



ATKINS

# BRIDGES

World-class structures

## 21<sup>ST</sup> CENTURY CHALLENGE

Delivering a 21st Century transport network that meets the needs for our society is an exciting challenge and transport networks need bridges. Done well, bridges form strong symbols of beauty and local pride for many years as well as serving their community day by day.

**Atkins** is the UK's leading engineering and design consultancy and one of the world's largest global design firms. We have the expertise to deliver the most technically challenging and programme-critical infrastructure projects. Our size brings significant value to our clients, allowing us to harness an unrivalled breadth of skills and deep technical expertise to produce outstanding solutions to the most challenging problems.

**FRONT COVER: TING KAU BRIDGE,**  
HONG KONG, PEOPLE'S REPUBLIC OF CHINA



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## HOOVER DAM BYPASS, UNITED STATES OF AMERICA

**ENABLE**

Construction inspection and quality assurance to support the Central Federal Lands Highway Division's construction management team.

# PLAN DESIGN ENABLE

## A GLOBAL APPROACH

The simplest description of what we do is **Plan, Design and Enable**.

**PLAN** The challenges facing our clients are multidimensional, often because of an increasingly complex modern environment. From cost and risk planning, feasibility studies and logistics to impact assessments and stakeholder engagement activity, we plan every aspect of our clients' projects.

**DESIGN** Atkins designs intellectual capital such as management systems and business processes. We also design physical structures such as office towers, schools, bridges and highways. Whatever we design, we apply the same passion and creativity combined with rigorous quality standards.

**ENABLE** Our clients choose Atkins because they need assurance that their projects are procured safely and predictably. They entrust us with the management of projects, people assets and issues – ensuring that deadlines are met, costs are controlled and success is delivered.



## PLAN LONDON 2012 OLYMPIC PARK, UNITED KINGDOM

Atkins was part of the team delivering the design of the Olympic Park infrastructure for the Games and the Legacy Transportation projects. Working in collaboration, we helped transform the 246ha site in time for London 2012. A 450-strong Atkins team worked side-by-side on the project to allow 11,000 workers safe access to the park's differing construction sites.

In a short period of time our bridges have seamlessly transformed from construction utility structures into dramatic park spaces during the games and then into durable legacy bridges for the local community.



## Collaboration

Having the right people to work on an infrastructure programme or project is essential in making the right choice. Even when it is necessary to have rapid and clear decisions the right expertise and preparation can make all the difference.

Atkins has a worldwide bridge engineering community of 700 staff working on a huge variety of bridge projects whichever stage of the Asset Lifecycle your project has reached. Whether it is a restoration of a remote Alaskan boat portage or a new metro system in Riyadh or Hong Kong we can provide the bridge expertise required by the project team.

## Innovation

Most bridge projects are novel; that's what keeps our passion for engineering solutions fresh. Often solutions are incremental developments to best fit the project's constraints. Occasionally more fundamental changes shift the way we do work such as the introduction of Polymer Composite bridges or new design standards.

Our Bridge Engineering Working Group is our forum for developing, communicating and testing innovation across the Atkins offices in four continents. This Working Group develops guidance and best practice for our engineers, and provides a forum to discuss problems and test out new ideas.

## Sustainability

As engineers we have a responsibility to society to provide practical and holistic solutions, so sustainability is part of our approach. Our designs affect our environment for many decades and touch lives in many different ways. Safety of the constructors, safety of the users, protection of habitats, creation of jobs, use of recycling, and the beauty of the result are just some of the influences that shape our work and that we shape through our work. Our designers can help bring clarity in understanding complex problems.





## DESIGN **BAMBOO BRIDGE,** HONG KONG ISLAND, PEOPLE'S REPUBLIC OF CHINA

One of three footbridges in the South Island Line (East) Project in Hong Kong, the Bamboo Bridge spans approximately 40m across the Staunton Creek Nullah. The superstructure of the bridge is prefabricated and

comprises a reinforced concrete deck and steel tied-arch trusses assembled using circular hollow sections. The main structure was delivered to site by barge before installation of the glass canopy and parapets with glass balustrade.



