



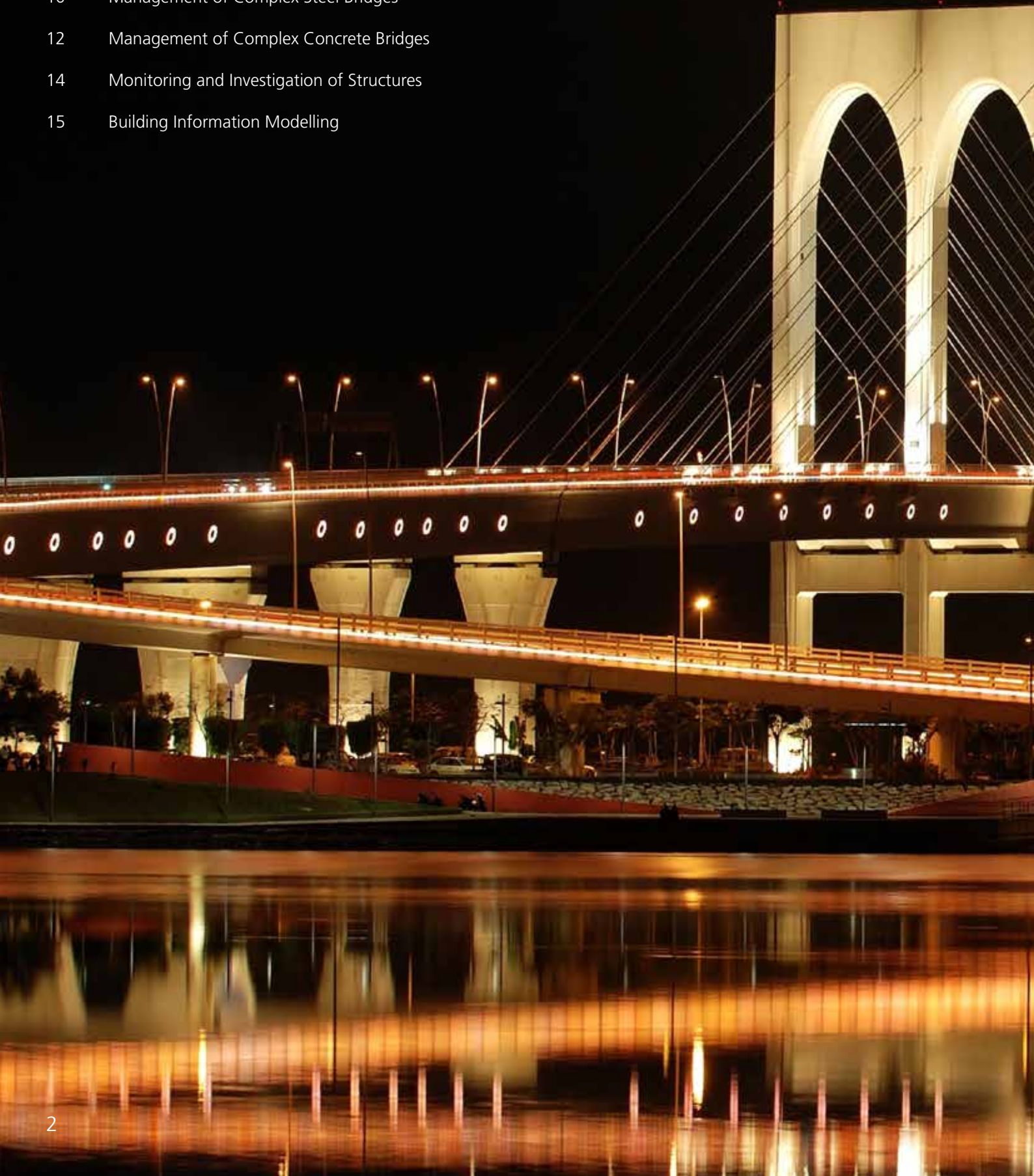
ATKINS

Management, Rehabilitation and
Strengthening of Long-span Bridges

Plan Design Enable

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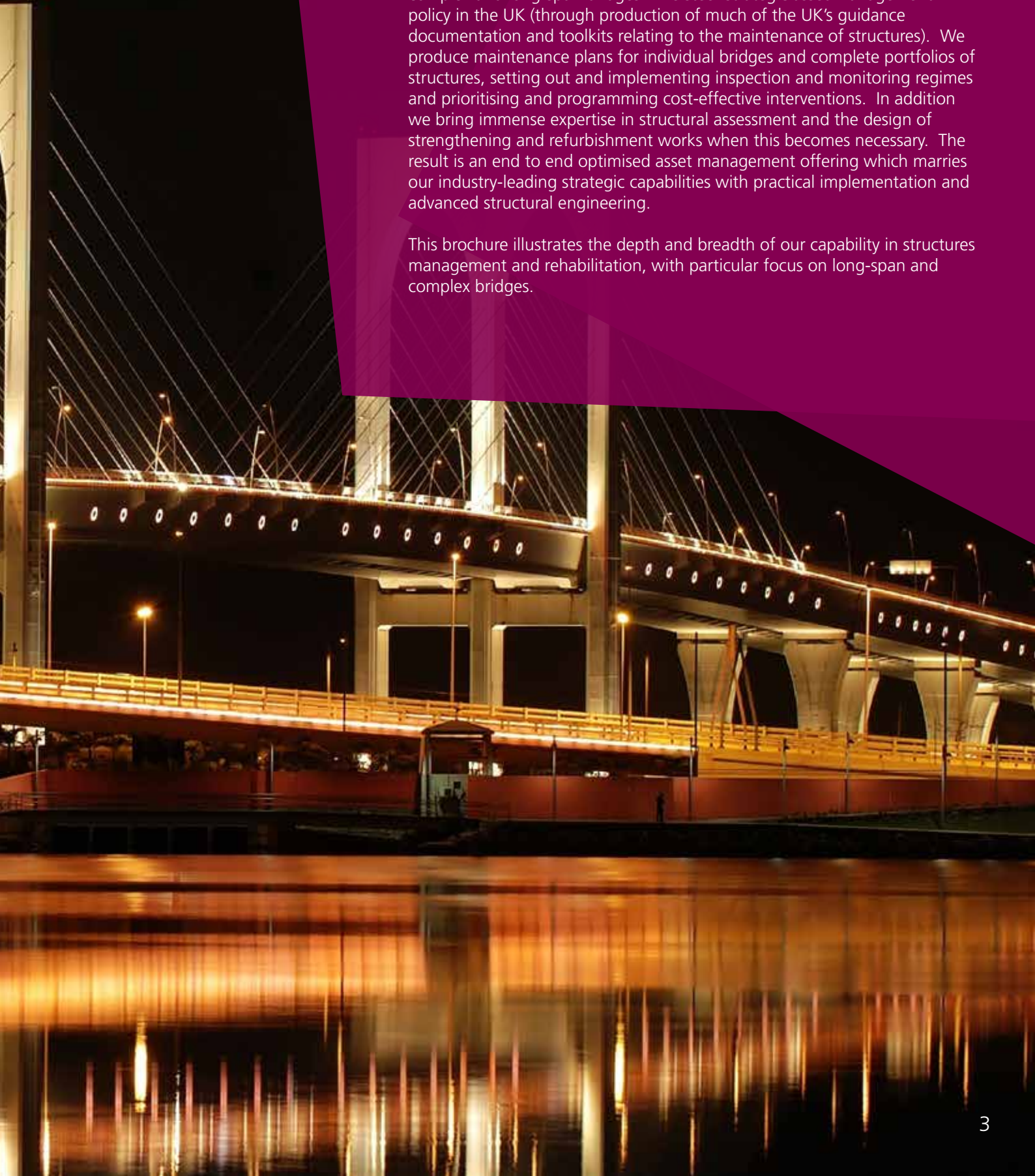


Introduction

Atkins is the UK's largest engineering and design consultancy and one of the world's biggest global design firms. We have the depth and breadth of expertise to deliver the most technically challenging and programme-critical infrastructure projects. From innovative transport planning and design, to the management of highway and rail structures, we plan, design and enable transportation solutions.

