

Summary of Bridge Research Projects brought to the attention of the Bridge Owners Forum by Member Organisations (BOF17-26)

Highways Agency

The following projects have brought to the attention of the Bridge Owners' Forum by Awtar Jandu, Ron Ko and Neil Loudon. In addition the Highways Agency has a publicly accessible compendium of research available at <http://www.ha-research.co.uk/>. Where a project number has been reported to BOF, details have been confirmed by cross referencing the project number against the corresponding entry in the research compendium. However, not every project number reported at BOF appears in the compendium. In addition, the compendium contains information on far more projects than those that have been explicitly referred to at BOF meetings.

Completed

Bridge Inspection Manual

This replaces the Bridge Inspection Guide. It is comprised of two complementary volumes, intended to assist organisations in appreciating the wide range of issues involved in the inspection process, and enable them to set up practices which deliver safe, compliant, consistent, and high quality inspections. Volume 1 covers all aspects of highway structures inspection that both inspectors and engineers should be aware of, while Volume 2 is intended as a quick reference for inspectors on site. Available from The Stationary Office (<https://www.tsoshop.co.uk/>):

Inspection Manual for Highway Structures: Volume 1 - Reference Manual (£65)

Inspection Manual for Highway Structures: Volume 2 - Inspector's Handbook (£25)

Natural Weathering Paint Trials (Y201363)

Joint project with Network Rail. Regular monitoring of painted test samples exposed over 20 years to observe the onset and mode of failure of the coatings in different environments and to compare the performance of single packs with that of the allegedly more resistant 2 pack materials. 09/2004 to 09/2008

Gamma Ray Tomography for reinforced concrete (Y623765)

Concrete tomography using gamma-rays offers some promise as a non-destructive technique to detect a range of defects including voids, cracks, delamination, misplaced reinforcement and corrosion in concrete. It has been developed and used fairly extensively in Argentina, but has not to date been tried in the UK.

Effectiveness of Washing Bridges (YY91963)

Structural steelwork in bridges rapidly becomes covered in grime which is likely to contain contaminants that can reduce the durability of the protective treatment applied to the steelwork. Removal of the contamination by regular washing should increase the life of the protective treatment reducing whole life costs and disruption on the network associated with maintenance painting work.

Bridge deck waterproofing systems: the effect of membrane stiffness on the strains induced in surfacing

Identify the factors that affect the performance of waterproofing systems and assist in preparing the most appropriate specification for surfacing of different type and thickness.

Special Order Bridge Loading Model (L 206375)

The main objective of the project is to develop standard loading models for Special Order (SO) vehicles for use in the design and assessment of bridges and other highway structures. The work will involve consultations with the heavy haulage associations, collate data on the configurations of SO vehicles and carry out desk study to develop standard loading models.

Expansion Joints For Integral Bridges (Y104191)

To obtain information on the methods that have been used to deal with expansion joints at the ends of integral bridges in our current bridge stock. Best and worst practice should be identified from this information enabling future guidelines to be established for future design and maintenance.

Tunnel Unit Costs (Y201361)

Determine a range of unit costs for tunnel structure, M&E and communications items and their ongoing maintenance and operational costs.

Review of Assessment Rules for Concrete Bridges (Update BD44) (Y201408)

The research took the form of a desk study examining recent research, its efficacy and appropriateness, carrying out necessary calibration and sensitivity analyses in order to draft clauses and clause amendments for BD/BA 44.

Design & strengthening of bridges for vehicle impact (Y204130)

A number of methods including impact collars, deck slab and column restraint systems have been proposed for strengthening bridges against vehicle impact. The research investigated these and other approaches in order to develop best practice guidance and requirements for the cost-effective and rapid strengthening of existing bridges and the design of new bridges.

Impact of revised HSE standards on tunnels (Y204280)

Appraise the ability of tunnel ventilation systems to control NO. Evaluate the energy consumed and implications of increased capital and running costs. Identify the likely changes required to BD78. Investigate implications of reduced exposure levels on construction methods and costs.

Risk analysis methods for tunnels (Y204281)

The project will comprise a review of current risk analysis models, study of the use of these models in current design practice and assessment of the information base of these models.

Mossband viaduct testing (Y206874)

Not in the HA Research compendium under this project number

CIRIA NDT report (Y206876)

Improved safety and better management of bridgestock.

Development of new single pack coating system (Y206877)

Not in the HA Research compendium under this project number

KPIS For Bridge Maintenance Activities (YY86731, 3/359)

The indicators will be developed from information held on the Structures Management Information System (SMIS). An algorithm will be developed for the performance indicators and this will then be coded into SMIS to allow generation of the indicator values at any time. The project will include trials to calibrate the indicators and identify appropriate target values.

In Progress

Expansion Joints for Integral Bridges (Y104191)

To obtain information on the methods that have been used to deal with expansion joints at the ends of integral bridges in our current bridge stock.

Investigation into aluminium metal spray coatings (Y204204)

The objectives of the project are assessment of the value for money of the increase cost of the work by the study of the mechanisms of protection afforded by the additional AMS coating and comparison to the contribution made to long term performance.

