Smart from the Start

Embedding O&M into Bridge Design

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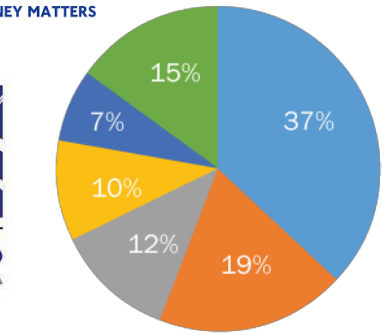
Upgrade work on Falkirk district motorway bridge to cause 23 weeks of lane closures
News › Bristol News › Traffic & Travel
Updates as Brunel Way hit with long delays due to bridge repair
There were long queues last night as well
ers warned of delays during bridge repair work
News
Hundreds of motorists face delays as busy bridge in village near Northampton closes – here's when it reopens
M27: Chaos as drivers face lengthy delays on motorway amid lane closures for maintenance works on two bridges
WORKS ACCESS

Survey Respondents in 2017

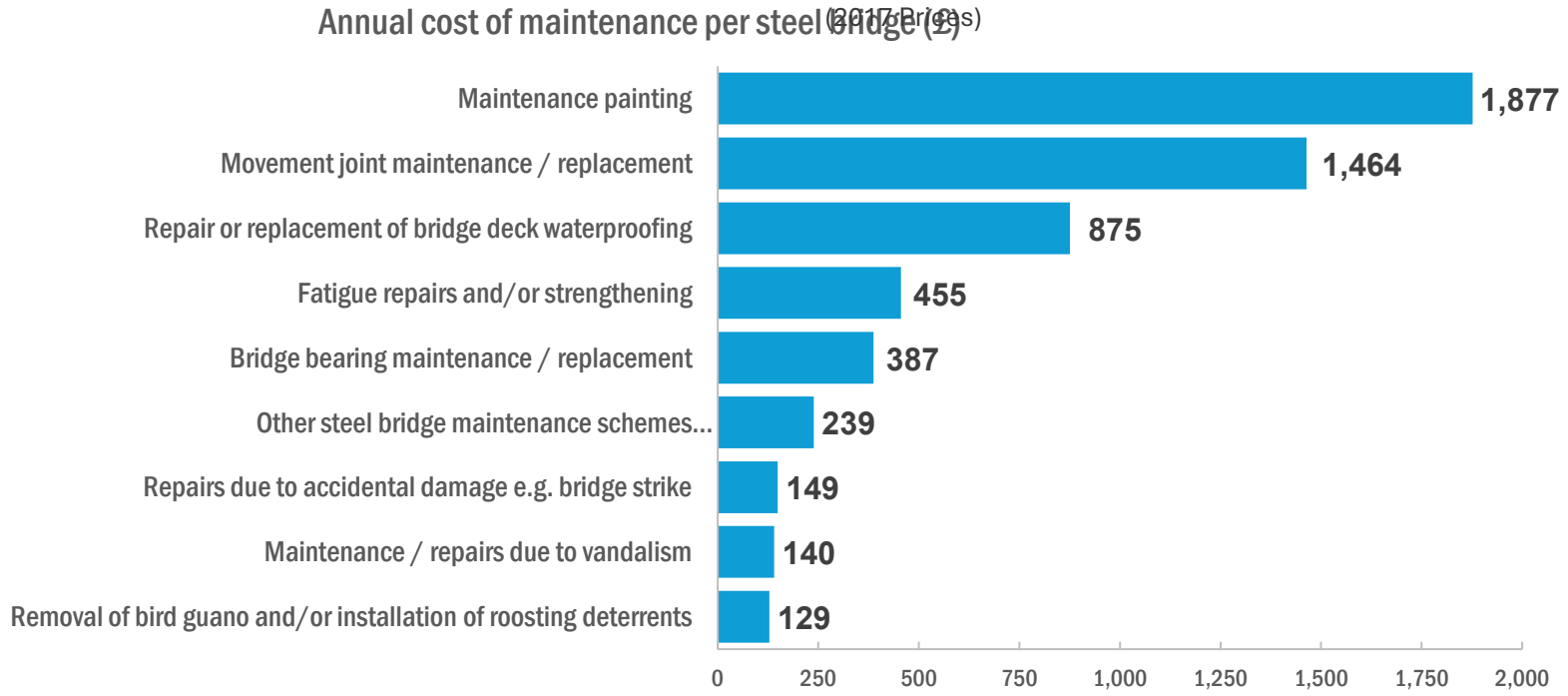


RESPONDENTS' AFFILIATIONS

Railway Authority	37%
Local Authority	19%
Trunk Road Authority	12%
Maintaining Agent/Contractor	10%
PPP Concessionaire with Maintenance Responsibility	7%
Other bridge asset owner or maintainer	15%

Respondents represented nearly 34,000 bridges (≈ 29% of estimated bridge stock in GB)

Maintenance/Renewal Costs



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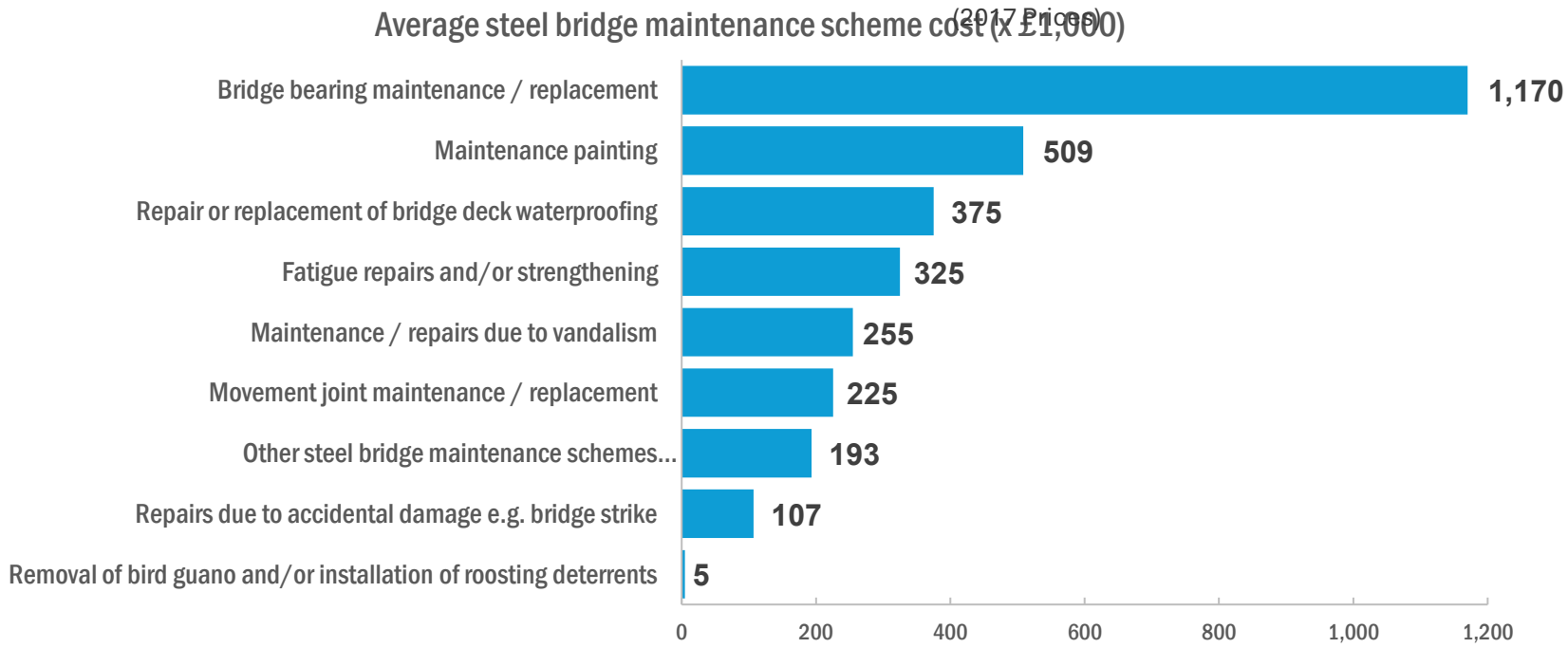
Maintenance/Renewal Costs



