BRIDGE OWNERS FORUM
MINUTES OF BOF 71: TUESDAY 22 NOVEMBER 2022
via MS TEAMS and in THE BEVES ROOM,
KINGS COLLEGE.CAMBRIDGE

PRESENT:

In person:

Tim Arianpour	TfL (LUL)
Malcolm Cattermole	Forestry England
Graham Cole	HRIG
Andy Featherby	C&RT
Paul Fidler	CUED
Richard Fish	Technical Secretary
Colin Hall	Network Rail
Keith Harwood	ADEPT
Nicola Head	TfL
Jason Hibbert	Welsh Government
Trish Johnson	Big Bridge Group
Neil Loudon	National Highways
Osian Richards	CSS Wales
Paul Thomas	Railway Paths Ltd.
Sue Threader	Rochester Bridge Trust

Guests:

Sarah Fray	CIRIA
Pedram Heshmat	TfL
Ioannis Mavvidis	DfT
Eloy Tabares	EWR

Virtual:

Hugh Brooman	LoBEG
Henry Dempsey	SCOTS
Liam Duffy	Transport Infrastructure Ireland
Tomas Garcia (Part)	HS2
Hazel McDonald	Transport Scotland
Martyn Thomas	SSE

Guests:

Brian Jenkins (Part)	Transport for Wales
Angie Nagle (Part)	Munster Technical University
Kieran Ruane (Part)	Munster Technical University
Hideo Takano (Part)	National Highways
Pierfrancesco Valerio (Part)	National Highways

NB These minutes are recorded in the agenda order and not necessarily in the order in which they were taken in the meeting.

1. Welcome

As with BOF 70, this meeting had also coincided with (yet) another visit to Australia by BOF Chairman, Cam Middleton, as part of his sabbatical year. Following her successful chairing of BOF 70, it had been agreed that Sue Threader would also chair this meeting.

Sue warned that she would not make a habit of chairing BOF meetings and looked forward to Cam's return for BOF 72 next year. She noted an excellent turn-out, both in person and on-line, but warned that the agenda was a busy one and advised that she would asking presenters to keep to time for their items.

2. Introductions and Apologies

In keeping with tradition, new members and guests were invited to give a short introduction.

Tim Arianpour had recently succeeded Nick Burgess (although Nick had not as yet fully retired as he was being retained by TfL as a part-time consultant). Tim was Head of Bridges and Structures for London Underground and had worked for TfL for seven years. Prior to this he had worked for DLR as Infrastructure Manager and had previous experience with consultants (Aecom, Atkins and WSP) both in the UK and in New Zealand. His specific bridge interest was in forensic engineering.

Eloy Tabares is the Head of Engineering on East West Rail (EWR) and was attending as a potential new member of BOF. He is a civil engineer with 20 years' experience, both in his native Spain where he started his career in 1994 joining a concrete panels precast manufacturing company, INDAGSA, as an apprentice in the structural design of buildings. In 1998, Eloy completed his degree, Ingeniero de Caminos, Canales y Puertos, in the Polytechnical University of Madrid. In 2006, he joined Arcadis in the UK, via INECO, before joining HS2 in 2013. He joined EWR in 2018. He has recently expanded his remit to be the Acting Head of Infrastructure Systems at EWR.

Pedram Heshmat works with Nicola Head at TfL in a Technical Assurances role and was attending BOF as a guest. He has 14 years' experience, having previously worked with LUL under the direction of an earlier BOF member, Graham Beasant. He has worked as a bridge designer with experience of Eurocodes. On site, he had overseen the installation of a new bridge at Rickmansworth.

Ioannes Mavvidis works in the DfT Infrastructure and Carbon team and was representing DfT as a result of David Coles (Chief engineer at DfT) attending the IABSE Henderson Colloquium in July (covered under agenda item 3). Part of his role is to see a reduction in carbon across all construction activities, including the

development of business cases and reduction targets, specifically with respect to Whole Life Carbon issues. He was a civil engineer with previous experience in the private sector. It was hoped that he might be a regular attendee at BOF where he would be interested in tracking all carbon related topics.

Sarah Fray confessed that she is *not* a bridge engineer but a Senior Research Manager with CIRIA, whom she joined in July this year. She saw her role as being to re-energise and bring a new focus to CIRIA's civil and ground engineering activities. Sarah's earlier career had been varied with academic posts at UCL and UWE as well as being the Director of Engineering at IStructE.