Atkins offers a unique service in the management and refurbishment of complex and long-span bridges. We steer strategic asset management policy in the UK (through production of much of the UK's guidance documentation and toolkits relating to the maintenance of structures). We produce maintenance plans for individual bridges and complete portfolios of structures, setting out and implementing inspection and monitoring regimes and prioritising and programming cost-effective interventions. In addition we bring immense expertise in structural assessment and the design of strengthening and refurbishment works when this becomes necessary. The result is an end to end optimised asset management offering which marries our industry-leading strategic capabilities with practical implementation and advanced structural engineering.

This brochure illustrates the depth and breadth of our capability in structures management and rehabilitation, with particular focus on long-span and complex bridges.



Structural Assessment, Refurbishment and Strengthening

With around 650 bridge engineers internationally, we have the depth and breadth of technical expertise to undertake the most complex of challenges.

We specialise in the assessment and strengthening of complex bridges in all materials, whether necessitated by deterioration (such as due to corrosion or fatigue) or by change in use (such as the need to cater for increased or modified traffic arrangements).

Eliminating the need for strengthening works or limiting the extent required has a profound effect on minimising spend and maximising the availability of the network, thus also minimising disruption to the travelling public. We seek to achieve this through challenging traditional assumptions and analysis methodologies and applying current research, reliability based methods and advanced structural analysis to prove structural adequacy where more standardised approaches fail.

Rehabilitation for deterioration mostly requires consideration of numerous possible solutions to achieve the goals of minimised spend and maximised asset availability. For example, concrete structures with reinforcement corrosion will necessitate consideration of many options including concrete removal and reinstatement, addition of corrosion inhibitors, strengthening with materials with enhanced corrosion resistance like stainless steel and carbon fibre and the application of cathodic protection. The right option will vary from structure to structure for a variety of reasons including the causes of corrosion and site and concession constraints.

Whatever the problem, we will always look for the right solution that balances cost, network availability and disruption to suit the clients strategic objectives.

Sai Van Bridge, Macau



Atkins undertook a structural assessment of the existing bridge, comprising a 180m span cable stayed bridge and 1.6km of approach viaducts, to determine what modifications were necessary to permit the addition of light rail within the deck box.

Existing Medway Bridge, UK



The M2 widening required a new 953m long viaduct and refurbishment of the original 1960 design. The new bridge has the longest externally post-tensioned span in the UK (152m) and won the Concrete Society Award for Excellence and Innovation. The refurbishment of the original viaduct required replacing the entire suspended central concrete span with a lighter steel-concrete composite one, together with repairing the half joints.

Forth Road Bridge, UK

We have worked closely with the Forth Estuary Transport Authority to design refurbishment of the suspension bridge main expansion joints and bearings. The design team has used a wide range of techniques from non-linear analysis to the application of research by industry groups such as fib and ECCS to design and plan the execution of the works with the minimum of strengthening, cost and disruption.



End to End Asset Management

As the largest UK consultant for highway and bridge design, we are uniquely positioned to provide industry wide technical advice and guidance on the design and management of bridges. Atkins has been at the forefront of producing many of the UK's key standards, codes of practice and design manuals aimed at delivering efficient design and asset management of infrastructure. Our policy setting extends to bridge inspection where we have recently developed a competence framework for bridge inspectors for the UK Bridges Board and the NRA of Ireland.

Atkins knows how to look after a client's assets. With a history of acting as a Maintaining Agent for the UK Highways Agency and as a current Design Build Finance and Operate shareholder with responsibilities for assets across the UK, we understand the maintenance cycle and the necessity of planning appropriate and cost effective interventions within targeted budgets.