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Top 6 O&M Liabilities (Steel Bridges)

1. Bearing maintenance and replacement
2. Corrosion protection system repair or renewal
3. Bridge expansion joint replacement
4. Waterproofing renewal
5. Fatigue related strengthening
6. Hidden critical elements

Root Cause Analysis

Maintenance Issue	Design	Specification	Workmanship	Inadequate Maintenance
Bearing failure	■	■	□	□
Paint system failure	□	■	■	□
Expansion joint replacement	■	■	■	□
Waterproofing failure	■	□	■	□
Fatigue failure	■	□	□	
Hidden critical elements	■			□

■ Primary cause

□ Secondary cause

Addressing these O&M issues at the design stage will have a major impact in reducing future liabilities

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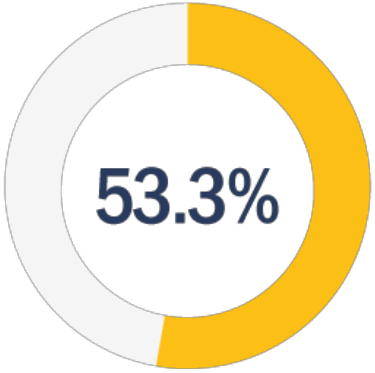
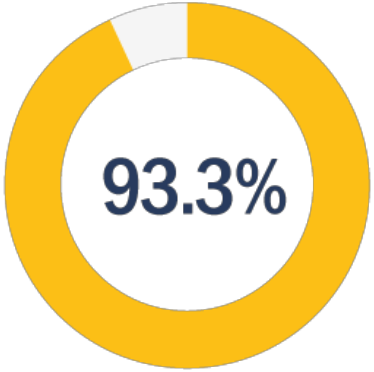
O&M prioritisation at the design stage

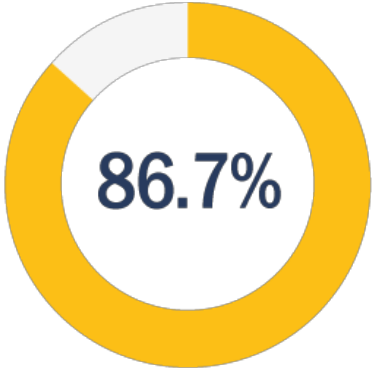
There is insufficient consideration given in the design approval processes (e.g. DMRB AIP or Network Rail Form F001) to whole-life costs



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



Key survey messages

1. We don’t think about O&M issues enough in design of new bridges
2. Earlier consideration in the design process is needed
3. There is not enough emphasis on O&M at AIP stage
4. Better “good practice” guidance is needed

Progress since 2017

- Update of DMRB from BD 2 to CG 300 has strengthened need to justify design in the context of minimising maintenance liabilities:

> 4.4 Set out measures that will be incorporated into design to minimise maintenance.[15]

15) Designs that have minimal maintenance provide significant benefits in reducing the safety risk to the workforce and reducing disruption to the network. Designs that include elements with relatively high maintenance interventions need to be justified through the maintenance and repair statement in accordance with GD 304 [Ref 5.N].

Progress since 2017

- Further emphasis in Network Rail FormA (NR/L2/CIV/003) with regards to thinking about key O&M issues at the concept design stage …

4.2 Examples of good practice

This sub-clause gives examples of good practice in design of Permanent Works

Review for evidence that access and maintenance requirements of Asset Manager and maintenance organisation have been incorporated within the design;

