted that Hazel McDonald of Transport Scotland was working with Strathclyde University. Rob Dean and Steve Roffe reported on a project using a remotely controlled boat with a sonar device and a Network Rail Technology Landscape Report which he agreed to issue.

ACTION 2: Rob Dean/Steve Roffe

Neil Loudon suggested that issues around the transient nature of scour and the need for mitigation measures should also be addressed.

Although the Chairman then invited questions on each presentation in turn, the discussion tended to flow between topics:

Rob Dean suggested that improved prediction techniques were needed, possibly linked to satellite technology and meteorological office forecasting. For Network Rail, this also included talking to the local angling community who generally had a sound understanding of their particular rivers. Rob also noted simple measures such as signs on a bridge advising who to call if water levels became dangerously high. Commenting on John McRobert's presentation, Wayne Hindshaw drew attention to a publication to be found on Transport Scotland's website on estimating the risk of ground wash out.

Neil Loudon pointed out the need to link operational planning with risk and resilience plans and the Chairman agreed that the bigger picture needed to be considered, addressing the whole catchment area and recognising that it was unrealistic to try to control floods in extreme circumstances. He also made the point that sensors should be fully automated to reduce risks to bridge inspectors and managers.

Discussion also covered options such as upstream booms across rivers to prevent debris build up against a bridge. Andy Featherby noted that C&RT have deployed these at some sites although Paul Thomas pointed out that debris on a boom or baffle would have to be cleared otherwise upstream flooding was likely. It was noted that the problem of debris was often exacerbated by works to watercourses upstream undertaken by the Environment Agency or by riparian landowners. Rob Dean suggested that this should be part of the overall bridge management strategy

at high risk sites which might also identify other changes in the catchment area. Neil Loudon pointed out that Inspectors were already required to look at bridge surroundings as part of both the Bridge Inspection Manual and BICS.

Jim Hall raised the question of availability of temporary bridges in cases where severe damage had taken place. Neil Loudon referred to Highways England's initiative which he had covered in previous meetings. The HE database suggestion was now with DfT.

Paul Thomas noted that not all scour events were major floods and it was often after the event that a problem was identified. Prakash Kripakaran suggested that scour risk maps would be useful. Steve Roffe referred to a flood warning database held by the Environment Agency. The Chairman agreed to consider inviting a representative from the EA to a future BOF meeting.

ACTION 3: Chairman
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John McRobert turned to the problem of detecting scour during a flood when the discolouration of the water made inspection with divers or remote cameras very difficult. Discussion extended into post event scour detection: Andy Featherby and Wayne Hindshaw respectively noted that C&RT and Transport Scotland used sonar devices but these were also backed up by diving inspections. The former referred to a presentation that C&RT had had from a company called Abyss which had demonstrated very clear imagery. Rob Dean suggested that it was important to distinguish between sites with a long term susceptibility and those that were subject to a flash flood event which could occur almost anywhere.

Steve Roffe returned to the question raised by Paul Thomas and suggested that it was the interpretation of scour investigation surveys that required a greater degree of engineering judgement, irrespective of how the survey data was obtained. Rob Dean counselled against jumping to immediate conclusions and implementing solutions which could simply transfer the problem elsewhere on the same bridge or to a nearby structure.

Based on John Smith's experiences in North Yorkshire, Graham Cole asked about the criteria against which a decision to close a bridge was taken. John replied that this was by degree, initially banning vehicles when water levels were perhaps above the springing then moving to prohibit pedestrians. This would vary bridge by bridge but the key was to have an intimate knowledge of both the structure and the river, and to continuously monitor the emerging situation.

Returning to the BridgeCat project, Paul Thomas asked how it fitted with other inspections regimes within Cumbria. Jenny Roberts explained that this would be part of the Cumbria trial and there would be a clear link to other operational strategies. Part of the Gaist commission was to share the learning experience during and after the trial period.

## **j. Summary and Conclusions**

The Chairman again thanked both presenters and BOF members for an interesting discussion and suggested that links to the Environment Agency and their understanding of river hydrology and morphology should be strengthened, possibly with future EPSRC funded research into the benefits gained by satellite technology or even UAVs.

