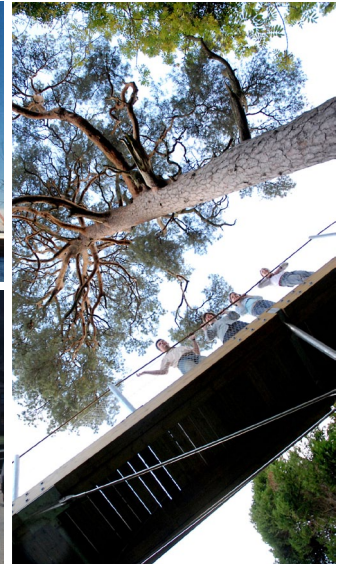




## Bridges

designing creative, sustainable solutions







Clackmannanshire Bridge, Upper Forth Crossing, UK

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## Introduction

Bridges are arguably the most well-recognised component of the Civil Engineer's contribution to engineering infrastructure, possibly as a result of their visual prominence and the technological achievements often evident in their construction. Not surprisingly then, bridge engineering is an important area of URS' business, one in which we have developed an enviable reputation over more than fifty years.

The company has worked worldwide on the design of new bridges and also on the inspection, assessment and strengthening of existing ones, in both the Highways and Railways sector. In these contexts, "bridges" incorporates the other significant structure types associated with them: typically tunnels, culverts and retaining walls. We have experience of working under a variety of procurement regimes – traditional client design, Design and Build, DBFO/PFI, Early Contractor Involvement – and in the various associated roles – Designer, Checker, Technical Advisor.

Whilst some of our commissions are solely bridge-related, the majority of our involvement in this field is as an integral part of a multi-disciplinary team engaged on Highway or Rail projects where we work closely with our colleagues from the highway or railway design disciplines, geotechnical specialists, drainage engineers, hydrologists and environmentalists.

In order to maintain our position at the forefront of bridge engineering, we actively encourage staff participation in research and relevant industry bodies; we have Engineers presently active in the Steel Construction Institute, Concrete Bridge Development Group, World Road Association and ICE Bridge Engineering Journal.





## A1 Haddington to Dunbar Expressway River Tyne Bridge, UK

This elegant three span post-tensioned prestressed concrete bridge was awarded a Certificate of Excellence at the Concrete Society Awards. URS was the Designer under a Design and Build contract.





The company's position as a leading global provider of design services in the Transportation Sector has led to our staff having experience in the design of structures ranging from short-span simply-supported bridge decks and low-rise retaining walls, through those normally associated with major highway interchanges, to long multi-span viaducts and cable-stayed bridges. The materials used include reinforced in-situ and pre-cast concrete, pre-stressed in-situ and precast concrete, structural steel, and natural and laminated timber.

Designs in concrete have included post-tensioned precast segmental construction and post-tensioned in-situ construction, both to be constructed span by span and as balanced cantilevers, as well as simpler forms adopting reinforced in-situ concrete and precast prestressed concrete beams.

Structural steel has been used compositely with reinforced concrete in plate or box girder form and also in major through-truss girder forms of construction.

Designers have at their disposal state-of-the-art Finite Element analysis and design computer software which, when used by skilled staff, ensure optimisation of design and in some circumstances allow analysis methods outwith the scope of current standards to be adopted to the Client's benefit.



Blackwater Viaduct, Ireland



A1 Haddington to Dunbar Expressway, River Tyne Bridge, UK



P1-P2 Interchange, Hong Kong





A46 Newark to Widmerpool Improvement, UK



Brisbane Gateway Bridge, Australia



Taney Road Light Rail Bridge, Dublin



## Highway Bridges

Bridges, retaining walls and culverts are an integral part of almost all significant highway projects; indeed it is often the presence and form of the former two which give the overall scheme its identity.

Our Bridges staff have extensive experience of working closely with their highway, drainage design and geotechnical colleagues in producing integrated schemes from inception to final design. Particular attention is given to the appearance of the structures since,

as noted, this is often the feature which is most prominent in the eyes of the user as well as being an inherent part of quality design in any circumstance. Continuity within major highway schemes is usually achieved by adopting the concept of “a family of structures” with similar or complementary structural forms and consistent finishes.