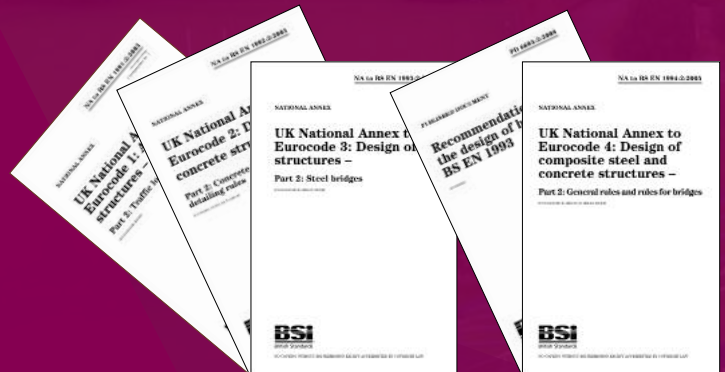
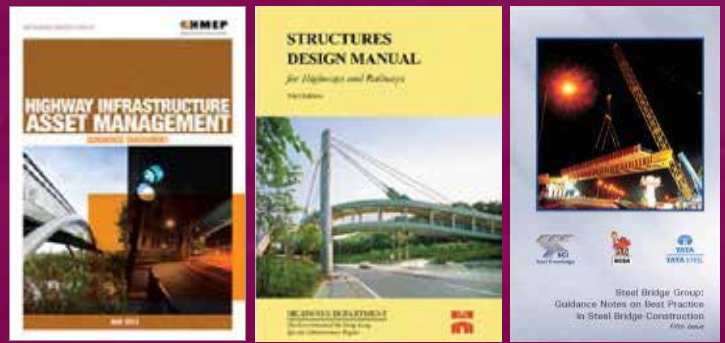
Uniquely, we introduce our strategic national and international policy thinking into what we do operationally on projects. We have developed a structures asset management planning toolkit on behalf of the Department for Transport, Highway Asset Management Financial Information Group and The Chartered Institute of Public Finance and Accountancy. This supports bridge engineers and managers in their financial planning, prioritisation of needs, lifecycle planning, and asset valuation.

Our teams understand the importance that accurate inspections and condition surveys have on the decision on how an asset should be managed. Utilising a targeted risk based approach, identifying more vulnerable structures allows us to target limited physical and financial resources to critical areas. Derivation of rates of degradation and extrapolation to identify the point at which degradation risks compromising the stability of the asset permits a planned programme of works and expenditure to be developed.

Our knowledge of whole life cycle costs, practicalities of maintenance and detailed engineering capability forms a fundamental part of how we ensure that bridge infrastructure continues to operate at the desired level.



Under the UK Roads Liaison Group (UKRLG) we introduced codes of practice such as "Well-lit Highways", "Well-maintained Highways" and "Management of Highway Structures", "Management of Electronic Traffic Equipment" together with other guidance documents



M4 Elevated Viaducts, UK



Asset Management Plans

On behalf of Connect Plus we are preparing asset management plans for the sub structure of the M4 viaducts based upon our inspection and condition assessments.

The substructure maintenance strategy is being developed through a risk based approach to prioritise the substructure elements that are most critical. Deterioration modelling coupled with structural assessment permits future structural adequacy to be evaluated and enable a prediction of time to intervention for each substructure element.

Severn Bridge, UK

Atkins is working with the Highways Agency under the Area 2 Asset Support Contract and is responsible for continuous monitoring and structural assessment for the M48 Severn Bridge, deriving cable strength from inspection data and applied traffic loading from weigh in motion equipment.



Management of Suspension Bridge Cables

Our specialist engineers provide expertise in the assessment and management of suspension bridge main cables.