Discussion between all parties continued over lunch before the meeting resumed to cover the rest of the agenda:

### **1. b) Introductions and Apologies (Continued)**

Richard Fish reported that the following had given apologies:

Nick Burgess	LUL
Huw Davies	SUSTRANS
Liam Duffy	Transport Infrastructure Ireland
Tomas Garcia	HS2
Nicola Head	TfL
Nigel Threadgold	LoBEG

Richard noted that Nigel Threadgold of the London Borough of Bexley was now representing LoBEG in place of Paul Monaghan but had been unable to attend this meeting.

The Chairman introduced Jim Hall who was now the BOF representative from CSS Wales, succeeding Jacqueline Mynot who had moved to a new job with Rhonda Cynon Taf County Borough Council. Jim was invited to give a brief overview of his career to date: he described how he had started with Ward Ashcroft and Partners before moving to British Waterways Board and then to Denbighshire County Council. He is the current chair of the CSS Wales Bridges Group.

The Chairman also noted that this meeting was to be the last for John McRobert who was due to take “early” retirement at the end of the year. He thanked John for his contributions to BOF over the last few years.

### **3. BOF 53 Minutes:**

#### **a. Accuracy**

The minutes of the last meeting were accepted as a true and accurate record and could be uploaded to the BOF website.

ACTION 4: Paul Fidler

## **b. Matters Arising**

### **Action 2: BOF Promotion - Liaison with Hemming Group**

Richard Fish reported that he remained in contact with Adrian Tatum, albeit infrequently.

### **Action 4: BOF and Social Media**

It was agreed that Richard Fish should set up a BOF LinkedIn Group and a BOF Twitter account.

ACTION 5: Richard Fish

### **Action 10: CIRIA Research Programme**

Richard Fish noted that Kieran Tully of CIRIA had been invited to attend BOF 54 and participate in the scour session but he had declined to do so.

Discussion extended to the CIRIA charging policy for research reports, especially when the projects (such as the Hidden Defects work) had largely been funded by public bodies as a result of BOF pledges and commitments. Rob Dean agreed to challenge CIRIA on this issue.

ACTION 6: Rob Dean

### **Action 11: Proposed Network Rail Guidance on Bridge Examination and Monitoring**

Rob dean agreed that this could now be issued for circulation.

ACTION 7: Rob Dean/Richard Fish/Paul Fidler

### **Actions 12: Masonry Arch Assessment Guidance Steering Group**

Graham Cole repeated his call for volunteers to join a group to help develop the emerging arch bridge assessment guidance which Matthew Gilbert had presented at BOF 51 in January. Andy Featherby agreed to join and any other nominations, either from BOF members or from their organisations, should be sent to Richard Fish.

ACTION 8: All

Graham also noted a EPSRC project proposal which was to consider 3-D arch effects and agreed to forward details.

ACTION 9: Graham Cole

### **Action 13: Possible future BOF on Arch Bridge Behaviour**

It was agreed that this should be planned for BOF 56 in May 2018. Names of possible invited guest presenters should be sent to Richard Fish.

ACTION 10: All

Discussion extended from the preceding arch bridge topics into asset management databases and, in particular, bridge management systems that were commercially available. Wayne Hindshaw reported that the combined Queensferry Crossing and Forth Road Bridge had a new system based on managing critical elements and offered to present on this at a future meeting. Similarly, Rob Dean suggested that he could also present on Network Rail's system. It was agreed that these might be scheduled for BOF 55.

ACTION 11: Wayne Hindshaw/Rob Dean/Richard Fish

**Action 14: BOF and SCOSS**

Richard Fish will invite Alastair Soane to BOF 55.

ACTION 12: Richard Fish

#### 4. Grand Challenges

Richard Fish reported that progress on Grand Challenges Themes, as allocated to individual BOF members, was patchy. Whilst some had been completed in whole or in part, he had had no feedback whatsoever on others. Rather than name and shame, it was agreed that all should either issue Richard with their work to date or at least give a status report.

ACTION 13: All

After discussion, it was agreed that the best way forward would be to commission an external resource to complete the Grand Challenges work. Rob Dean said that Network Rail would be able to contribute up to £10k and others agreed to see if additional funding could be pledged. It was agreed that Richard Fish should be advised of any possible contribution.