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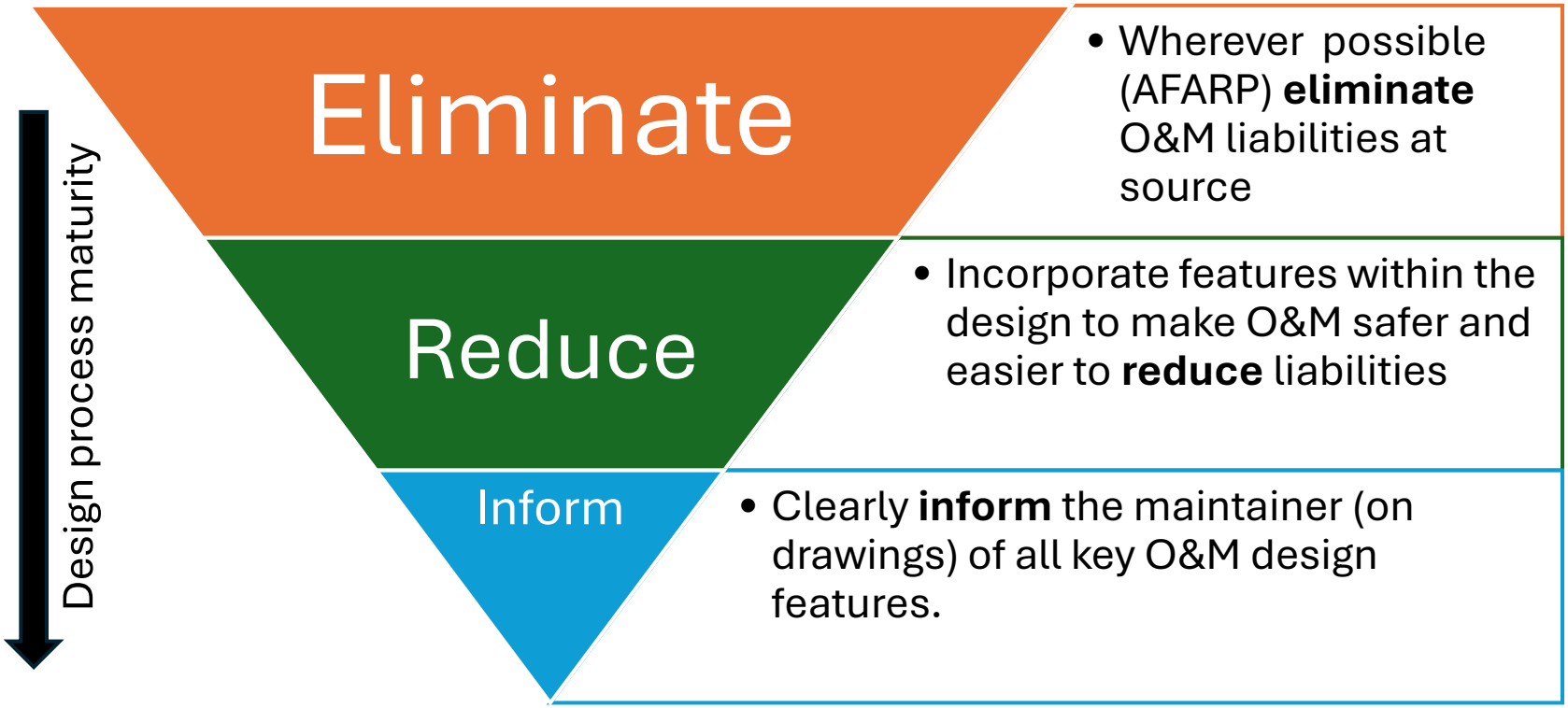
Proposed Framework