Atkins has unique experience in implementing dehumidification systems on the Forth, Severn and Humber suspension bridges. This has included not only producing the detailed M&E specification for the dehumidification plant and SCADA control systems, but also the design of the mobile access gantries needed to install the equipment along each cable, 130m above sea level. The self-propelled gantries provide full and safe access without disruption to the traffic below.

Our services have included:

- Monitoring of dehumidification and Acoustic Emissions systems
- Interpretation of cable inspection data
- Cable strength evaluation
- Derivation of Bridge Specific Assessment Live Loading from Weigh in Motion data
- Main cable assessment
- Main cable access system specification
- Main cable dehumidification system specification
- Cable wrapping machine design

Forth Road Bridge, UK



Atkins has unique experience and expertise in the preparation of main cable dehumidification system specification and the design of mobile access gantries and cable wrapping machines.

Management of Cable Stayed Bridges

Atkins provides end to end asset management services for some of the world's most vital cable stayed bridges. Our services have included initial inspection and diagnosis, design and implementation of remedial schemes (including wholesale cable replacements) and the development of long term bridge maintenance strategies to keep structures safe and available for use with a spend profile tailored to the client's operational requirements and budget.

We have extensive experience with the assessment of cable stayed structures and have unique experience in the field of stay cable vibration and fatigue.

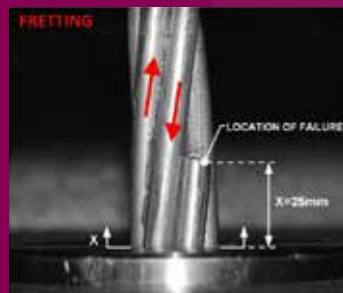
Our services have included:

- Maintenance prioritisation and planning
- Bridge inspection
- Structural assessment
- Cable fatigue and vibration investigations
- Fatigue management
- Monitoring specification
- Cable replacement design
- Strengthening and modification
- Construction auditing
- Toll plaza design

QEII Bridge, UK



Atkins is part of a consortium that is responsible for the long term operation and maintenance of the QEII Dartford Crossing. The bridge carries four lanes of traffic over the River Thames in each direction.



Atkins is carrying out leading research into stay cable fatigue and vibration which will lead to an update to fib guidance on the subject.

Penang Bridge, Malaysia

Atkins was the Client's Special Advisor for the cable stay replacement scheme on the 13.5km crossing, carried out structural analysis of bridge due to traffic increases and advised on maintenance regime.



Management of Complex Steel Bridges

Atkins has extensive expertise in providing solutions for the repair, strengthening and maintenance of steel box girders and other complex steel bridges. Our steel box girder experience is particularly unrivalled in the UK, which has been constant and sustained over two decades.

Whether the problem is fatigue damage, material deficiencies, structural overload, impact damage, detailing, workmanship or just general deterioration, we will find the right solution to match the specific project constraints.

Our services have included:

- Bridge structural assessment and live load derivation
- Design for strengthening and repair of box girders
- Fatigue management of orthotropic steel decks and box girders
- Emergency repair works caused by accidental situations
- Principal Inspections
- Bearing replacement
- Demag expansion joint replacement
- Specification of Acoustic Emissions monitoring for fatigue
- Specification of in-situ strain monitoring with laser shearing interferometry
- Specification of NDT
- Heat straightening and other repair methods for impacted steelwork

Boston Manor Viaduct, UK



Atkins was responsible for carrying out an independent check for the emergency repair works on the Boston Manor Viaduct. Cracks in electroslag butt welds forced a full bridge closure during the run up to the 2012 London Olympics. Atkins immediately mobilised the right team to enable repair works to be completed quickly and to allow the bridge to be reopened to Olympic Family traffic.

Avonmouth Bridge, UK



Atkins produced a fatigue management plan for the orthotropic deck, which suffered from longitudinal cracks in the deck to trough welds, and designed the scheme for replacing the Demag expansion joints.

Erskine Bridge, UK

Atkins carried out structural checking of the bridge and the necessary strengthening works. In addition, we carried out structural checking of the damaged bridge and emergency strengthening subsequent to a collision by an oil rig.