Richard Fish recorded apologies that had been received from the following:

Kris Campbell	Infrastructure Northern Ireland
Campbell Middleton	CUED (Chairman)

Richard also noted that no word had been received from David McKeown at the Environment Agency since April this year. In a subsequent conversation, Keith Harwood advised that he had recently discussed BOF with an EA engineer and agreed to contact him on this issue.

ACTION 1: Keith Harwood

Post meeting note: Keith emailed Andrew Usborne of the EA on 28th November 2022.

3. Matters Arising from BOF 70 Minutes

The Chair confirmed that the accuracy of the BOF 70 minutes had been approved by email and that they were now on the BOF website.

She then referred to the BOF 70 Action Update sheet that had been issued with the agenda:

Action 5: BCI Review
Nicola Head reported that the feedback from LoBEG on possible changes was still being analysed. Neil Loudon advised that National Highways were also working on BCI changes, mostly in terms of the language in which scores are recorded, to ensure that condition is more accurately presented. Hazel McDonald confirmed that Transport Scotland were assisting in this review but also felt that this all this work should be taken at UKBB. Richard Fish noted that National Highways were working on the revision to the Bridge Inspection Manual which should also be added to the UKBB agenda.

ACTION 2: Hazel McDonald/Richard Fish

Action 11: Technical Approval and Carbon Reduction
Jason Hibbert explained the background to this action which had been led by a secondee, Nick Trump, who had presented at recent BOF meetings on his work on embodied carbon. Neil Loudon confirmed that possible revisions to include carbon

requirements in the Technical Approval process were being considered which might lead to a revision of CG 300. He agreed to report on this at a future meeting.

ACTION 3: Neil Loudon

Actions 14 and 40: Research Update and Links to Academia Proformas

Richard Fish reported that only a relatively few responses had been sent to him to date. Whilst thanking those who had done so, he asked for others to be completed and emailed before Christmas for collation and consideration at BOF 72.

ACTION 4: All/ Richard Fish

Action 16: Report into Eastham Bridge Collapse in May 2016

Keith Harwood reported that Worcestershire CC had yet to produce a report on the collapse. Options were discussed, including another FoI request, but Keith agreed to keep trying through ADEPT channels.

ACTION 5: Keith Harwood

Action 23: IABSE Henderson Colloquium on Carbon and Procurement

This event had taken place in July in Christ's College, Cambridge, and had been led by Ian Firth. BOF members who had attended were Hazel McDonald, Neil Loudon, Tomas Garcia and Richard Fish (as well as Eloy Tabares). Chatham House rules meant that detailed reporting could not be given but Ian Firth was preparing a "Henderson Accord" which would cover outputs from the sessions. In the meantime, Ian had produced a response to the Westminster government's review being led by Chris Skidmore MP[1]. Among other points, this called for the setting up of Green Growth Taskforce, similar to the Covid Taskforce, and had been signed by those Henderson attendees without governmental roles.

Neil Loudon noted that some had promoted a drive to lowest capital carbon with the consequence that design life would be reduced. He (and others) had argued against this as it was more important that structures lasted as long as they possibly could. Tomas Garcia recalled one contributor's organisation as having set up a carbon budget which had led to an increase in "re-use" of structures. Sue Threader agreed, emphasising the need to consider Whole Life Carbon.

Hazel McDonald noted the push to use cement replacements, such as ggbfs, which was seen as a carbon reduction option. She considered this to be disingenuous as nowhere near enough material could now be sourced in the UK and stocks had to be imported from overseas, particularly China, at the expense of more carbon than could be saved.

Action 30: Grand Challenge Zero

Richard Fish explained that the new grand Challenge relating to all things carbon would be developed as part of a workshop on day 2 of next year's bridge conference, which he had agreed to lead.

ACTION 6: Richard Fish

[1] Chris Skidmore launches net zero review - GOV.UK (www.gov.uk)

It was also noted that the Grand challenges should be a key part of the new BOF website.

ACTION 7: Richard Fish/Sue Threader/Paul Fidler/Keith Harwood

Actions 38 and 39: GRP Replacement for Timber Decks and UAV Presentations.

Although these actions were recorded as having been completed, Paul Fidler pointed out that he had been unable to upload these presentations as the files were too big. He agreed to resolve this issue; if necessary, waiting for the new website to come online.

ACTION 8: Paul Fidler

4. Linking Data Management to Operational Management.

This item had had its genesis in past BOF discussions on bridge management systems and Colin Hall had volunteered at BOF 70 to explain the journey that Network Rail had been on to move away from a traditional bridge management system to one which was forward looking rather than simply storing records. Colin agreed that his presentation could be uploaded to the BOF website.