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Eliminate

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Eliminate

CD 350 Revision 0 — 8. Design for durability

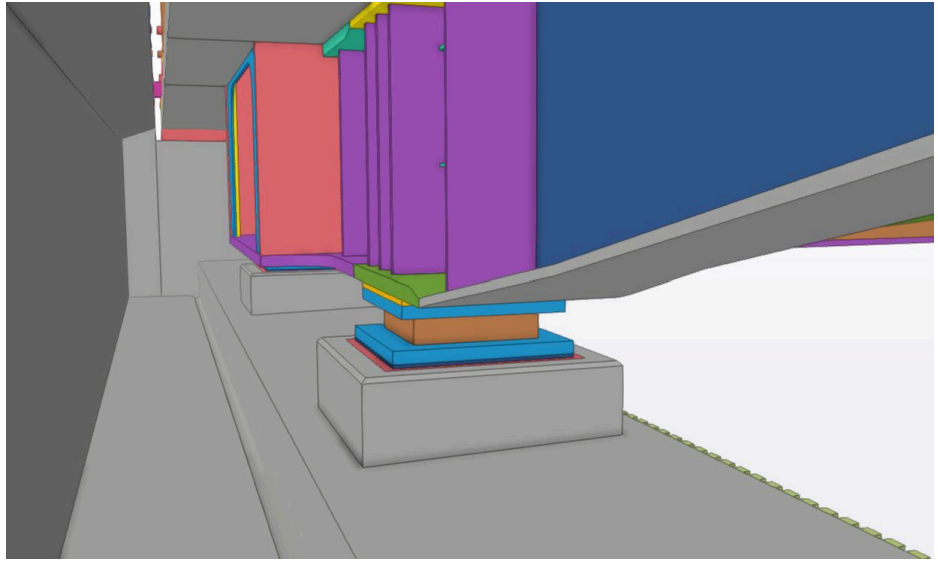
8. Design for durability

8.2.1 Bridges with a skew angle greater than 30 degrees or lengths greater than 60m ~~may~~ should be designed as integral structures, wherever technically feasible

Pont Briwet Viaduct, N. Wales
134m long – fully integral

Reduce

- Abutment galleries
- Working space around bearings
- Secondary bearing plates
- Defined temporary jacking points



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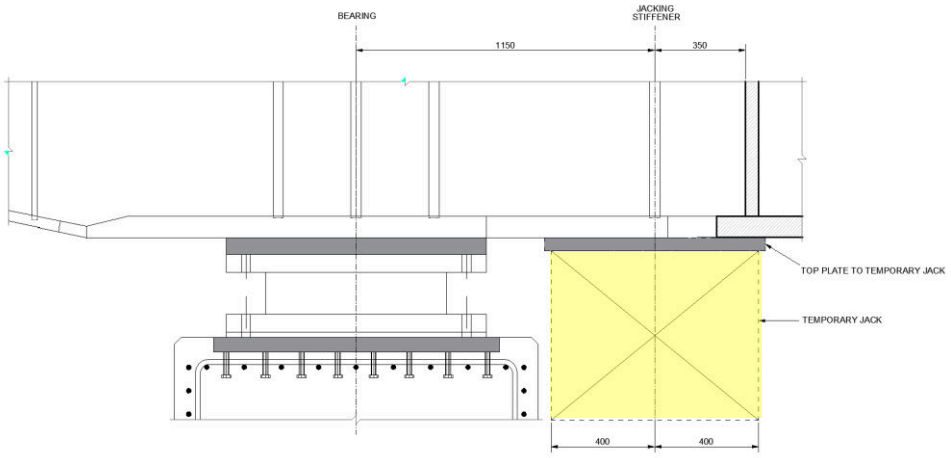
Inform

- Bearing placement will (hopefully) only take place many years after the original construction.
- State the design assumptions for bearing replacement:
  - Sequence
  - Traffic loads
  - Return periods for environmental actions
  - Concurrent maintenance activities
  - Any other constraints
- Provide a clear temporary jacking schedule consistent with design assumptions



TEMPORARY JACKING SCHEDULE

				All Jacks
Design load (kN)	Serviceability limit state	Vertical N	max.	12765
			permanent	7620
			min.	4480
		Transverse Vy,sd		435
		Longitudinal Vx,sd		390

