Introduction

SCI's Steel Bridge Group (SBG) held an industry consultation in 2017 involving a wide range of clients, consultants, contractors, fabricators and other specialists. We wanted to know what areas we should be focusing for the development of best practice guidance over the next few years. A key theme that arose from this consultation was a strong belief that the whole-life performance of a structure needs better consideration at the early stages of the design process in order to consider whole life costs and minimise the need for expensive maintenance interventions in later life. We know that UK bridge owners are spending millions of pounds every year operating and maintaining their assets. We therefore wish to identify the main access and maintenance problems on steel bridges in order to develop better guidance for the future.

We are doing this by first asking you to tell us about your steel bridge problems, maintenance regimes and your current design approval procedures for new bridges. We are very grateful for your time spent answering this questionnaire as it will form the basis of the future guidance we will produce on this important subject.

The Steel Bridge Group is very grateful for your assistance in completing as much of this questionnaire as you are able to.

Please be reassured that the all information you provide when completing this survey will be processed in strict confidence by the members of the SBG involved in the 'Design for Operation & Maintenance' workstream (only), and that all data will be subsequently fully anonymised for the purpose of reporting on the survey results.

In addition, the SBG and SCI will fully adhere to your contact preferences as specified at the end of this survey.

For further information on SCI's Steel Bridge Group, please visithttps://steel-sci.com/the-steel-bridge-group.html. Please also do not hesitate to contact Mr Guillaume Vannier, the Secretary for the SBG at SCI (click above link for full contact details).

You and your organisation

* 1. About you

Name:

Email:

Phone:

* 2. Your position within your organisation:

* 3. Name of organisation & division on behalf of which you are responding to this survey:

* 4. Organisation type:

- Railway authority
- Trunk road authority
- Local authority
- Maintaining agent / contractor
- PPP concessionaire with maintenance responsibility
- Other bridge asset owner or maintainer (please specify)

5. Number of steel bridges that you have direct financial responsibility for maintaining:

* 6. Are you able to provide information on behalf of your organisation with respect to annual bridge maintenance budgets?

- Yes
- No

Annual bridge maintenance budgets

7. Annual bridge maintenance budget (for all bridges) within your organisation / division (x £1k):

8. Amount of this bridge maintenance budget that is spent on steel bridge maintenance (x £1k):

Historical costs for maintenance of existing steel bridges

* 9. Are you able to provide information on behalf of your organisation with respect to historical cost of bridge maintenance (past 5 years)?

- ◯ Yes
- ◯ No

Historical costs for maintenance of existing steel bridges

Please provide the annual average costs you have spent over the past 5 years on the types of steel bridge maintenance schemes listed below.

Costs quoted should be inclusive of all direct costs including scheme preparation, tendering, project management and supervision.

10. Bridge bearing maintenance / replacement

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

11. Movement joint maintenance / replacement

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

12. Repair or replacement of bridge deck waterproofing

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

13. Maintenance painting

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

14. Removal of bird guano and/or installation of roosting deterrents

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

15. Fatigue repairs and/or strengthening

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

16. Repairs due to accidental damage e.g. bridge strike

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

17. Maintenance / repairs due to vandalism

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

18. Other steel bridge maintenance schemes not falling into one of the above categories

Please specify:

Average annual cost of maintenance (x £1k):

Average scheme cost (x £1k):

Inadequate access for inspection and maintenance of steel bridges

* 19. Have you, your organisation or division experienced issues related to inadequate access for inspection and maintenance of steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Inadequate access for inspection and maintenance of steel bridges

20. Thinking about your experience of inadequate access, please rank the following locations in terms of where you encounter the greatest difficulties (drag options below to the desired position):

- Inside spaces of box girder decks
- Below-deck areas
- Bearings at abutments
- Bearings at intermediate piers
- Movement joints at abutments
- Movement joints at intermediate piers
- Pylons and towers
- Voided substructures
- Other

21. Please specify the other location(s) referred to above, if relevant:

22. Please describe the major issues that you encounter with the areas you have ranked above as 'most difficult to access':

Hidden critical elements that are not practical to inspect on steel bridges

* 23. Have you, your organisation or division experienced issues related to hidden critical elements that are not practical to inspect on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