ACTION 9: Paul Fidler

Colin began by giving details of Network Rail's asset stock: there were almost 30,000 bridges which translated into over 55,000 spans, mostly masonry arches. Other assets included over 20,000 culverts and almost 20,000 retaining walls.

The need for improved management systems had initially been triggered by the Stewarton bridge collapse in 2009.[2] A tripartite review in 2010 – Network Rail, ORR and Arup – identified poor data collection and data management which led to decisions being made without a full appreciation of condition. It was recognised that, although some 20 activities were systemised, there was very little interaction between systems. By 2018, there were 21 separate systems and by 2022 the number was 23. In numerical terms, 70,000 assets resulted in 100,000 deliverables, such as examination reports, every year which were being managed by just 250 people. This translated to each individual having to appraise about 400 detailed reports every year, meaning that identifying problems, such as at Stewarton, was like finding the proverbial needle in the haystack.

The tripartite review had recommended the adoption of CSAMS which was an attempt to amalgamate the various systems. It was now recognised, however, that this had been a flawed approach. Although it had worked reasonably well elsewhere in Network Rail, it had proved to be unsuitable for structures assets because there was simply too much data in this sector which had meant that IT suppliers were struggling to deliver systems to cope with that volume.

[2] Derailment of a freight train near Stewarton - GOV.UK (www.gov.uk)

The latest initiative focuses on having enough, accurate data with the emphasis on quality not quantity. Of equal importance is understanding ownership of data with an implicit cultural change which meant that some parts of the organisation had to let go of data when it was needed by others.

Colin explained the procurement process which had seen three competitors reduced to one as the other was unable to meet the Network Rail specification. The successful company was Salesforce[3] and their approach to the needle in the haystack issue was effectively to make the haystack smaller. The new system is NEST (Network Enterprise Structures and Tunnels) which relies on a central core with other workstreams (Inventory Management, Assessment, Scour, Examinations, Evaluation and Intervention) as bolt-ons. If one of these needs attention, it can be unbolted, fixed and reattached. The new system will also have to accommodate emerging technologies such as laser scans and, in a move away from miles and chains, will include bridge polygons to accurately determine limits of structures.

Colin concluded by adding that the system was intended to be accessible to other parties, such as outsourced examination teams and local authorities, and it was hoped that an open exchange of ideas would be encouraged.

The Chair thanked Colin for his presentation and invited questions.

Paul Thomas asked about deadlines and timescales. Colin replied that the core was to be in place by June 2023, the assessment module by January 2024 and that for examinations by Autumn 2024. He pointed out, however, that future funding was, as yet, not guaranteed.

Neil Loudon endorsed the approach being taken by Network Rail. National Highways had an integrated asset management system but, in Neil's view, it was not integrated in terms of the interface with other assets nor directly about structure asset management and acted as an inventory and repository for structure information. Data was then used by other tools to assist asset management decisions. He reprised the concept mentioned at previous meetings: the need for DIKW (Data, Information, Knowledge, Wisdom). Colin gave an example of poor integration on the railway in which the permanent way teams had raised ballast which had pushed the parapets off structures. This reflected the lack of a common system where all assets, and the links between them, had to be understood by all parties.

Eloy Tabares asked how a new system could fit with existing asset management standards and the ways in which structure information had previously been recorded. Colin replied that the standards had had to be re-written as part of this process.

Keith Harwood asked if this system would be commercially available to other asset owners, and it was agreed that this would be a commercial decision for Salesforce in

[3] Salesforce UK: We Bring Companies and Customers Together

due course. Keith saw the USP as being the 3-D identification of structures. Colin added that current R&D was working on auto defect recognition, including from on-board train cameras. He further noted that the system had excellent flexibility and adaptability, with additional suggestions coming forward for its future development.

Liam Duffy questioned the current industry position on mobile data capture (MDC): he recalled that Colin had suggested that there was an over-reliance on this and yet it was also being proclaimed as the way forward. Colin replied that MDC had its place but there had lately been evidence that it was becoming the "tail wagging the dog". He suggested that it was more important for inspection outputs to fit the needs of an asset management system, irrespective of how they are obtained. Colin confirmed, however, that the use of MDC for inspections would be fully compatible with NEST, once the core function had been completed.

Ioannes Mavvidis noted the trend towards data informing all asset management decisions but warned of the dangers of inconsistent acquisition of data. He asked if NEST could be used to check consistency and also whether carbon data might be added. Colin confirmed that a future carbon capture package is feasible.