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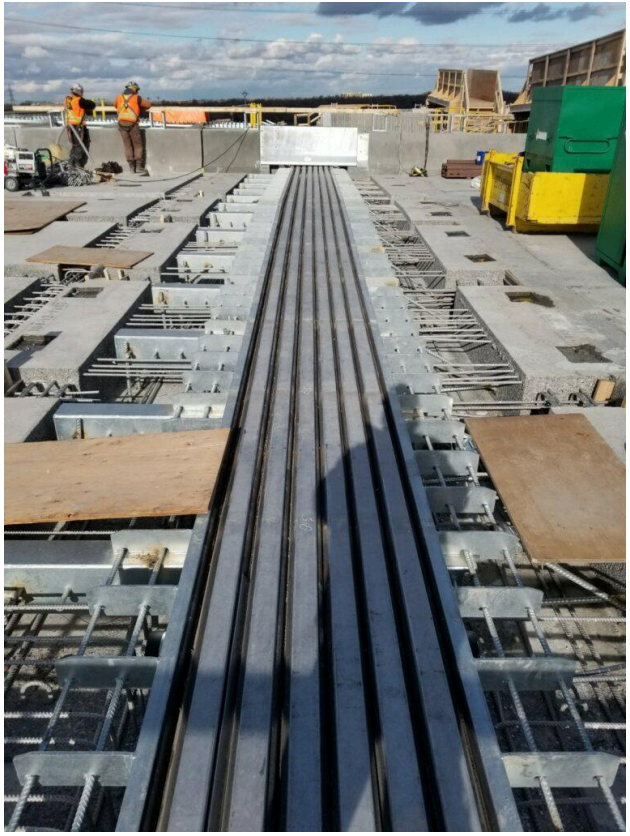

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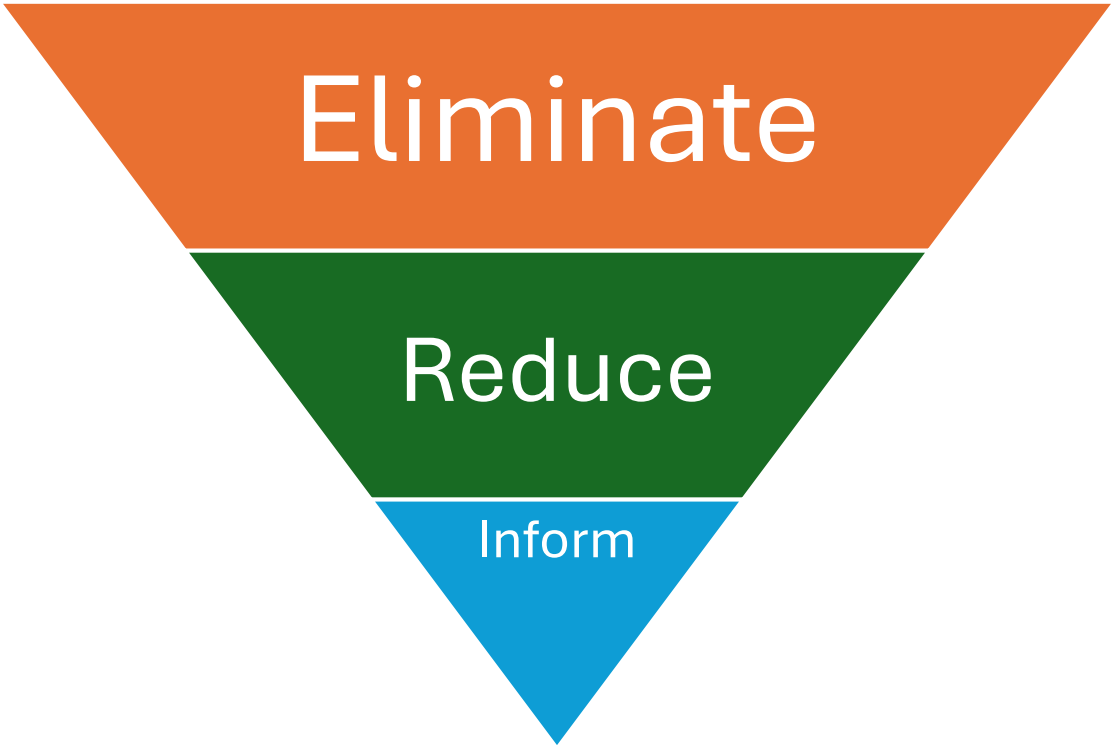
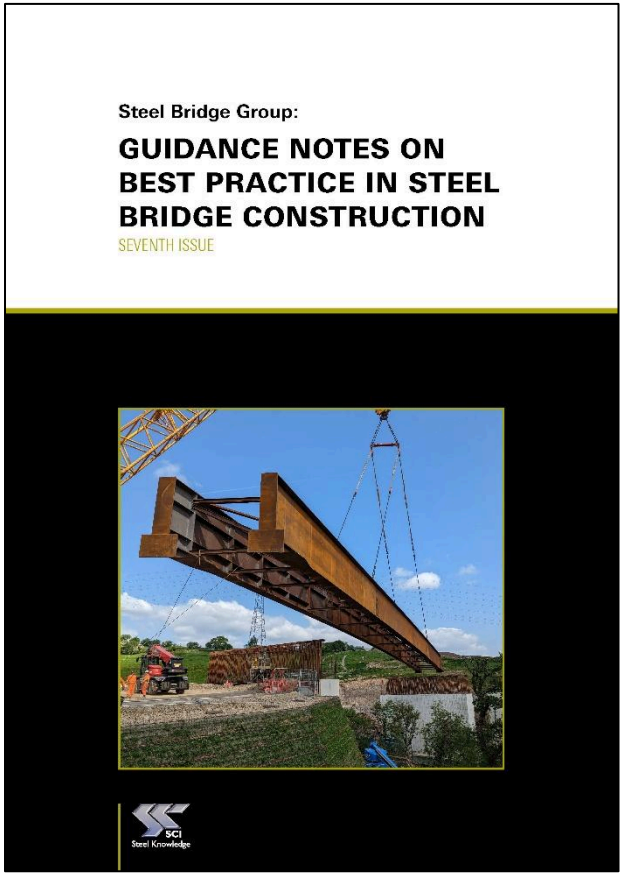
Proposed Framework