24. Please describe the hidden critical elements that you believe you should be able to inspect on steel bridges but are usually not able to do so:

Deterioration of corrosion protection systems on steel bridges

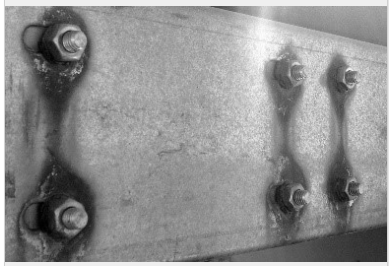
* 25. Have you, your organisation or division experienced issues related to deterioration of corrosion protection systems on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Deterioration of corrosion protection systems on steel bridges

26. Which of the following causes of protection system deterioration and failure do you most often encounter on your painted steel bridges? (tick all that apply)

Abrasion



Bimetallic corrosion

Blistering

Bridging (paint failure as shown)

Chalking

Cracking

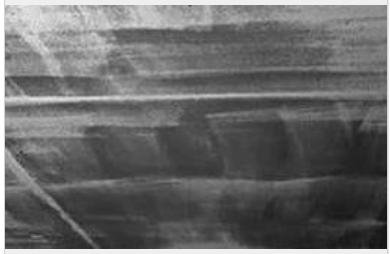
Delamination

Discolouration of top coat

Edge / corner failure

27. Continued.. (tick all that apply)

Flaking



Rust rashing

Spotting

Rust staining

Stress cracking

Other

Other

28. Please specify the other cause(s) / failure(s) referred to above , if relevant:

29. In your experience over the past 5 years, which of the following are the major causes of paint system failure? (tick all that apply)

- [ ] Inappropriate paint system specification
- [ ] Poor workmanship in the fabrication shop
- [ ] Poor workmanship at site connections
- [ ] Damage on site not adequately repaired
- [ ] Subsequent damage
- [ ] Bird roosting / guano damage
- [ ] Other (please specify)

Weathering steel bridges issues

* 30. Have you, your organisation or division experienced weathering steel issues in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Weathering steel bridges issues

31. Which of the following issues have you encountered on your weathering steel bridges over the past 5 years: (tick all that apply)

- [ ] Rust staining onto substructures
- [ ] Uneven patina development
- [ ] Accelerated corrosion due to damp environment
- [ ] Corrosion at steel/concrete interface
- [ ] Crevice or pocket corrosion
- [ ] Galvanic corrosion due to contact with dissimilar metal.
- [ ] Difficult to remove graffiti
- [ ] Other (please specify)

32. Please describe the specific problems you have had with weathering steel bridges that could have been avoided with better design, detailing or fabrication:

Bearing maintenance or replacement on steel bridges

* 33. Have you, your organisation or division experienced issues related to bearing maintenance or replacement on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Bearing maintenance or replacement on steel bridges

34. Which of the following bearing problems have you encountered over the past 5 years? (tick all that apply)

- [ ] Inappropriate type of bearing specified
- [ ] Bearing installed incorrectly
- [ ] Insufficient movement allowance
- [ ] Insufficient designed load capacity
- [ ] Steel element failure
- [ ] Elastomer failure
- [ ] Fatigue
- [ ] Fixing failure
- [ ] Deterioration / failure of sliding surface
- [ ] Articulation failure / lock-up
- [ ] Corrosion protection system failure
- [ ] Other (please specify)

Bearing maintenance or replacement on steel bridges

* 35. Have you undertaken any bearing maintenance or replacement schemes on steel bridges over the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Bearing maintenance or replacement on steel bridges

36. Have you encountered any of the following problems? (tick all that apply)

- [ ] Difficult access to bearing shelf
- [ ] No defined temporary jacking points on steel deck
- [ ] No temporary jacking plinths on substructure
- [ ] Insufficient space to install temporary jacks on bearing shelf
- [ ] No secondary bottom plate to ease bearing removal
- [ ] Structural alterations required to install new bearings
- [ ] Other (please specify)

Bridge movement joint maintenance or replacement on steel bridges

* 37. Have you, your organisation or division experienced issues related to bridge movement joint maintenance or replacement on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Bridge movement joint maintenance or replacement on steel bridges