In many circumstances where infrastructure is already well developed, highway schemes are essentially improvements to

existing routes e.g. motorway widening, by adding more lanes or enhancing existing grade-separated junctions to provide additional movements. In such instances the design of structures must take cognisance of their constructability within the constraints of acceptable temporary traffic management; this is an area where the company has much recent relevant experience of working closely with either the end client or the Design & Build or ECI Contractor to establish the optimum design solution.



St James Interchange, UK





Bhairab Bridges, Bangladesh



A30 Bodmin to Indian Queens, UK







## Upper Firth Crossing, UK

The Upper Firth Crossing gained numerous awards for its significant achievement in planning, designing and constructing a new crossing to the Upper Firth estuary which brought substantial benefits to the surrounding area while protecting the sensitive ecology of the Firth of Forth.

The centrepiece of the project was the Clackmannanshire Bridge. 1200 metres long with 45 spans, it was launched as a prestressed concrete box girder across the environmentally sensitive firth, becoming the second longest launched bridge in the world.



Gdansk Bridge, Poland



Carrick Bridge, UK



River Shannon Bridge, Ireland





## A5 Newtown Stewart Bypass, UK

The company provided the complete consultancy service for this project which received a CEEQUAL (Civil Engineering Environmental Quality Assessment) Award. It included the design of two 100m long bridges across the River Strule.









## A1 Beech Hill to Cloghogue Dualling, UK

This project included 17 significant highway structures among which were two major river crossings and an extension to an existing railway tunnel. As Technical Advisor to the client under DBFO procurement, the company was responsible for preliminary design of the structures, preparation of contract documentation and contract supervision which included review and acceptance of final designs.



## Rail Bridges

URS has a substantial resource in the Railway Engineering field, and particularly in recent years our bridge designers have played a pivotal role within multi-disciplinary design teams on several high profile projects such as Network Rail's West Coast Route Modernisation and East Coast Main Line.

In many instances the bridge design is undertaken within the context of minimising or completely avoiding any disruption to existing operational lines, a factor which is often the dominating influence in the initial selection of the design solution as well as in its subsequent detailed development.

Working closely with the infrastructure owner and contractors, we have been responsible for award-winning innovative designs which have permitted the construction or replacement of bridges on critical network links within some incredibly short line closure windows.

Where high speed lines (>200km/hour) are being introduced, consideration must also be given to the structure's dynamic response to the impact of passing rail traffic for which our specialists have developed bespoke finite element analysis packages.