ACTION 14: All

It was also agreed that, if this plan was to work, an accountable body would be needed. Richard Fish was asked to investigate this, initially approaching TfL.

ACTION 15: Richard Fish

Jason Hibbert reported that he was a member of steering group on an EPSRC Cardiff University project called Materials for Life (M4L) and asked if he could also be considered as representing BOF on the group, especially as there were links to Grand Challenges. The Chairman agreed and welcomed this type of involvement by anyone as it helped to keep BOF in touch with all bridge related research initiatives.

Wayne Hindshaw noted that research being undertaken by the Scottish Road Research Board might also be of interest and questioned how any party could be made aware of parallel research programmes.

Neil Loudon reported that Highways England were funding work at CUED on half joints which he considered as tactical research. He suggested that higher level research on a more strategic basis might be funded by the Transport Systems Catapult and this might be appropriate for Grand Challenges.

## 5. Future of Bridge Inspections

Neil Loudon gave a presentation on what bridge inspections might look like in the future. He centred his ideas around People, Product and Process:

- **People:** Neil referred to BICS and what might flow from that, including a possible “academy” for bridge inspectors. Rob Dean noted that Network Rail were also considering a civil engineering academy. Neil’s desire was to see safer inspections but with less traffic management and access equipment.
- **Product:** Neil recognised that the quality of inspection reports remained an issue and that audits would need to continue. That said, a move towards digital technology should be seen as an opportunity.
- **Process:** Neil suggested a move to smart interfaces with databases, including scanning of instrumentation and a move to risk based inspections. The current process remains merely a snap-shot but in the future it was essential to inspect against trends and deterioration rates.

In short, Neil suggested that all aspects needed to change: mindset, standards, databases and new technology to embrace areas such as LIDAR, digital models, BIM, capturing and storing data.

The chairman invited discussion. Keith Harwood stressed that establishing the rate of change of deterioration was essential. Rob Dean recognised that complacency could lead to disaster, citing an example of a long-standing defect being reported year on year before a catastrophic collapse. Rob also suggested that it was a common mistake to assume the bridge condition reflected both capacity and capability; it was this level of understanding which was the bigger issue and therefore questioned the value of inspections. This was particularly the case with retaining walls where inspection tended to be superficial. Graham Cole suggested that inspections were only one tool in the bridge management portfolio.

Discussion extended into the need for combining inspections and assessments with the Chairman recalling many poorly reported assessments during the early stages of the assessment and strengthening programme. John McRobert referred to the importance of knowing the exact arch ring thickness and depth of fill which could not be established simply by visual inspection. It was agreed that underlying the whole process of bridge management was the need to acquire knowledge of, as well as confidence in, a structure.

Returning to the value of General Inspections or Visual Examinations, it was agreed that these should remain part of the overall methodology as they both generate immediate reactive maintenance interventions and/or trigger the need for further investigation.

Finally, Rob Dean suggested that an exercise of comparative benchmarking between inspectors in any organisation would be beneficial.

## **6. Feedback from UKBB – 12<sup>th</sup> October 2017**

Richard Fish reported that this meeting was the first for the new Chairman, Liz Kirkham of Gloucestershire County Council (also chair of the ADEPT Bridge Committee), who had succeeded Dana Skelley. Rob Dean was the UKBB vice-chairman. It was agreed that Liz should be invited to attend a future BOF meeting, possibly BOF 55.

ACTION 16: Richard Fish
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Rather than go through details of the UKBB meeting, Richard Fish agreed to issue a short note, as well as the minutes when they were made available.

ACTION 17: Richard Fish
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## **7. Additional Feedback from ADEPT Bridges Committee**

Graham Cole referred to discussions at the last ADEPT meeting on the Bridge Inspector Certification Scheme (BICS) where it had been announced that SCOTS were considering introducing a somewhat diluted version. Wayne Hindshaw noted that this was mainly due to the fact that bridge inspectors' job descriptions and terms and conditions would need to be amended once they were certified.

Neil Loudon reported that Highways England had had to extend the deadline of requiring all organisations to have at least a lead inspector certified from November 2017 to June 2018. He also reported that there were over 400 inspectors who had registered with LANTRA and were progressing towards certification.