Specimen Monitoring for Continued Durability (Y206145)

Periodic monitoring of specimens, and reporting on durability issues.

Bridge Infrastructure (500404)

This work forms part of a phased study which will assist the Highways Agency to discharge its responsibility to ensure that the stock of structures on the Trunk Road and Motorway network in England are maintained in a safe and serviceable condition, and that the maintenance budget is spent cost effectively, on the highest priority needs. (Was reported to the Bridge Owners' Forum as project Y206872 - State of bridge infrastructure)

Optimum maintenance strategies for structures (Y206873)

To build on the work already undertaken and carryout further development, trial testing on a small sample of structures and then develop a model for the whole network.

Performance of impregnants (Y206875)

The advent of European Standard EN1504 has meant that a range of hydrophobic pore-lining impregnants are now available on the UK market. However it is unclear how effective they are in-service as regards long term durability.

Bridge Deck Waterproofing: Non-U4 Concrete Surfaces (Y623773)

Much time is taken preparing the surfaces of old bridge decks in order to provide a U4 surface finish for the application of the bridge deck waterproofing system. This time would be saved if it could be proven that waterproofing systems perform satisfactorily when applied to rougher surfaces without detailed surface preparation.

Early Application of Waterproofing (Y204149)

to test a number of different waterproofing systems applied to concrete of different ages ≤ 28 days (and mix designs) and compare these with the performance of the same system applied to the current specification, to discover if early application with reduce the life of the system.

Bridge deck waterproofing systems: the effect of membrane stiffness on the strains induced in surfacing (Y201345)

To identify the factors that affect the performance of waterproofing systems and assist in preparing the most appropriate specification for surfacing of different type and thickness.

Study to raise speed limit of vehicles carrying Special Order abnormal load (Y623979)

Reported to Bridge Owners Forum but no details in research compendium under the above number.

Adoption of CEN Concrete Execution Standards (possibly Y105050)

This project was reported to the Bridge Owners' Forum without a reference number.

FRP participating formwork and steel-free bridges

This project was reported to the Bridge Owners' Forum without a reference number.

ATM Monitoring Trials - Stage 2 (Y205932)

Active Traffic Management uses lightweight gantries to carry signs and equipment. These structures can be designed for wind and snow load, in addition to the dead loads using published data. However there is no information on the possible dynamic effects caused by vehicles passing beneath. If these loads were significant they could affect the performance of the equipment on the mast and could reduce the life expectancy of the structure.

The Durability and Performance of Deck Hinges (YY77729)

Following the completion of earlier research work at TRL studying the shear behaviour of hinge deck bridges, there is a need to study the behaviour of such bridges in a deteriorated condition ie. cracked and with critical reinforcement corroded.

Crevice corrosion investigation (YY91895)

Crevice corrosion is a highly localised and rapid phenomenon and is influenced in particular by the presence of chlorides in concrete. Research work carried out at TRL for the Highways Agency has shown that crevice corrosion can occur in post-tensioned concrete bridges.

Performance assessment of FRP bridge decks (63Y76188)

Testing of deck sections under static and dynamic loading.

Proposed Projects

- Economic Viability of FRP road and foot bridges
- Application of Whole-Life Costing for Scheme Analysis
- Implementation of BS EN 1504
- Critical review of materials-related technologies for the improved protection of cable-supported bridges
- Development and evaluation of systems for the detection of corrosion in bridge cables and ground anchors

Design Manual for Roads and Bridges

The Bridge Owners' Forum was also made aware of the following updates and additions to the Design Manual for Roads and Bridges (DMRB). (The full DMRB may be found at <http://www.standardsforhighways.co.uk/dmr/>)

New or recently amended documents

- BD13/06 – Design of Steel Bridges – Use of BS5400-3:2000
- BD35/06 – QA Scheme for Pains and Similar protective coatings
- BD79/06 – The Management of Sub-Standard Structures
- BA74/06 – The Assessment of Scour of Highway Structures
- BA86/06 – Advice note on NDT of Highway Structures
- TD19/06 – Requirements for Road Restraint Systems
- BD62/07 - As Built, Operational and Maintenance records for Highway Structures
- BD63/07 - Inspection of Highway Structures

Documents under review

- BD48/93 The Assessment and Strengthening of Highway Bridge Supports

BD60/04 Design of Highway Structures for Vehicle Collision Loads

Network Rail

The following projects or activities relating to bridge research have been brought to the attention of the Bridge Owners' Forum by Brian Bell. Some are Network Rail projects. Others are part funded by Network Rail and others are simply projects in which Network Rail has some involvement (e.g. as a member of a steering group). There may be an online resource available at <http://portal.railresearch.org.uk/> but it is not publicly viewable.