5. Management of Structures with Critical Elements

Neil Loudon gave a brief introduction to this item by noting that, although most of National Highways' 24,000 structures were relatively simple, there was a sizeable number which had to be considered as "special" from a management point of view.

Neil then introduced his colleague, Pierfrancesco (Pier) Valerio, to present on how such structures are managed. Before his presentation, Pier covered his early career with his first degree having been in his native Italy before completing his PhD at Bath University. He now works for National Highways in the south and east regions. Neil confirmed that the presentation could be uploaded to the BOF website, but only in the members' area.

ACTION 10: Paul Fidler

Pier described those "special" structures as having a combination of hidden features and low redundancy. They included the following:

Form	Number	DMRB Standard
Post-tensioned bridges	1,200	CS 465
Half-joints	420	CS 466
Hinges	95	CS 467
Scour susceptible	2,800	CS 469 (expected to be published soon)
Fatigue susceptible	800	
Cable-stayed bridges	Approx. 30	

Pier also noted some other issues that applied more generally to the stock, such as:

Supports at risk from impact	CS 453
Sub-standard headroom	CHE Memo 417
Concrete deterioration	CS 462
Safety critical fixings	Presently being drafted
Sub-standard bridges	CS 470

To emphasise the importance of this work, Pier referred to recent major bridge collapses in Italy, Spain, Taiwan and the USA, including a video clip of the 2018 Polcevera viaduct collapse in Genoa.

Pier also noted the importance of consistency in the DMRB standards in dealing with these bridges. The common approach to all was to identify whether there was likely to be a problem, and then to establish the risk before mitigating against it. Challenges associated with this approach included the reliance on data collection, risk prioritisation, having the appropriate level of technical skills and resources, and the tools for investigation and diagnostics. Pier noted that it was essential to be able to integrate all of these for a successful outcome. Work was ongoing within National Highways and various consultancy frameworks, but it was also necessary to ensure consistency of approach across all of the National Highways regions.

The Chair thanked Neil and Pier and invited questions.

Ioannis Mavvidis asked how cost factors were built into this process. Pier replied that estimated costs for any investigation and assessment are established on a six-yearly cycle but, ultimately, costs of strengthening and/or replacement would also have to be included in base budgets.

Tomas Garcia asked how new designs could eliminate these risks. Pier noted that DMRB standard CD 350 outlines what *can* be built but confirmed that half-joint and hinge details are no longer permissible, as is glued segmental post-tensioned construction. In terms of fatigue, Pier's view was that the current Eurocodes provided sufficient rigour to prevent future problems. Tomas noted that HS2 have been obliged to accept some hidden elements but based on contractor guarantees of there being no need for future maintenance issues!

Martyn Thomas asked whether the identification of ASR was covered in the DMRB. Pier replied that this was covered in CS 462 which relied on an initial visual identification followed by cores being taken to provide petrographic information and to identify progressive internal expansive reaction, all based on current IStructE advice.

6. TfL Sub-standard Bridge management

Nicola Head presented on TfL's approach and agreed that her presentation could be uploaded to the members only section of the BOF website.

ACTION 11: Paul Fidler

Nicola began by noting the comparison between 2016/17 when TfL had 24 sub-standard bridges with interim measures (IM) in place with the current financial year when there were 60. Respective costs had increased from £566,000 to £6.86m as well as additional traffic delay costs. TfL are fully compliant with the requirements of CS 470, not least to provide an audit trail. All IMs therefore follow the forms as prescribed in CS 470. There is an Interim Measures Board which meets quarterly to review all IMs, as well as regular Continued Safe Operation (CSO) meetings, all of which means a fully formalised and formulated process. She emphasised the point that more IMs were coming on stream each year than can be removed with the extrapolation showing that by 2031 there would be 130 IMs based on current funding levels.

Nicola concluded with a case study on the A127 Gallows Corner Flyover, a "temporary" structure consisting of 13 simply supported composite spans, assessed in 2020 and found to be sub-standard. Interim measures included a 7.5t weight, and a 20mph speed, restrictions as well as some relatively simple interventions such as bolt replacement and an enhanced inspection regime. Additionally, an Emergency Preparedness Plan (EPP) defined trigger points and a pre-determined communications strategy in the event that further action needed to be taken.

The Chair thanked Nicola for a refreshingly realistic appraisal and invited questions.