38. Which of the following bridge movement problems have you encountered over the past 5 years? (tick all that apply)

- [ ] Inappropriate type of joint specified
- [ ] Joint installed incorrectly
- [ ] Insufficient movement capability
- [ ] Excessive vertical movement
- [ ] Water leakage through joint
- [ ] Corrosion of joint elements
- [ ] Deterioration / failure of joint seals
- [ ] Debonding or separation of joint material from pavement
- [ ] Rutting of joint material
- [ ] Backfill settlement resulting in accelerated joint deterioration
- [ ] Holding down fixing failure
- [ ] Other (please specify)

Bridge movement joint maintenance or replacement on steel bridges

* 39. Have you undertaken any movement joint replacement schemes on steel bridges over the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Bridge movement joint maintenance or replacement

40. Have you encountered any of the following problems? (tick all that apply)

- [ ] Hidden joint support structure requiring repair and refurbishment
- [ ] Insufficient space to install replacement joint
- [ ] Other (please specify)

Deck waterproofing repair or replacement on steel bridges

* 41. Have you, your organisation or division experienced issues related to deck waterproofing repair or replacement on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Deck waterproofing repair or replacement on steel bridges

42. What are the causes of deck waterproofing failure that you have encountered over the past 5 years? (tick all that apply)

- [ ] Inadequate preparation of steel or concrete substrate
- [ ] Poor installation workmanship
- [ ] Inadequate sub-surface drainage
- [ ] Failure / blockage of sub-surface drainage
- [ ] Adhesion / bond failure
- [ ] Damage to waterproofing during resurfacing works
- [ ] Laps between waterproofing systems
- [ ] End of life
- [ ] Other (please specify)

Fatigue problems on steel bridges

* 43. Have you, your organisation or division experienced fatigue problems on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Fatigue problems on steel bridges

44. Which of the following fatigue related problems have you encountered over the past 5 years? (tick all that apply)

- [ ] Web to flange longitudinal weld cracking
- [ ] Longitudinal plate stiffener weld cracking
- [ ] Trough stiffener weld cracking
- [ ] Transverse butt weld cracking
- [ ] Flange doubler plate cracking
- [ ] Diaphragms and cross-bracing connections
- [ ] Shear connector failure in composite decks
- [ ] Coped end and cut-short flange detail cracking
- [ ] Laminar tearing
- [ ] Friction connection slippage
- [ ] Stay cable anchorage failure
- [ ] Prestressing bar or hanger fracture
- [ ] Cast steel element fracture
- [ ] Bridge bearing failure
- [ ] Thin surfacing (e.g mastic asphalt) cracking
- [ ] Other (please specify)

Graffiti or vandalism on steel bridges

* 45. Have you, your organisation or division experienced graffiti or vandalism issues on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Graffiti or vandalism on steel bridges

46. What types of vandalism have created the most significant maintenance or refurbishment issues?

- ◯ Graffiti on superstructure
- ◯ Graffiti on substructure
- ◯ Vandal induced vibration damage
- ◯ Damage to bridge components
- ◯ Acid damage
- ◯ Other (please specify)

Accidental damage or failure on steel bridges

* 47. Have you, your organisation or division experienced issues related to accidental damage or failure on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Accidental damage or failure on steel bridges

48. What have been the causes of accidental damage to your steel bridges over the past 5 years? (tick all that applies)

- [ ] Bridge strike on low headroom bridge deck
- [ ] Bridge strike due to over-height vehicle or vessel
- [ ] Vehicle or vessel collision with substructure
- [ ] Vehicle fire damage
- [ ] Other (please specify)

Bird roosting and guano induced deterioration on steel bridges

* 49. Have you, your organisation or division experienced issues related to bird roosting and guano induced deterioration on steel bridges in the past 5 years?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

Other maintenance issues

50. Please specify any additional maintenance issues experienced by you, your organisation or division in relation to steel bridges in the past 5 years:

Procuring New Steel Bridges

* 51. Does your organisation also influence the design of new steel bridges?