Completed

CIRIA Tunnels Manual

Published as '*Tunnels: inspection, assessment and maintenance (RP712)*'

Sustainable Bridges

FP6 Program. Final conference held Wroclaw, Poland 11 Oct 2007

European Construction and Technology Platform

Network Rail is no longer part of the ECTP

CIRIA Rock Manual

Published as '*The Rock Manual. The use of rock in hydraulic engineering (2nd edition) (C683)*'

FRP patching of Fatigue Cracks in Wrought Iron

PhD Project at the University of Surrey

CIRIA – Intelligent monitoring of concrete structures

Published as '*Intelligent Monitoring of Concrete Structures (C661)*' and available from <http://www.ciria.org/acatalog/c661.pdf>

In Progress

CIRIA Projects:-

- A Clients' Guide for Assessing Risk on UXO Sites (RP732)
- Noise and vibration issues in Urban Development (RP772)
- Culvert design and operation guide (RP901)
- Flood resilience and resistance of critical infrastructure

University Research (PhDs, Post-doc etc.) :-

- Shear resistance of elderly pre-stressed beams with transverse post tensioning (Bath)
- Low Energy Lime Mortars (Bath, Bradford and Bristol)
- Dry Stone Walls (Bath and Southampton)
- Fatigue in Masonry Arches (Cardiff)
- Mine Shaft Detection (Edinburgh)
- Use of GPR on masonry Arches (Edinburgh)
- Radar on arches (Edinburgh). Awaiting PhD viva
- FRP for Metallic Strengthening (Leeds)
- Management of shallow mine workings (Newcastle). Currently writing up
- Soil/Structure interaction in arch bridges (Salford)
- Radial pinning of Masonry Arches (Salford)

- Acoustic Emission testing (Salford)
- Corrosion in elderly metallic bridges (Surrey)
- Reliability Based Bridge Inspection (Surrey Uni)
- Fatigue in masonry arch bridges (UWE)

Commercial/Other research :-

- Whole-life costing across industries
- Monitoring of concrete structures (Jointly funded with DTI/BERR)
- Detection of Rebar corrosion (Keel University/SciSite)
- Proprietary FRP products for use in Bridges (Parsons Brinckerhof)
- Concrete monitoring demonstrator (National Physical Laboratory)

Proposed Projects

- Extreme events on critical infrastructure (Bath)
- Disruption and Damage to Critical Transport and Power Infrastructure (Birmingham)
- Construction procurement (International Construction Client Forum)
- Masonry arch bridges (University College, Dublin)
- Effective Bridges (European Commission FP7)
- Risk and value management (CIRIA)

Department for Transport

The Department for Transport has funded a number of projects via the UK Roads Liaison Group and Bridges Board. Some of these have been initiated by the Bridge Owners Forum.

Completed

Well-Managed Structures

Project on bridge maintenance management. Published as '*Management of Highway Structures*', available from the Road Liaison Group website:

http://www.ukroadsliaisongroup.org/pdfs/p02_management_of_highway_structures.pdf

CIRIA Masonry Arch Guide

Part funded by Network Rail. Published as '*Masonry arch bridges: condition, appraisal and remedial treatment (C656)*' and available from: <http://www.ciria.org/downloads.php?id=C656>

CIRIA Metallic Bridges Guide

Published as '*Iron and steel bridges: condition appraisal and remedial treatment (C664)*' and available from <http://www.ciria.org/downloads.php?id=C664>

In Progress

CIRIA Dry-Stone Wall Guide

To be published soon as '*Dry stone retaining walls: condition appraisal and remedial treatment (RP723)*'

Electronic Service Delivery for Abnormal Loads (ESDAL)

This started as a DfT project, although it is now back under the auspices of the Highways Agency. The Bridge Owners Forum has heard presentations on the progress of ESDAL from Andy Cook and Fiona Steele at various stages of the project.

Proposed projects

Project to produce practical application advice from DTI-funded project on inspection of concrete bridges. (Steering Group appointed).

London Underground

The following projects were brought to the attention of the Bridge Owners' Forum by Jim Moriarty.

In Progress

Whole Life Costing Model

Creation of a Whole Life Costing and management accounting model based on a statistical sampling model.

Lifecycle Plans and Risk Based Maintenance

Maintenance regimes at present follow time-based intervention. It is hoped to develop a system that is based on risk and whole life costing.

Asset Risk models

Develop asset risk management methodology.

Competency Assessment

Develop a competence assessment system for asset managers that bridges the traditional boundaries of business manager, engineering specialists, operations and maintainers. It will endeavour to ensure that its management staff have the right core competencies.

Asset Management Training

This will develop a training programme to equip new members of staff with skills, tools and techniques for asset management. It will dovetail into the asset management competency assessment mentioned above.

Asset Deterioration Modelling

This is a development of Intervention planning to replace the deterioration modelling as the prime mechanism for investment planning. rather than wait for assets to deteriorate and then apply for funding to repair them, it hopes to be able to predict when assets will deteriorate, and so predict the optimum time for intervention and thus be able to predict funding requirements.

Co-Patch Project

This is a project being led by Associate Professor Tsouvalis of the National Technical University of Athens into FRP repairs. London Underground has agreed in principle that their structures can be used to test FRP bonding and materials trials.

Other Research Projects

The Bridge Owners' Forum is often made aware of bridge-related research taking place around the world:

Long-term Bridge Performance Program (FHWA)

Extension of the commercial development work on the novel flexible concrete arch from 6m to 12m in span using lightweight concrete was noted. (BOF23)