Neil Loudon fully endorsed the point that dealing with sub-standard structures was an issue facing *all* bridge owners and it was important for all to push the point with political masters.

Osian Richards suggested that real-time sensors might be a better way of managing sub-standard bridges such that a better understanding of structural behaviour might be established. Neil Loudon accepted an understanding of pre-existing condition was important but, although sensors might help, questioned whether it was a realistic proposition to install them on every sub-standard structure.

Whilst accepting the principles of sub-standard bridge management, Hazel McDonald expressed her frustration with Transport Scotland's bridge management system which struggled with the treatment of such bridges. Nicola replied that TfL, as a user of BridgeStation, had been able to use it to manage all of the CS 470 processes, including the recently added prioritisation and SAVI modules.

Noting the interim measures on the case study on weight and speed, Paul Thomas asked how these were enforced. Nicola replied that, although the police had occasionally looked into infringements, it mostly relied on signage.

7. Vehicle Weights

Neil Loudon noted that this item reflected recent policy discussions with DfT and introduced Hideo Takano to give a presentation which could also be uploaded to the BOF website.

ACTION 12: Paul Fidler

Although he had attended BOF meetings in the past, Hideo spoke briefly of his career of over 30 years, the last 18 being with National Highways (and predecessors). Part of his responsibilities now included the Heavy and High Load Route network which, although last reviewed in 2007, was no longer thought to reflect present needs. Other factors included the fact that the heavy transport industry bodies had raised issues on vehicle weights with the DfT and also that there was a growing understanding that overloading of C&U vehicles was not uncommon. The latter issue was part of a study being undertaken jointly by National Highways, Transport Scotland and Transport for Wales.

Hideo also raised the issue of the need to review thermal actions as a result of climate change impacts as noted in a recent Joint Research Centre report[4] and with respect to UK evidence from the 2022 summer heat wave.

Other issues included the "48 for 48" concept[5], a proposal to consider longer and heavier vehicles, and increasing fuel tankers to 50t gvw.

Before the Chair invited questions, Neil Loudon emphasised that this had effectively been a briefing on current issues and agreed to provide updates at future meetings, not least on the Heavy and High Load Route review. Keith Harwood added that this review would be very welcome by local authorities.

ACTION 13: Neil Loudon

On the issue of climate change, Sarah Fray suggested that a further dynamic of climate "shock" needed consideration. An example of this might be an intense thunderstorm ending a prolonged heat wave with subsequent rapid cooling effects.

Hazel McDonald raised the issue of solar radiation, especially on bridges aligned on a north-south axis. She had had experience on the M8 Kingston bridge in Glasgow which had a tendency to deflect laterally depending on the time of day. Hazel also noted, on the subject of "48 for 48", that this had been rejected by Scottish Ministers.

8. A465 Mutual Investment Model

Jason Hibbert had asked Brian Jenkins, Transport for Wales Highways Contracts Director, to present on this item via Teams. Although having earlier joined the meeting,

[4] JRC Publications Repository - Thermal design of structures and the changing climate (europa.eu)
[5] 48 tonne intermodal freight trial: consultation document - GOV.UK (www.gov.uk)

Brian was unavailable when it came to his presentation. It was decided therefore to defer this to another meeting.

ACTION 14: Richard Fish/Jason Hibbert

Post meeting note: Although present for part of the meeting, Brian had later apologised for his absence, explaining that he had been called away on urgent business.

9. CIRIA Bridge Detailing Guide

Sarah Fray gave a presentation on this item which she agreed could be uploaded to the BOF website.

ACTION 15: Paul Fidler

Sarah began by summarising CIRIA's recent history since its founding in 1960 and the facts that it was neutral and independent, self-funding and a recognised influencer in the research sector. She also listed various other CIRIA reports which were relevant to bridge engineers.

CIRIA Report C543, the Bridge Detailing Guide, had been published in 2001 and it was now considered that a refresh would be appropriate. This had been driven by a number of factors such as the introduction of Eurocodes, the use of BIM, the new DMRB, the new CDM regulations and advances in bridge related technology as well as new forms such as integral bridges. Sarah also pointed out that the existing C543 had no reference to rail bridges.

A further factor was to consider the implications of the 2008 Climate Change Act and other sustainability issues. Sarah suggested that climate change should drive a shift from precedence to prediction in terms of a structures' future performance when faced with 45°C summer temperatures and potentially a 40% increase in rainfall, mostly in extreme events.

In conclusion, Sarah reminded the meeting that funding would be needed for a revision of C543 and asked BOF representatives of constituent organisations to consider supporting the project.