A14 Orwell Bridge, UK

Atkins has carried out structural assessment, monitoring and bearing replacement to ensure the structural integrity of the crossing over the Orwell River. We implemented an extensive monitoring regime to ensure efficient management of the bridge and timely interventions when required.



Management of Complex Concrete Bridges

Atkins has historically looked after the refurbishment and strengthening of some of the UK's most important elevated concrete viaducts, such as the Midland Links Motorway viaducts and, most recently the elevated sections of the M4 at the approach to central London. We have particularly extensive experience in the assessment and rehabilitation of long span prestressed concrete box girder bridges. Whatever the structural form, we pride ourselves on mitigating the need for strengthening wherever possible and practical, and providing the most appropriate solutions for refurbishment schemes such as the replacement of half joints, bearings and expansion joints.

Our services have included:

- Bridge structural assessment and live load derivation
- Design for strengthening
- Design for concrete repair including Cathodic Protection
- Assessment and management of deteriorated post-tensioned tendons
- Specification for non-destructive testing
- Specification for monitoring of joint movement
- Principal Inspections
- Half joint management and repair
- Bearing replacement
- Management of expansion joints

Itchen Bridge, UK



Atkins was commissioned to carry out the Category III structural assessment of the superstructure of the bridge together with an assessment of the piers on the main crossing. A number of Departures from Standards were used to demonstrate adequacy of the bridge under full traffic loading when earlier assessments demonstrated potential shortfalls in capacity.

Monitoring and Investigation of Structures

Inspection and monitoring of existing structures can reveal deficiencies in condition, capacity or operation. Structural monitoring can provide an economic and sustainable alternative to closure or expensive reconstruction.

Atkins has expertise in remote monitoring systems using a wide range of sensory equipment to gather data, and in interpretation of the results. It is important that the correct monitoring system is specified for the problem being investigated, so that meaningful data are recorded and credible conclusions made. For complex problems it may be necessary to use a range of different sensors to gain a full understanding of the situation. Atkins skills also include the ability to identify asset specific requirements, develop specifications and interpret results over a wide range of destructive and non-destructive testing methods which in parallel with monitoring and inspection given a full understanding of the structure.

We are committed to advancing our own and industry's capability in remote monitoring and diagnostics. One example is our participation on the CROSS-IT European funded (FP7) project to develop better remote monitoring and condition evaluation methods by harnessing ultrasonic guide wave technology.

Project website address: <http://www.crossit-project.eu/>

Bowdon View, UK



We specified Acoustic Emission monitoring to detect prestressing wire breaks in the post-tensioned boxes whilst maintaining the bridge in service before demolition due to severe deterioration and loss of section of the post-tensioning cables.

M4 Elevated Viaducts, UK



We specified remote crack monitoring in conjunction with specifying intervention trigger levels to enable safe continued operation of the concrete viaducts in the interim before necessary permanent strengthening, designed by Atkins, is installed.

Midland Links, UK

Atkins used the results from full scale load tests and in-situ strain measurement from laser shearing interferometry to determine an increased fatigue life for these vital steel boxes carrying the M5 and M6 motorways in the UK.



Building Information Modelling

Atkins has cutting edge capability in the development of BIM solutions for different purposes including structures asset management. We frequently create 3D models of existing assets by processing point cloud data from laser scanning, which can then be used in the development of refurbishment schemes. Examples where our 3D virtual reality capability has played an important part in delivering maintenance and refurbishment schemes include:

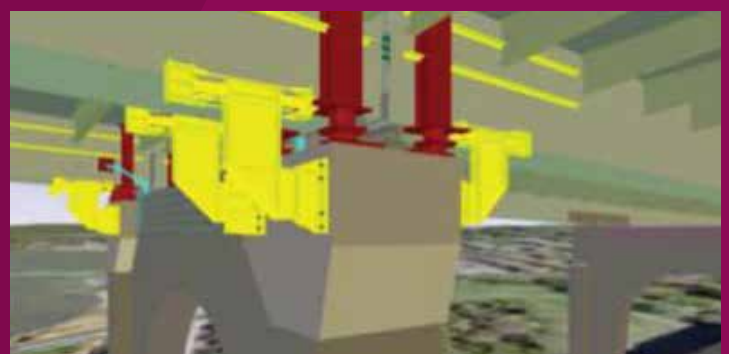
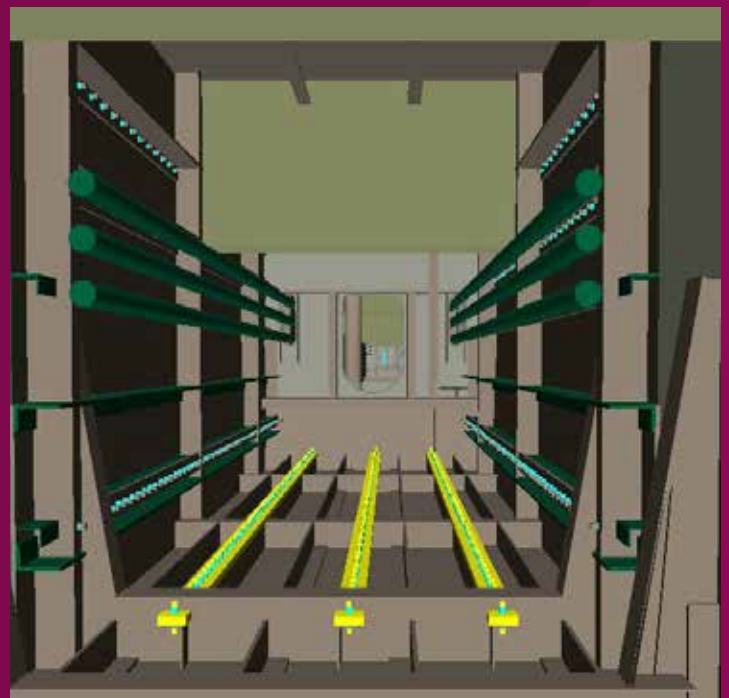
- Creating visual representations of schemes to gain planning permission
- Improving buildability of designs through clash detection
- Improving construction planning and safety risk management through visualisation of construction sequences
- Facilitating progress monitoring

With no off the shelf solutions available, we are currently leading the industry with the development of our BIM offering to cover all stages of operation and maintenance. On the M4 Elevated Viaducts in the UK we are currently using our 3D models to host other critical data such as inspection and condition information, testing history, assessed strength and, once evaluated from this data, the planned maintenance interventions and programme.



Forth Road Bridge

BIM and 3D visualisation techniques were used extensively on the Forth Road Bridge to assist in the optioneering, heritage approval, design and construction sequencing of the bearing replacement scheme. The structure had limited access to the top of the piers and insufficient space for jacks to be installed so the piers were widened with the addition of corbels and the steelwork strengthened to receive jacking loads. 3D modelling of the pier head and box girders enabled pier head widening, locations of temporary works and associated additional girder stiffening to be coordinated around existing reinforcement, steelwork and service cabling.



UK & Europe:

Euston Tower, 286 Euston Road, London
NW1 3AT, UK
T: +44 (0)20 7121 2000

Asia Pacific:

5th Floor, Wharf T&T Centre, Harbour City,
Tsim Sha Tsui, Kowloon, Hong Kong
T: +852 2972 1000

Middle East and India:

PO Box 5620, 3rd Floor, Al Rostamani
(Al Hamriya) Building, Khalid Bin Waleed
Road, Dubai, UAE
T: +971 4405 9300

North America:

4030 West Boy Scout Boulevard, Suite 700,
Tampa, FL 33607, USA
T: +1 813 282 7275

ATKINS

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transportation@atkinsglobal.com

www.atkinsglobal.com