

## **Research Project Specification**

### **Metallic bridges: condition appraisal and remedial treatment**

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## **1. OBJECTIVE**

To provide best practice guidance for infrastructure owners, their designers, contractors and maintenance managers, about the asset management, condition appraisal and repair of metallic bridges.

## **2. BACKGROUND**

The transport network of the UK (road, rail and canal) contains many thousands of metallic bridges, ranging in size from single span structures to multi-span viaducts. Few such structures have been built in the last 100 years; most are the legacy of the eighteenth and nineteenth centuries. By and large they have performed well, particularly in the light of increased traffic loadings, but all need regular inspection and maintenance. Many have suffered forms of distress that have required remedies, often applied long ago. Among issues of current concern are **XXXXX**, parapet strengthening and water penetration. Modern understanding of the behaviour of metallic bridges and improved maintenance and repair techniques however means that, with the proper application of this knowledge, these vital structures can be kept in use for the foreseeable future.

The Bridge Owners Forum (BOF) has recognised that there would be benefit in drawing together into a single guidance note the combined knowledge of the principal bridge owners on the asset management of such bridges. Asset management in this context includes risk management, inspection and appraisal techniques, analytical methods and repair techniques. Each owner will already have specific procedures drawn up over many years to suit the operational methods of the organisation. Each set of procedures will be similar, but will vary in detail. Previous work by CIRIA, funded by infrastructure owners and regulatory bodies (Network Rail, Highways Agency, London Underground/InfraCos, British Waterways, Her Majesty's Railway Inspectorate, Department for Transport) has provided best practice guidance on the condition appraisal, remedial treatment and assessment of infrastructure embankments (CIRIA C550, 2001 reprinted as C592, 2003) and cuttings (CIRIA C591, 2003). A current project (CIRIA RP692) will provide guidance for the assessment and repair of masonry and brick arch bridges. These projects have demonstrated that considerable benefits will arise from synthesising different owners' asset management procedures into a common, current best practice, approach for all such bridges.

This project will build on the successful CIRIA reports on infrastructure embankments and cuttings and the forthcoming guidance on masonry and brick arch bridges referred to above to provide infrastructure owners, their designers, contractors and maintenance managers with comprehensive, authoritative and impartial best practice guidance on all aspects of the appraisal, treatment and long-term maintenance of metallic bridges. The report will lead to cost savings through a reduction in metallic bridge deterioration and failures and increased confidence of owners to apply whole life costing with improved safety and cost-effective long-term management strategies to their assets.

This CIRIA project is being supported by major metallic bridge owners, including Network Rail, Highways Agency, County Surveyors Society and British Waterways. Funding is principally from ??The Department for Transport with support from ??Network Rail and CIRIA Core Programme Sponsors.

### **3. SCOPE**

#### **3.1 Description**

This project is to prepare needed guidance in the form of a report that will use case histories, laboratory and field studies, other published data and experience to describe how to appraise the condition of metallic bridges. It will also cover the selection, design, execution and maintenance of remedial and/or upgrading of those found to need repair, and provide lessons for the design and routine management of metallic bridges.

#### **3.2 Coverage of the Research Project**

The project will answer questions including:

- How can the safety of metallic bridges as an infrastructure asset be maintained/improved as appropriate?
- What are the performance requirements that the metallic bridge has to satisfy?
- What are the causes of loss of performance of metallic bridges?
- What are the serviceability limit states for metallic bridges?
- How can these causes be identified?
- What risk assessment and risk analysis tools are available, and how should they be used?
- What appraisal techniques are available for localised and overall asset management of metallic bridges including the use of NDT, etc?
- How can the nature/rate of degradation of level of performance of the metallic bridge be assessed including ‘hidden strengths and weaknesses’?
- What actions will be required if a bridge fails a loading assessment?
- What factors should be considered in the selection and design of necessary remedial or upgrading works?
- What routine and special investigations will be required during the life of the structure?
- How can future maintenance requirements be assessed (after the remedial/upgrading works have been completed)?
- What lessons, drawn from existing practice, can be applied to future inspection, assessment, maintenance and re-construction?
- What are the key references that should be relied on?
- What are the uncertainties that could be answered by further research?

The project will include consideration of:

- Reasons for loss of metallic bridge performance
- Metallic bridge appraisal methods
- The performance of metallic bridge parapets
- Remedial treatments and preventative measures
- The design and application of remedial treatments and preventative measures
- Environmental considerations for metallic bridge repair and management including aesthetic and reuse of materials issues
- Recommendations for good practice.

The report will contain relevant case histories and highlight the importance of health and safety whilst working close to live traffic, etc, but is not required to be a definitive treatise on health and safety.

## **4. METHOD**

The Research Contractor shall prepare a report which provides best practice guidance for the asset management, condition appraisal and repair of metallic bridges, by undertaking the following tasks:

- Consultation with UK and international experts and organisations knowledgeable in the assessment and repair of metallic bridges
- Consultation with owners and those responsible for the UK's metallic bridges, including heritage railways and light rail (metro) systems
- Review of published information, from UK and abroad, on the design, specification, construction and monitoring of metallic bridge remedial works
- Explain the different techniques available for assessing the condition of metallic bridges
- Introduce common generic remedial techniques used for metallic bridge repair and assess the merits of the various techniques (but not to appraise different propriety solutions).
- Use case studies to set out the rationale for the proper design and installation of remedial works
- Evaluate knowledge of the long-term deterioration of engineering characteristics/performance, including any relevant issues from recent and projected changes in weather patterns.