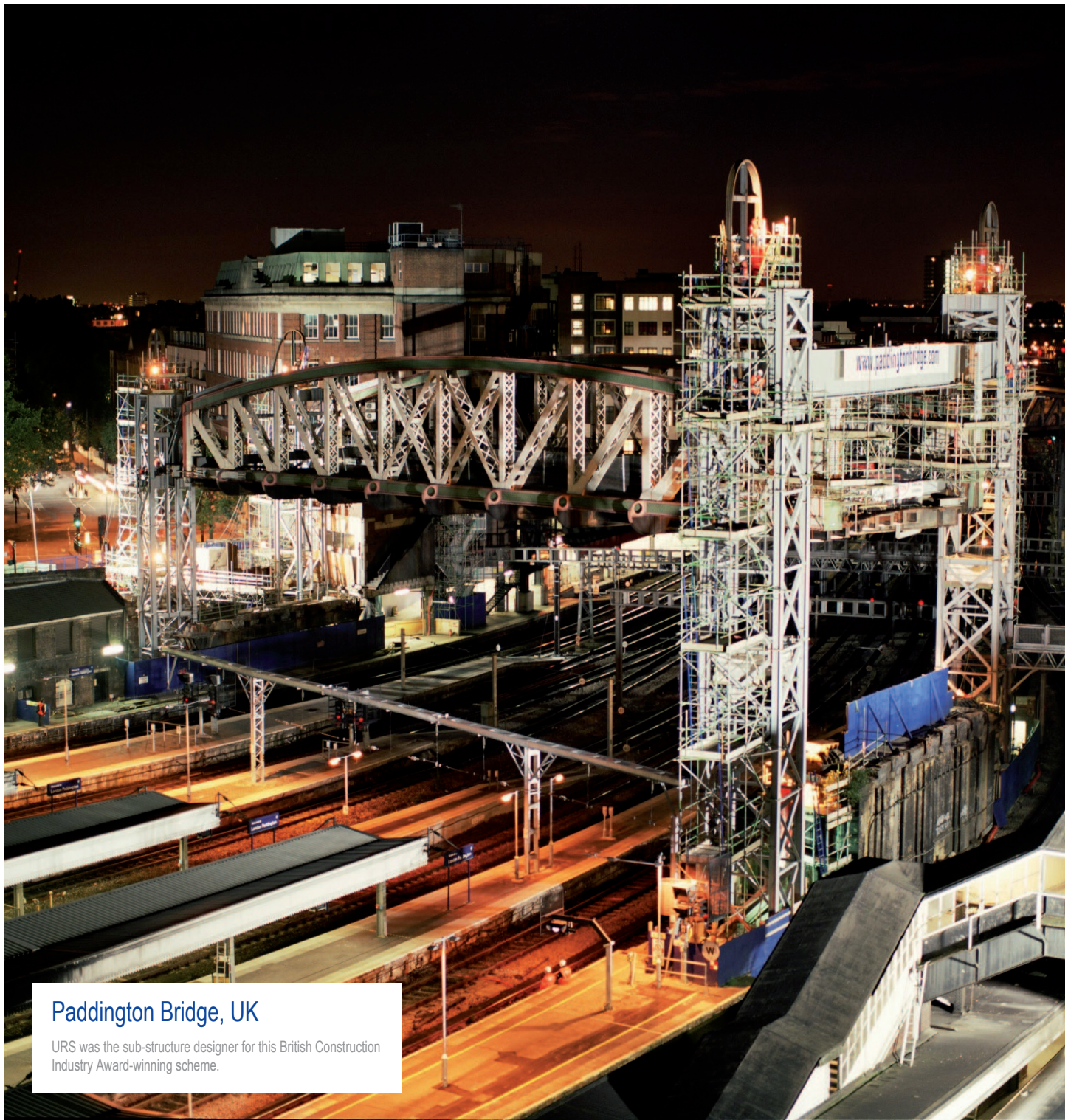


## Portrack Viaduct, UK

Working closely with Network Rail and their appointed contractor, URS designed this award-winning 2km railway realignment and viaduct over the River Nith in Dumfriesshire, aesthetics and mitigation of environmental impact being key factors. The twin 90m long curved truss girders forming the main span, each with a mass of some 400 tonnes, were lifted into place on consecutive weekends using the largest mobile crane in the world.







## Paddington Bridge, UK

URS was the sub-structure designer for this British Construction Industry Award-winning scheme.





Float Viaduct, UK



West Rail Viaducts, China



Larkhall - Milngavie Reopening of the Lines, UK



## West Coast Route Modernisation - Trent Valley, River Tame Viaduct, UK

URS was responsible for conceptual and detailed design of all of the civil engineering components of the £300m Trent Valley Four Tracking scheme for Network Rail as part of their West Coast Route Modernisation Project. Over the River Tame twin 94 metre long three span viaducts were designed as half through superstructures supported on piled foundations. These were among the first of such structures in the UK to be designed in accordance with the guidelines covering the dynamic effects caused by the passage of high speed trains.







## GE 19 East London Line Bridge, UK

A single 84 metre span steel truss girder bridge spanning six railway lines at a high skew angle which was launched to minimise disruption to rail traffic.



## Footbridges

Foot and cycle bridges often present the bridge designer with a greater opportunity to produce something unique and visually attractive as the geometrical and functional constraints are typically less onerous than those associated with road and

rail structures. The company has been responsible for the conceptual and detailed design of a large variety of footbridge forms in various settings. Working closely with clients, and in some instances with specialist architect input, our designers

have produced many attractive examples of all of the main forms as well as those less common: beam and slab, through truss (Vierendeel, Pratt & Warren and helical types), tied arch, cable-stayed and even 'rope'.



Newcastle Promenade Footbridge, UK





## Carrick-a-Rede Rope Bridge, UK

The company was appointed by The National Trust to design a replacement rope bridge connecting the small fishing island to the mainland over a 25 metre drop.







## Westlink Footbridge, Belfast, UK

The concept and preliminary design of this landmark footbridge in Belfast were developed by URS who were then responsible for its procurement through a DBFO contract arrangement. The tube-like superstructure comprises a through Vierendeel type truss which oversails the cradle supports at each end before connecting with the stair and ramp structures.