The Chair thanked Sarah for her presentation and invited questions.

Osian Richards agreed that climate change added an additional dynamic in the need to future proof structures but questioned how this could work with existing masonry arch bridges with restricted flow capacity but at the same time were Listed Buildings or Scheduled Ancient Monuments. It was agreed that this was as much an issue for Historic England (or national equivalents) as it was for bridge mangers. Paul Thomas referred to culverts – in his words, the forgotten asset – especially with respect not only to hydraulic capacity but also with regard to the problem of debris blockages.

Returning to the Bridge Detailing Guide, Keith Harwood welcomed the CIRIA initiative, noting that it was largely no longer used because it was out of date. Graham Cole supported the refresh proposal, although admitting that he had been a member of the steering group that had led to the 2001 publication of C543. He also pointed out the good historical working relationship between BOF and CIRIA, not least with regard to the recently published C800 report on masonry arches, with its genesis coming from BOF discussions. Pier Valerio pointed out that the DMRB effectively endorses the CIRIA guide and confirmed that National Highways would support a revision.
Eloy Tabares questioned whether the new guide might be an online system that could be linked to a BIM library. Sarah Fray suggested that this might be a step too far for CIRIA at this stage, recognising the need to maintain and update any such library which would be beyond their current capacity.

ACTION 16: All

10. Carbon and the Blade Bridge

Liam Duffy introduced this item, having previously attended an Engineers Ireland meeting on the subject. He then handed over to Kieran Ruane and Angie Nagle of Munster Technical University (MTU) who presented on the topic. They also agreed that the presentation could be uploaded to the BOF website.

ACTION 17: Paul Fidler

Kieran began by explaining the current position with wind turbine blades which, having achieved their 15-year design life (determined by fatigue) were simply landfilled. He gave an outline of a blade design, noting that this project sought to re-use, or re-purpose, blades with an opportunity coming as a result of the re-opening of an old railway line for recreational use in County Cork and the potential of using discarded blades as a part of a footbridge replacement. Although there were some issues with the complex blade profile and geometry, the use of laser scanning had greatly helped with the necessary detailing of connections for transverse members. As well as theoretical structural analyses, there had also been a material testing regime, as well as some static load tests, at the MTU laboratory.

Angie Nagle went on to consider the life cycle sustainability assessment of the new bridge in comparison with a conventional structure. This considered environmental and societal benefits as well as an economic business case. Angie noted that UN SDGs 12 and 17 were prominent in this analysis which would assist in other uses for blade bridges.

The Chair thanked Kieran and Angie for their presentation and invited questions.

Trish Johnson was surprised that a turbine blade design life was only 15 years and asked if any research was underway to extend this. Kieran replied that the 15-year fatigue life had not been accurately quantified but pointed out that blade technology was moving very fast, including a better understanding of fatigue. Paul Thomas advised that Railway Paths wanted to replace some timber bridges and asked whether an 8m

span was likely to be achievable He also questioned why the Blade Bridge deck had been steel and not also in GRP. For the latter point, Kieran explained that there was a wheel loading requirement (12t gvw) for service vehicles. For the former, he was aware that a 20m span had been proposed in Georgia.

Liam Duffy noted that the TII technical approval process required a 120-year design life which would require a departure if the form was to be in widespread use. Kieran accepted that more research was needed in terms of design life as there were already some concerns over creep and loss of material strength due to water penetration. Liam noted that the challenge to all bridge owners looking to consider a blade bridge was to balance sustainability benefits against risk.

The Chair thanked Kieran and Angie for their presentation and suggested that this might be a good topic for the 2023 Bridge Conference. Richard Fish agreed to propose this to José Sanchez.

ACTION 18: Richard Fish

Post meeting note: This suggestion was accepted and the Blade Bridge is to be presented at Bridges 2023.

11. Menai Suspension Bridge

Jason Hibbert gave a presentation on the events which had led to the recent emergency closure of Telford's Menai Bridge. Jason agreed that this could be uploaded to the members only section of the BOF website.

ACTION 19: Paul Fidler

Jason gave the background to the two crossings of the Menai Strait, both the 1826 suspension bridge and the A55 Britannia Bridge. The latter was more exposed and once every couple of years would have to be closed due to high winds. On those occasions, therefore, all traffic to and from Anglesey would have to use Telford's bridge. For this reason, although the suspension bridge ostensibly carried only local traffic, both had been included in a DBFO contract which had started in 1998. This contract, however, was such that the Welsh Government remained the Highway Authority. An anomaly in the contract was that Principal Inspection frequencies had been set at 10 yearly intervals for Menai Suspension Bridge and Britannia Bridge, whilst all other existing structures had six yearly intervals.