Announcing SBG Guide P185 – 7th Issue

STEEL BRIDGE GROUP

P185 7th Issue



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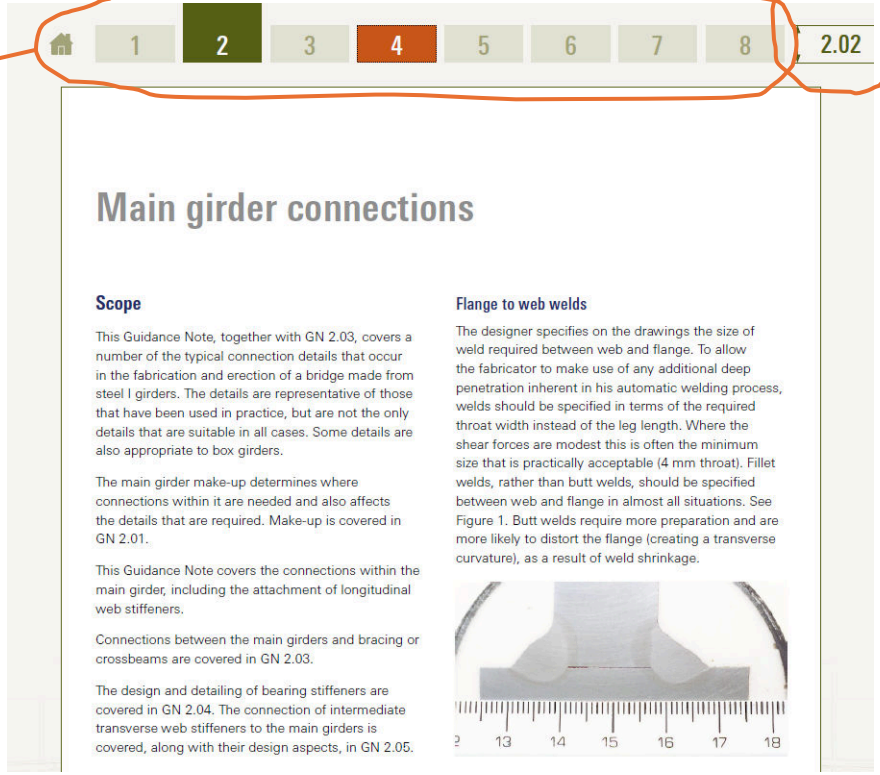
Key Features