Holyhead Gateway Footbridge, UK



M8 Harthill Footbridge, UK



Tilford Bridge, UK



## Lough Key Timber Tree Top Walk

The design of this innovative bridge complements its scenic surroundings in Lough Key Forest Park.







## Cragside Footbridge, UK

URS was appointed to design an innovative and sympathetic package of restoration works to enable The National Trust to re-open this historic footbridge in Northumberland. The appearance and basic fabric of the structure had to be preserved and in order to achieve this the resurrection of long-forgotten hot riveting techniques was required.





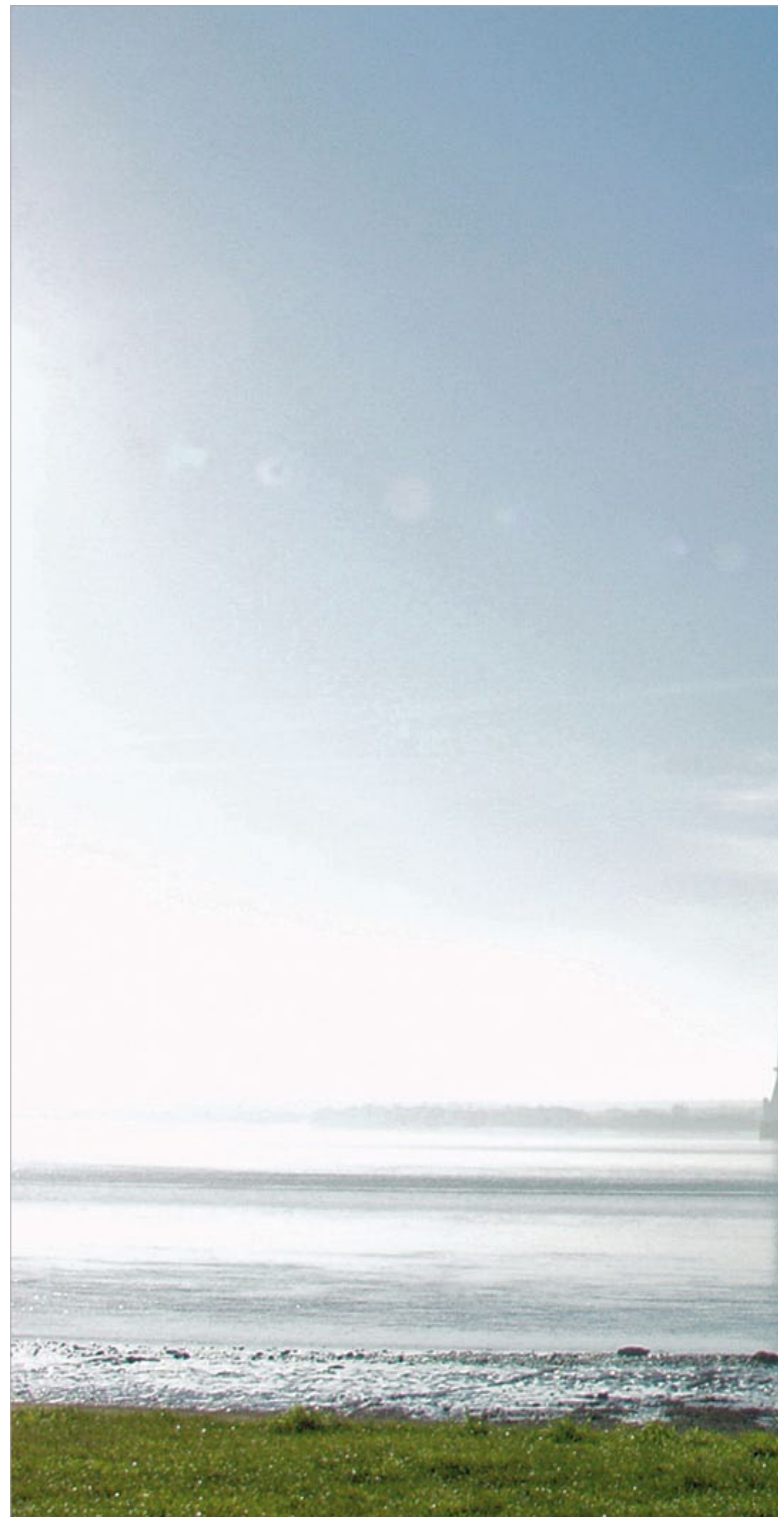


## Construction Supervision and Project Management

Bridge designs should seek to produce durable results which minimise the need for disruptive maintenance or component replacement throughout their design life, which is typically over one hundred years. However, no matter how successful the design and material specifications are in this respect, the quality of the build process itself remains a vital factor in achieving a durable end product with an attractive appearance.