Jason explained some of the maintenance history of Menai which had seen major interventions of chain and deck replacement in the 1930s, and another deck replacement in 2000. The hangers were wire rope, other than the mid-span area where they were solid bars. The 2019 Principal Inspection had identified some priority maintenance, but the planned hanger refurbishment had required specialist input from COWI. They had concluded that there was a risk of brittle failure and had recommended a 7.5t weight restriction based on a qualitative assessment. COWI had then moved to a quantitative assessment and determined that a shock load through

vertical impact or harsh braking, for example, could induce immediate brittle failure with a consequential risk of unzipping and progressive collapse. On receiving this conclusion, Jason immediately recommended closure of the bridge. The bridge was closed at 2pm on 20th October. In the meantime, Mott MacDonald are progressing a Cat III check and Spencer are developing a temporary hanger arrangement to allow the bridge to be re-opened, pending a permanent solution.

The meeting fully supported Jason in the decision he had taken, and the Chair thanked him for his candid presentation and invited questions.

Neil Loudon noted that National Highways also had a number of DBFO contracts of the same era as the A55, but all inspection reports had to come back to them for review. Graham Cole asked who would pay for the costs of closure and subsequent works, Jason replied that this would be the DBFO company. Liam Duffy asked about timescales; Jason replied that the temporary hanger arrangement should be in place in January 2023 which would coincide with the Cat III check report.

Paul Thomas thanked Jason for sharing his problems with BOF, recalling how Stephen Pottle had been equally open in 2011 when the Hammersmith Flyover problems had first come to light. The meeting echoed these thoughts.

12. Rochester Bridge Trust – Bathymetric Survey and UAV Experience

The Chair gave two presentations, mostly in the form of video clips. She agreed that these could be uploaded to the BOF website.

ACTION 20: Paul Fidler

The first related to a recent Port of London Authority (PLA) bathymetric survey of the river Medway in the vicinity of the Rochester bridges. Not only had this captured a very detailed topography of the riverbed but also, via laser scanning, very detailed images of the bridges' superstructures.

Responding to a question from Paul Thomas, the Chair confirmed the RBT's intention to repeat this exercise every six years. Colin Hall reported that Network Rail had trialled this technology as an alternative to, or to supplement, underwater examinations. Costs, however, had been found to be prohibitive, other than in emergency situations, such as the need to re-open an at-risk bridge after a flood, or for bridges over large waterways.

The second presentation was a series of UAV surveys in some of the more inaccessible areas of the RBT bridges, with some potential defects such as mortar loss in an abutment chamber which had previously been impossible to inspect. Another unexpected issue was the degree of dust and small debris which was kicked up by the drone inside the box girder of the new bridge.

In the following discussion, Neil Loudon confirmed that National Highways had undertaken some recent UAV surveys which he could share at a future meeting. It was agreed that all BOF members should offer to do the same as and when they had more UAV experience.

ACTION 21: Richard Fish/Neil Loudon/All

13. Bill Harvey and Great Musgrave Bridge

The meeting noted, with great sadness, the death in October of Professor Bill Harvey. Graham Cole paid tribute to Bill, using a presentation which he agreed could be uploaded to the BOF website.

ACTION 22: Paul Fidler

Graham noted Bill's many contributions to BOF over the years, starting with BOF 17 in 2006, when he had been part of an expert panel scrutinising methods for arch bridge strengthening, through to BOF 66 in 2021. Bill had also received the inaugural BOF lifetime achievement award at Bridges 2021. Graham (along with Richard Fish and Trish Johnson from BOF, as well as many fellow professionals) had attended Bill's memorial service in Exeter Cathedral on November 10th when many moving tributes had been paid.

Graham referred to Bill's many legacies, not least his Bridge of the Month (BoM) series of newsletters which were as valuable as any text on the behaviour of arch bridges. Graham cited BoM 137 on the Great Musgrave Bridge which had been controversially infilled on the alleged grounds of safety, having failed a MEXE assessment. Bill had approached a reassessment in his inimitable forensic style, based on readily available information which concluded that the arch's capacity remained at 40t as well as questioning the structural theory in which infilling offered even an at rest condition support to the arch.

The meeting echoed Graham's thoughts on Bill and Paul Thomas reminded us of another of Bill's edicts, that of being very clear about what we do not know.