- ◯ Yes
- ◯ No

* 52. Does your organisation act as a technical approval authority for new bridges?

- ◯ Yes
- ◯ No

Procuring New Steel Bridges

53. When you set requirements for new steel bridge design, do you explicitly require that the design/designer considers operational and maintenance issues within the options evaluation?

- ◯ Yes
- ◯ No
- ◯ Unable to answer

54. If so, what specific requirements do your designers have to follow?

55. How much input do you/your team have in the design of new bridge structures? (tick all that apply)

- ☐ Undertake assurance only
- ☐ Output specification provided
- ☐ Details specification provided
- ☐ List of documents/guidance to follow is included in the project requirements/design brief
- ☐ Undertake concept design in-house
- ☐ Undertake detailed design in-house

Industry guidance

56. Please review the following statements and give your opinion:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
There is insufficient consideration given in the design approval processes (e.g. DMRB AIP or Network Rail Form F001) to whole-life costs	○	○	○	○	○
There should be a standard method for calculating the whole life cost of bridges that allows design options to be reliably compared	○	○	○	○	○
There is a need for more specific and detailed guidance on good practice in design for operation and maintenance of steel bridges	○	○	○	○	○

57. Which industry guidance do you refer to or make a mandatory requirement for the design of new bridges for which you have design procurement responsibility?

	Never heard of this guidance before	I'm aware of this guidance but we don't actively use it	We actively refer to this guidance when reviewing new bridge designs	This guidance is a mandatory requirement for all new bridge designs
SCI Publication 154: Design of Steel Bridges for Durability	○	○	○	○
SCI Publication 185: Steel Bridge Group: Guidance notes on best practice in steel bridge construction	○	○	○	○
SCI Publication 241: Durability of steel bridges: a survey of the performance of protective coatings	○	○	○	○
SCI Publication 340: Integral Steel Bridges: A summary of current practice in design and construction	○	○	○	○
CIRIA Report C543 Bridge Detailing Guide	○	○	○	○
TRL Application Guide 33: Water management for durable bridges	○	○	○	○
DMRB Advice Note BA 57/01: Design for Durability	○	○	○	○

58. Please tick the subjects where you believe that there is a need for better guidance:

- [ ] Designing access for inspection and maintenance
- [ ] Avoiding hidden critical elements
- [ ] Durable corrosion protection systems.
- [ ] Detailing of weathering steel bridges.
- [ ] Bridge articulation solutions to minimise maintenance
- [ ] Detailing
- [ ] Deck waterproofing repair or replacement
- [ ] Fatigue problems
- [ ] Bird roosting and guano induced deterioration
- [ ] Graffiti or vandalism
- [ ] Accidental damage or failure
- [ ] Other (please specify)

Contact preferences

As noted in the introduction, please be reassured that the all information you have provided in this survey will be processed in strict confidence by the members of the Steel Bridge Group involved in the 'Design for Operation & Maintenance' workstream (only), and that all data will be subsequently fully anonymised for the purpose of reporting on the survey results.

The SBG and SCI will fully adhere to your contact preferences as specified below.

For further information on SCI's Steel Bridge Group, please visit https://steel-sci.com/the-steel-bridge-group.html. Please also do not hesitate to contact Mr Guillaume Vannier, the Secretary for the SBG at SCI (click above link for full contact details).

59. We would like to keep you informed about this project, and would also like to give you the opportunity to keep up-to-date with SBG and SCI activities. As such, if you would like us to contact you, please tick the relevant option(s) below:

- [ ] Project progress updates
- [ ] More information about the Steel Bridge Group
- [ ] SCI Publications
- [ ] SCI Membership
- [ ] SCI Training and Conferences
- [ ] Other (please specify)

* 60. Based on your selection above, please select 'yes' below to confirm that you are willing for us to keep your contact details on record for the purpose of contacting you in the future (according to your preferences as indicated above), or 'no' to confirm that you do not wish us to contact you or keep your contact details on record.

- ◯ Yes
- ◯ No

Survey completed - Thank you

Thank you for completing this survey. Your responses will be reviewed and collated to assist the Steel Bridge Group in developing better guidance on the design of steel bridges for operation and maintenance.