URS has experience of monitoring and supervising bridge construction in various roles; as Engineer under traditional procurement methods and as Designer's Site Representative or the Client's Technical Advisor on Design and Build/DBFO Projects. In whatever role we play we seek to work constructively with all other stakeholders, using our considerable knowledge and experience to exert a positive influence on the quality of construction.

Bridge design and construction supervision activities are often undertaken within a wider project management role where the company is able to provide a truly one-stop shop service to clients of all sizes from the conceptual through to maintenance stages of projects. We have extensive experience in public and stakeholder consultation and management, risk management, value management, procurement management and financial control. These capabilities overarch the other technical disciplines, such as geotechnical engineering and environmental appraisal, which complement our bridge expertise.







## Izmit Bridge

A visual representation of the Izmit Bridge (based on the Humber Bridge, UK). The proposed Izmit Bridge will facilitate a continuous motorway link between Istanbul, Bursa and Izmir, respectively the largest, third and fourth largest cities in Turkey. The structure comprises a 1650m long suspension bridge with approach viaducts and is located close to the North Anatolia Fault, a major geological feature. The constructor, a joint venture of five Turkish and one Italian construction companies, has appointed URS in joint venture with AECOM as their consultants for the Design Check and construction supervision.





First Central Western Gateway, UK



Bridges in Trichy, Perambalur and Karur Districts of Tamil Nadu, India





Copnor Bridge, UK



Flyover at National Park Junction, India



M275 Tipner Interchange Bridges, UK



A50 Blythe Bridge, UK





Pulawy Bypass and Bridge, Poland







## S69 Expressway, Poland

The S69 Expressway is part of the European Transport Corridor. URS Scott Wilson was designer under a D&B contract to upgrade existing motorway interchanges which included 18 new structures.



## Bridges Management and Maintenance

The bridge stocks of public authorities worldwide are typically the subject of prescribed asset management regimes which generally include an ongoing inspection programme and guidance on the triggers for structural assessments. In addition to assessments which may be required as a response to deteriorating structural condition, they are often also necessary to determine whether modification and/or strengthening is required to accommodate revised loading conditions. Accurate assessment often requires sampling and testing of materials, particularly where original design and construction records are not available.

URS has extensive experience in all of these areas: inspection, assessment, sampling and testing. Indeed, assessment work contributes a significant proportion of our overall bridges design workload and often involves some of our most complex and technically demanding work. In many cases the use of leading-edge analysis techniques can enhance the calculated structural capacity such that the extent of any strengthening can be significantly reduced from that originally required.



M4-A34 Chively Interchange Improvements, UK



Half cell potential testing by in-house UKAS accredited personnel.



## M8 White Cart Viaduct Strengthening, UK

URS undertook a comprehensive inspection and assessment of the entire 900 metre long structure which carries 100,000 vehicles per day and identified the need for substantial strengthening and maintenance works. We then designed and supervised these works in four phases the third of which involved complex internal strengthening of the steel box girders at a cost of some £10m.





Allied to our extensive analytical ability is a specialist access capability committed specifically to bridge inspection work with the required certification for working in confined spaces, rope access and materials sampling.

Services include:

- General and Principal inspections
- Special inspections
- PPI / DBFO funding advice
- UKAS accredited nondestructive testing
- Structural assessment
- Development and whole life costing of remedial options
- Design of remedial schemes
- Design and operation of cathodic protection systems
- Preparation of contract documentation
- Site supervision
- Expert reports
- Roped access, confined space and MEWP access Strengthening



Inspection by in-house MEWP accredited personnel





Burnton Railway Viaduct, UK



Stones Railway Bridge, UK



Bridge inspection using in-house roped access certified personnel



## Associated Professional Disciplines

- Structural Engineering
- Highway Engineering
- Tunnel Engineering
- Transportation
- Flood Mitigation
- Architecture
- Environment
- Landscape Architecture
- Urban Design & Masterplanning
- Ecology
- Archaeology
- Waste Management
- Water
- Geotechnical Engineering
- Tourism
- Project Management