Wayne Hindshaw stated that Transport Scotland remained fully committed to the scheme and suggested that it was up to employing organisations to insist on using certified inspectors. Paul Thomas reported that Railway Paths will adopt BICS although recognised that were similar industrial relations issues, as had concerned SCOTS, which would need to be overcome. Rob Dean described how Network Rail has three tiers of examiners and, although fully committed, he reflected that the adoption of the scheme would be slower than he would have liked.

Although the discussion and outcomes on the financial implications have not been recorded here in detail, it was recognised that the slower than expected scheme uptake was having an impact on LANTRA's business model. It was agreed that

all BOF member organisations should consider options to help underwrite costs before BICS was fully sustainable.

ACTION 18: All

## 8. Research Updates

### a. Highways England

Neil Loudon reported as follows:

- i. WSP's Safety Critical Fixings work was drawing to a close with the last Steering Group meeting taking place in November. CIRIA will publish the findings, in parallel with a similar piece of work they have been doing on facilities fixings (as in buildings).
- ii. The State of Bridge Infrastructure project, as mentioned in previous BOF meetings had reached the point where Neil would be able to present it and this would be at BOF 55.

ACTION 19: Neil Loudon

- iii. The DMRB review was underway with about 100 standards to be re-written over the next two years.

### b. Network Rail

Rob Dean noted the following:

- i. A project was underway to measure bridge clearances from a moving vehicle, taking into account vertical alignments, and welcomed any input from other organisations.
- ii. CH2M were working on developing BIM models of existing bridges.
- iii. Network Rail were working on the concept of bridge "evaluation" as a new part of the bridge management process and agreed to present on this at a future meeting.

ACTION 20: Rob Dean

- iv. CIRIA were to publish guidance on the design and maintenance of FRP bridges in the new year.
- v. WSP were working on specific guidance for the assessment of lattice girder footbridges.
- vi. The proposed east-west rail link across the Pennines should provide opportunities for innovation.

- vii. Rob agreed to issue an update on European Railway Research Initiatives.

ACTION 21: Rob Dean

- viii. Network Rail were working with a Virtual Reality company (Hollow Viz) on a number of initiatives, including a 3-D prototype of a bridge derived from digital cameras and a fatigue simulator for train drivers. The former could be used to assist with Visual Examinations. Wayne Hindshaw reported that the same company had developed a virtual model of a 100m length of the Forth Road Bridge. It was suggested that this topic might make a good presentation at next year's Annual Bridges Conference at Coventry.
- ix. Lastly, Rob reported on the development of audio hammers, providing a similar audible response to conventional hammer testing.

## 9. Major Projects Updates

Not taken.

## 10. Any Other Business

### a. Parapets and Self-Harming

David List described the outcome of an inquest into a suicide on the Tamar Bridge at which the coroner had given a recommendation that parapet heights should be increased to 2.3m. Wayne Hindshaw noted that he had dealt with similar issues and had undertaken research into the impact of trans-location of suicides from major crossings to more local overbridges with a significant increase in disruption and the effects on the travelling public. Rob Dean added that Network Rail had also been faced with similar issues. It was agreed that this subject should be considered as an agenda item at a future BOF meeting.

ACTION 22: Richard Fish

### b. Asbestos

David List also reported on an unexpected discovery of asbestos during a routine programme of cable clamp bolt replacement on the Tamar Bridge and the consequential cost implications. Neil Loudon noted that asbestos was also to be found in some older waterproofing systems.

### **c. John McRobert**

The Chairman again thanked John for his contributions to BOF over the years and wished him well in his retirement; sentiments echoed by the meeting. John wished BOF continued success in the future and noted that a new representative from Northern Ireland would be confirmed in due course.

ACTION 23: John McRobert
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## **11. Next Meetings**

BOF 55 will be held on 16<sup>th</sup> January 2018 and BOF 56 on 15<sup>th</sup> May 2018, both at Kings College, Cambridge.

## **12. Close**

The Chairman thanked everyone for attending and closed the meeting.

Richard Fish,  
BOF Technical Secretary,  
30th November 2017