14. UKBB Update

Hazel McDonald gave a brief resumé of items discussed at the UKBB meeting in September:

- A small group (Hazel, Nicola, Keith and Richard) was working on a compendium of documents that related to bridge management. Keith Harwood noted that there were currently about 120 but CHE memos (as had been mentioned earlier in the meeting) had not been included as yet. This remained work in progress and would be reported at future BOF meetings.

ACTION 23: Hazel McDonald/Nicola Head/Keith Harwood/Richard Fish

It was also agreed that the compendium should be accessible from the new BOF website.

ACTION 24: Paul Fidler

Whilst the Chair agreed that this was a good idea, she pointed out that it would need regular updating and that would have to be properly resourced. It was agreed that this would have to be considered by BOF Chairman, Cam Middleton.

ACTION 25: Chairman

- Agreement with Network Rail on parapet upgrades.
- The need to review the 1998 CSS/Railtrack cost sharing protocol, originally agreed as part of the Bridgeguard 3 assessment programme and yet still being applied by some Network Rail regions. This work was being overseen by DfT's Matt Eglington.
- Boundary guidance with National Highways had now been agreed.
- The release of the new CIRIA C800 arch bridge guidance.
- BICS (as BOF 71 Agenda Item 15)
- BridgeCat – DfT were looking for further uses.
- Code of Practice update – results of a user survey to be considered.
- Network Rail standards – although accessible, it was noted that payment was still required to do so.[6]

15. BICS Update

Neil Loudon gave an update, with both good news and bad news:

- Good: LANTRA had appointed a new scheme administrator.
- Bad: Previously issued figures were now found to be wrong.
- Good: The numbers of scheme registrations had increased.
- Bad: The success rate at recent interviews had been poor (e.g. a candidate could not explain the difference between general and Principal Inspections!)
- Good: LANTRA were proposing to improve their website.

It was agreed that updates should continue to be given at future BOF meetings.

ACTION 26: Hazel McDonald/Neil Loudon/Graham Cole/Richard Fish

The Chair asked if cost was really an obstacle in inspectors seeking BICS accreditation. If so, it *might* be possible for RBT to consider a bursary scheme. This could not, however, replace costs which a public body would otherwise be obliged to pay.

ACTION 27: Sue Threader

[6] *Post meeting note: Keith Harwood has now managed to gain access to NR standards without payment, but this had not been easy!*

16. BOF Website Progress and Logo

The Chair summarised progress to date on developing a new website as had been discussed at BOF 70 and presented some ideas on its appearance. She requested five or six high quality images of bridges owned by BOF member organisations as well as their logos.

ACTION 28: All/Sue Threader/Paul Fidler

The Chair also presented eight possible new BOF logos. By a democratic show of hands, Logo 2 was selected (which was very similar to the current logo). It was also agreed to drop the apostrophe at the end of Owners.

ACTION 29: Sue Threader/Keith Harwood/Paul Fidler

17. 2023 BOF Lifetime Achievement Award

As last year, Richard Fish advised that he would be asking for nominations by email before composing a shortlist for BOF members to vote on. The award would be presented at Bridges 2023 in March.

ACTION 30: Richard Fish/All

18. Any Other Business

- The Chair passed on a request for papers from the editor of the ICE Journal of Engineering Heritage and History. She agreed to forward a link.

ACTION 31: Sue Threader/All

Post meeting note: the link was issued in the BOF email of 14th December 2022.

- Andy Featherby noted that C&RT had received a greater than usual number of abnormal load notifications and asked if others had seen the same. This was an observation generally shared by the meeting. Andy also noted that a very high number of bridge strikes had been recorded in the last six months.
- Following on from the issue above, Jason Hibbert noted that there had also been a huge increase in planning applications affecting the trunk road network in Wales.
- Pedram Heshmat expressed his gratitude for being able to attend a BOF meeting, noting that it had been very interesting and rewarding.
- Hazel McDonald noted that the Bridges Scotland conference and exhibition was to take place in Glasgow next week.

19. Next Meetings

BOF 72: 7th February 2023 to be held in Cambridge (but with hybrid facilities).

BOF 73: 13th June 2023 provisionally to be held in Cambridge (but with hybrid facilities).

ACTION 32: Richard Fish

20. Close

The Chair thanked everyone for their contributions to the meeting and wished everyone a safe onward journey (apart from those attending from home!).

Richard Fish,
BOF Technical Secretary,
1st January 2023