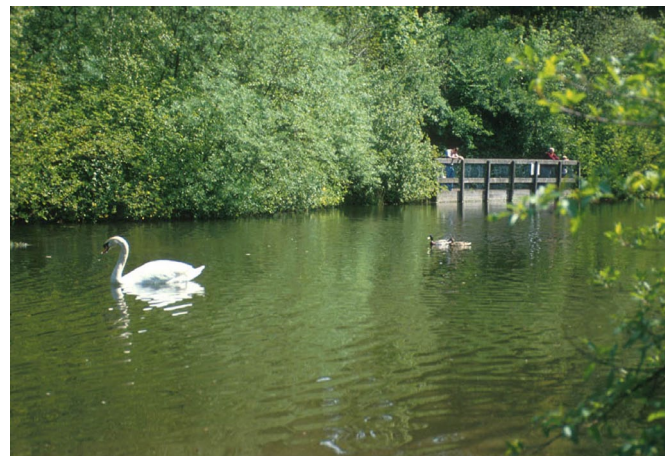
Highway Engineering, Ecology and Environment



Structural and Tunnel Engineering



Geotechnical Engineering

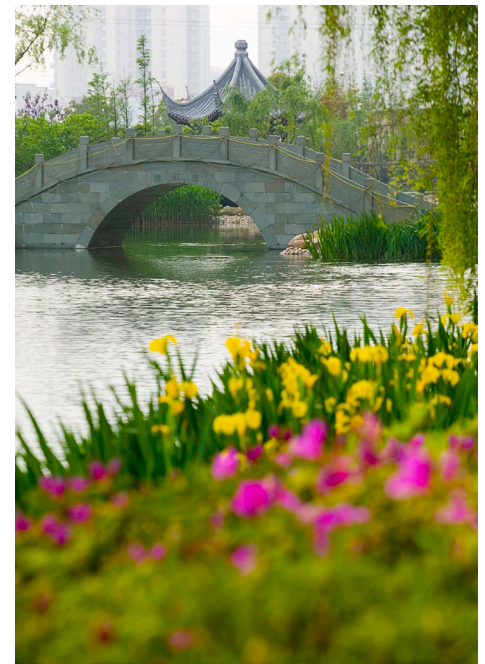


Ecology





Structural Engineering, Tourism, Leisure and Landscape



Landscape, Water and Waste Management



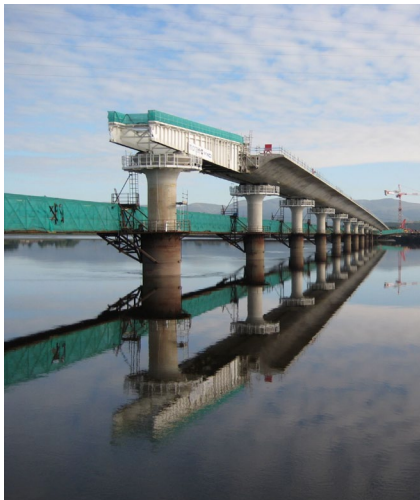
Landscape Architecture



## Selected Project List

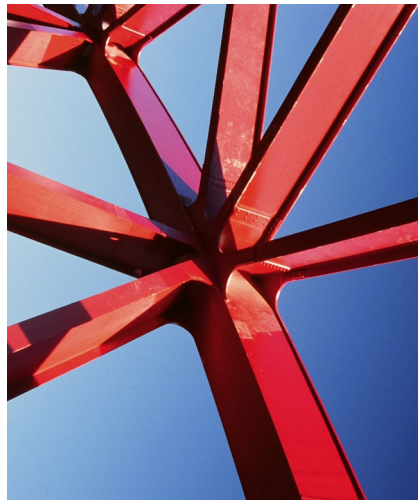
### Highway Bridges

A1 River Tyne Bridge, UK  
A27 Brockhampton Road Bridge, UK  
A46 Newark to Lincoln Improvement, UK  
A5 Newtownstewart Bypass, UK  
A1033 Hedon Road Improvement - Salt End Flyover, UK  
M8 St James Interchange, UK  
Au Tau Interchange, Hong Kong  
M77 DBFO, UK  
Blackwater Viaduct, Ireland  
P1-P2 Interchange, Hong Kong  
Brisbane Gateway Bridge, Australia  
Broadmeadow Estuary Bridge, Ireland  
Bhairab Bridge, Bangladesh  
A30 Bodmin to Indian Queens, UK  
Upper Forth Crossing, UK  
Gdansk Bridge, Poland  
Carrick Bridge, UK  
River Shannon Bridge, UK  
A1 Beechill to Cloghogue Duelling, UK