Hyperlinked navigation bar



Individual guidance note numbering retained and expanded

Clearer text and figures

… but the same trusted advice on steel bridge design and construction

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Guidance Note 1.11 – Design for O&M

- One of a number of new guidance notes in 7th Issue
- Includes a checklist of questions to be asked at AIP stage in relation to how O&M issues are being addressed.
- Consistent with the proposed "ERI" framework

1 2 3 4 5 6 7 8 1.11

Design for Operation & Maintenance

Introduction

In 2017, SCI's Steel Bridge Group (SBG) carried out an industry consultation including a workshop which involved a wide range of clients, consultants, main contractors, steelwork contractors and other specialists. The aim of this consultation was to identify the problems faced throughout the lifecycle of steel bridge projects and investigate what can be done to make steel bridge solutions more competitive, easier to procure and more appealing from a whole-life perspective. 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 minimize the need for expensive maintenance interventions in later life.

As a result, the SBG initiated a 'Design for Operation & Maintenance' workstream. An industry survey was undertaken as a first step to identify the main access and maintenance problems on steel bridges.

A good response to this survey was received from a

Figure 2 Annual cost of maintenance per steel bridge (£) (2019 prices)

A key conclusion that the SBG took from the survey was to improve the consideration of operation and maintenance activities at the conceptual design stage for new steel bridges and where possible to eliminate through design the costliest maintenance and renewal activities from the bridge life cycle.

This approach was supported by over half of the survey respondents who felt that operation and maintenance aspects were not sufficiently addressed at the Approval in Principle (AIP) stage under the UK DMRB and equivalent Network Rail Standards.

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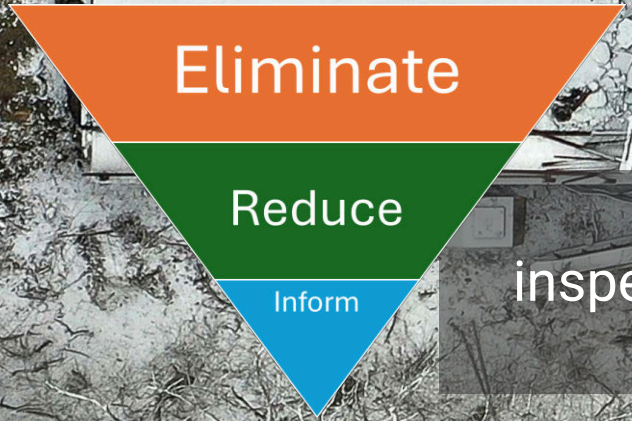
Guidance Note 1.11 – Design for O&M

O&M ISSUE	GUIDANCE
Bearings	- If bearings are proposed, justify why it is not possible to adopt integral construction and eliminate bearings in some or all locations e.g. intermediate supports. - Explain what provisions are to be made to allow bearings to be accessed on all sides for inspection. - Explain what provisions are to be made in the design to allow bearings to be replaced. (e.g. jacking points, secondary plates etc.)
Movement joints	- Confirm that the joint type proposed is suitable for the predicted movements. - For integral bridges confirm whether formal movement joints are needed. - Explain what provisions are to be made to allow movement joints to be inspected, maintained and replaced if necessary. - Explain the measures proposed to ensure that surface water coming through the joint will be managed to prevent deterioration of the structure.
Corrosion protection system	- Explain why it is not possible or desirable to adopt unpainted weathering steel - In especially corrosive environments, or where maintenance will be very costly, or good resilience to flood damage is required, consider whether the use of stainless steel for the bridge structure may result in the lowest life cycle cost (for example bridges over railways or water). - Justify the choice of corrosion protection system with respect to the exposure condition and ease of access.

“The Fern Hollow bridge catastrophe must serve as a wake-up call that we cannot take our infrastructure for granted. Only through diligent attention to inspection, maintenance, and repair can we ensure the roads, bridges, and tunnels we all traverse every day are safe for the travelling public. Lives depend on it.”



We must take seriously the need to embed inspection and maintenance requirements into our designs so they are **Smart from the Start**

P185 7th Issue