Amplifications or variations in the method of working may be proposed by prospective research contractors in their tender. If accepted, the proposed method of working will be incorporated in the research contract.

## **5. OUTPUTS**

The findings of the project will be disseminated via a best practice guidance report and seminars.

### **5.1 Best practice guidance report - Contractor's Project Report**

The Research Contractor shall prepare drafts and a final report, this being the Contractor's Project Report, which shall be submitted to CIRIA by the due date for completion. The production of the report will be agreed by CIRIA, the project steering group and the research contractor. It is envisaged that the report will follow the style set out in CIRIA's 'Guide for contractors'.

### **5.2 Seminars**

Two seminars will be held during the course of the contract, the first to consult with experts about the proposed coverage of the research project, the second to disseminate interim project results. The consultation seminar will be held during the first few weeks of the project, the dissemination seminar close to the end of the project. The seminars shall be held as CIRIA Project Seminars under the auspices of CIRIA and CIRIA will issue invitations to attend in its normal way to representatives of the funding organisations, Core Programme Sponsors and other identified invitees for the events. CIRIA and the Research Contractor shall plan the content and arrange speakers for the seminars, and may nominate persons to be invited.

## **6. DRAFT PROGRAMME OF WORK**

This is included as schedule 2 of the tender documents.

## **7. DRAFT REPORT STRUCTURE**

The structure of the report will be proposed by the Research Contractor and discussed and agreed by CIRIA, the research contractor, project funders and the project steering group. It is essential that the format and presentation of the output are appropriate for the intended readership. It is envisaged that the report will have a similar structure to those of other recent CIRIA ‘infrastructure asset’ best practice guidance reports. Chapters of the report might include:

- Introduction
- Asset management
- Loss of metallic bridge performance
- Metallic bridge condition appraisal
- Remedial treatment and preventative techniques
- Design and application of remedial treatment and preventative measures
- Environmental considerations
- Data management systems
- Areas requiring further research
- Recommendations for good practice
- A comprehensive reference list.

## **8. PRODUCTION AND HAND-OVER OF THE CONTRACTOR’S PROJECT REPORT**

CIRIA attaches great importance to the early dissemination of the results of its projects and therefore requires its research contractors to prepare the project reports in the form of the intended publication. When the intended outcome is a guidance document, considerable attention has to be given to presenting the guidance in an effective manner. The Contractor’s Project Report as approved by the Project Steering Group and taking account of CIRIA staff advice on editorial and presentational matters, shall be completed by the due date so that it can be issued to project funders and CIRIA Core Programme Sponsors. The Research Contractor will be required to supply a selection of photographs, in consultation with the Steering Group, for illustrating the reports and for subsequent promotion where appropriate.

The requirements for producing the Contractor’s Project Report are set out in *CIRIA’s guide to publishing* (2002) which provides guidance on acceptable formats and layouts for the report.

## **9. MANAGEMENT OF THE RESEARCH PROJECT**

CIRIA will appoint a Project Steering Group whose membership will include the principal funders plus a member to represent the interests of CIRIA Core Programme Sponsors and such other persons for their knowledge of, and interest in, the subject of the research project. The Steering Group will meet four times during the course of the work to advise CIRIA and, thereby, the Research Contractor on the technical sufficiency and progress of the work. The approval by the Steering Group of the final Contractor’s Project Report will be required prior to its submission to CIRIA as a completed task.

For each Steering Group meeting during the project, the Research Contractor shall carry out the tasks and provide the information listed in Clauses 9.1 and 9.2.

## **9.1 Attendance at project Steering Group Meetings**

CIRIA's Research Project Manager will call the meetings of the Steering Group and will normally invite the Research Contractor in the persons of supervisor and nominated author(s) to attend in order:

- to present a report on the progress of the work
- to seek advice from the Steering Group on matters which relate to the technical content of the project, including a draft contents list and section synopses for discussion at the first Steering Group meeting
- to note and take action on that advice and on comments of members about draft reports, discussion notes and other matters relevant to the project.

To achieve the maximum benefit for the project from the input of the Steering Group, the Research Contractor shall distribute direct to the members, at least 2 weeks before any meeting, drafts for comment of material for the Contractor's Project Reports. The Research Contractor shall allow for the costs of preparing and supplying up to 20 copies of the report in a suitable electronic format (plus paper copies if required) to the Steering Group, and for attendance at the meetings.

## **9.2 Progress and interim reports**

The Research Contractor shall submit to CIRIA's Project Manager regular progress reports which shall contain the following information:

- Research Project number and title
- Date of report
- Time inputs of staff assigned to the project (in man days)
- Progress statements in terms of degree of completion of components of the work, such as:
  - review of literature
  - planned consultations
  - review of case histories
  - proportion of drafting of proposed chapters etc.
- Assessment of the progress in relation to contract completion time and expenditure
- Proposed programme for the next month
- Proposed actions to achieve contract completion dates if progress has fallen behind targets.

### **Interim reports**

In the event of any problem, whether relating to technical matters within the coverage of the project work or to its programming and completion, the Research Contractor shall submit an interim report to CIRIA's Project Manager, drawing attention to the problem and proposing methods to solve it. CIRIA's Project Manager, if unable to find a solution acceptable to CIRIA and the Research Contractor, will consult the Chairman of the Steering Group, and together with the Research Contractor agree how to resolve the problem.