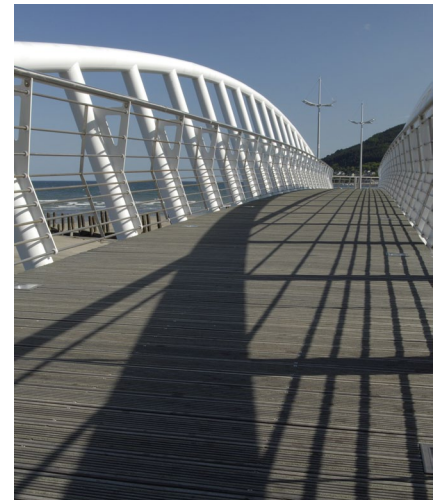
### Rail Bridges

Dunton Railway Bridge, UK  
Glasshoughton Railway Bridge, UK  
GE 19 East London Line Railway Bridges, UK  
Hayes Canal Bridge, UK  
Lower Portrack Bridge, UK  
Milngavie Railway Bridge, UK  
Portrack Viaduct, UK  
River Stour Bridge, UK  
Rivi Rivi Railway Bridge, Malawi  
Zezelj Railway Bridge, Serbia  
Waverley Railway Bridge, UK  
West Rail Viaducts, Hong Kong  
Taney Road Bridge, Ireland  
Paddington Bridge, UK  
Float Viaduct, UK  
Trent Valley River Tame Project, UK



### Footbridges

Carrick-a-Rede Footbridge, UK  
Holyhead Gateway Footbridge, UK  
Honeybourne Line Cyclebridge, UK  
Huntercombe Footbridge Replacement, UK  
Kendrum Cyclebridge, UK  
Lough Key Timber Tree Top Walk, UK  
Newcastle Promenade Footbridge, UK  
Preswick International Airport Station Footbridge, UK  
Sapley Square Footbridge, UK  
Tsuen Wan Skywalk, Hong Kong  
Tilford New Bridge, UK  
M8 Harthill Footbridge, UK  
Cragside Footbridge, UK





## Project Management & Construction Supervision

Izmit Bridge, Turkey  
First Central Western Gateway, UK  
Bridges in Trichy, Perambalur and Karur Districts of Tamil Nadu, India  
Copnor Bridge, UK  
Flyover at National Park Junction, India  
M275 Tipner Interchange Bridges, UK  
A50 Blythe Bridge, UK  
Pulawy Bypass and Bridge, Poland  
S69 Expressway, Poland

## Bridge Management & Maintenance

M4 - M34 Chiveley Interchange Improvements, UK  
M8 White Cart Viaduct Strengthening, UK  
Burton Railway Viaduct, UK  
Stones Road Bridge, UK  
Kingston Bridge, UK

## Selected Awards

M8 Harthill Footbridge, UK (The Saltire Society Awards 2009 - Commendation)  
Upper Forth Crossing, UK (The Saltire Society Awards 2009, CEEQUAL Awards - "Very Good" and Structural Awards 2009 - Award for Transportation Structures)  
A1033 Hedon Road Improvement, UK (Yorkshire Association ICE Award)  
A46 Newark to Lincoln Improvement, UK (ICE East Midlands Merit Award)  
A1 River Tyne Bridge, UK (ICE East Midlands Merit Award)  
Float Viaduct, UK (Structural Steel Design Merit Award)  
Copnor Bridge, UK (Major Project, Best Project & Community Involvement Awards)  
Shoreditch High Street Bridge, UK (ICE East Midlands Merit Awards)  
Tilford New Bridge, UK (Thames Valley & BCI Awards)  
Portrack Railway Realignment, UK (The Saltire Society Civil Engineering Society Award, National Rail Award)







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