## ABERDEEN CHANNEL BRIDGE, HONG KONG ISLAND, PEOPLE'S REPUBLIC OF CHINA

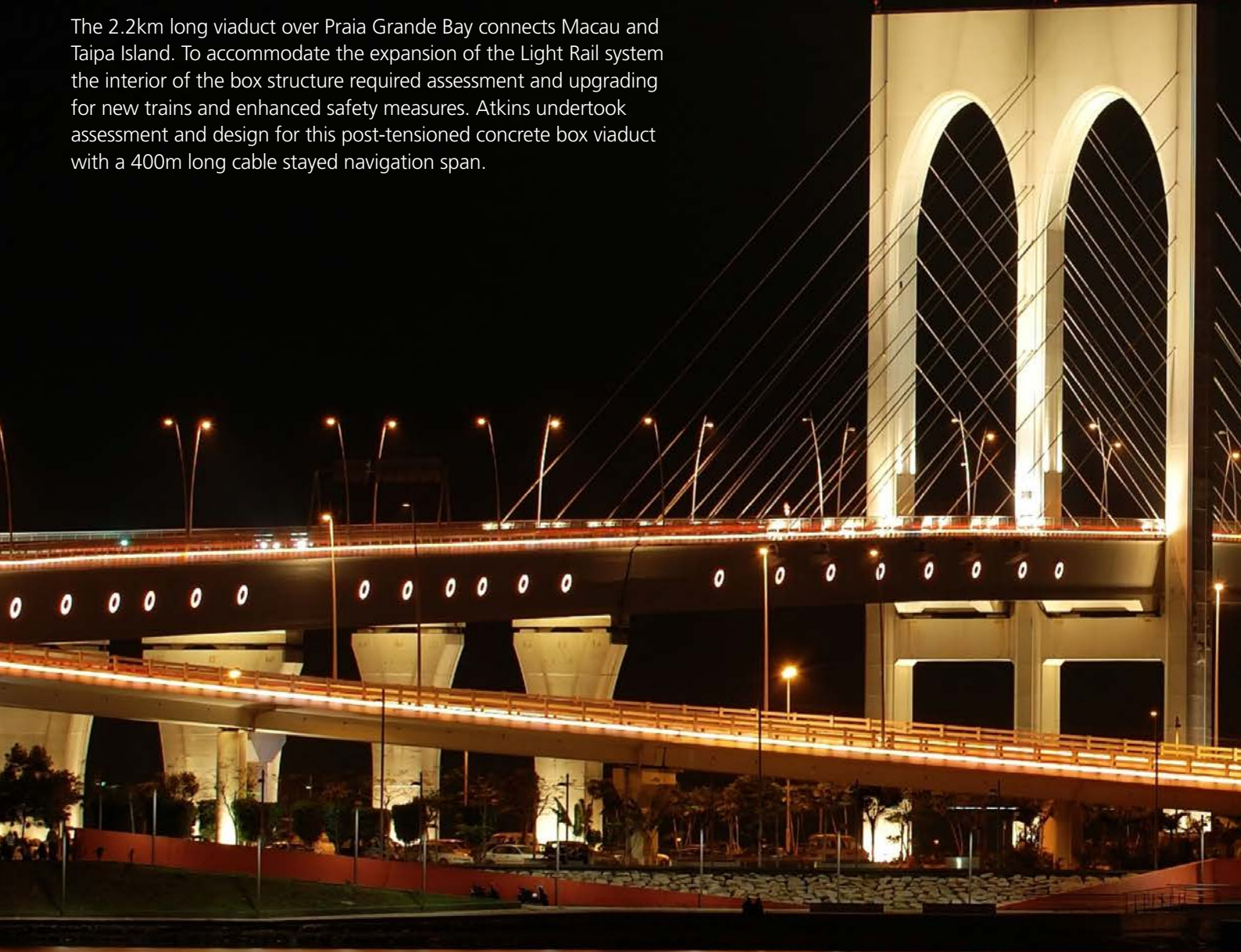
### DESIGN

Detailed design of 115m post-tensioned balanced cantilever bridge over the Aberdeen Channel and 7km of precast segmental viaduct, for the MTR South Island Line extension in Hong Kong. Tight site constraints to avoid existing structures, tie-in with an existing viaduct and matching the existing bridge were key challenges. Integral construction using split piers improved construction and long-term durability.



**ENABLE** **SAI VAN BRIDGE, MACAU,  
PEOPLE'S REPUBLIC OF CHINA**

The 2.2km long viaduct over Praia Grande Bay connects Macau and Taipa Island. To accommodate the expansion of the Light Rail system the interior of the box structure required assessment and upgrading for new trains and enhanced safety measures. Atkins undertook assessment and design for this post-tensioned concrete box viaduct with a 400m long cable stayed navigation span.







## PENANG BRIDGE, MALAYSIA

**ENABLE**

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





# MIDDLE EAST



## RIYADH METRO, KINGDOM OF SAUDI ARABIA

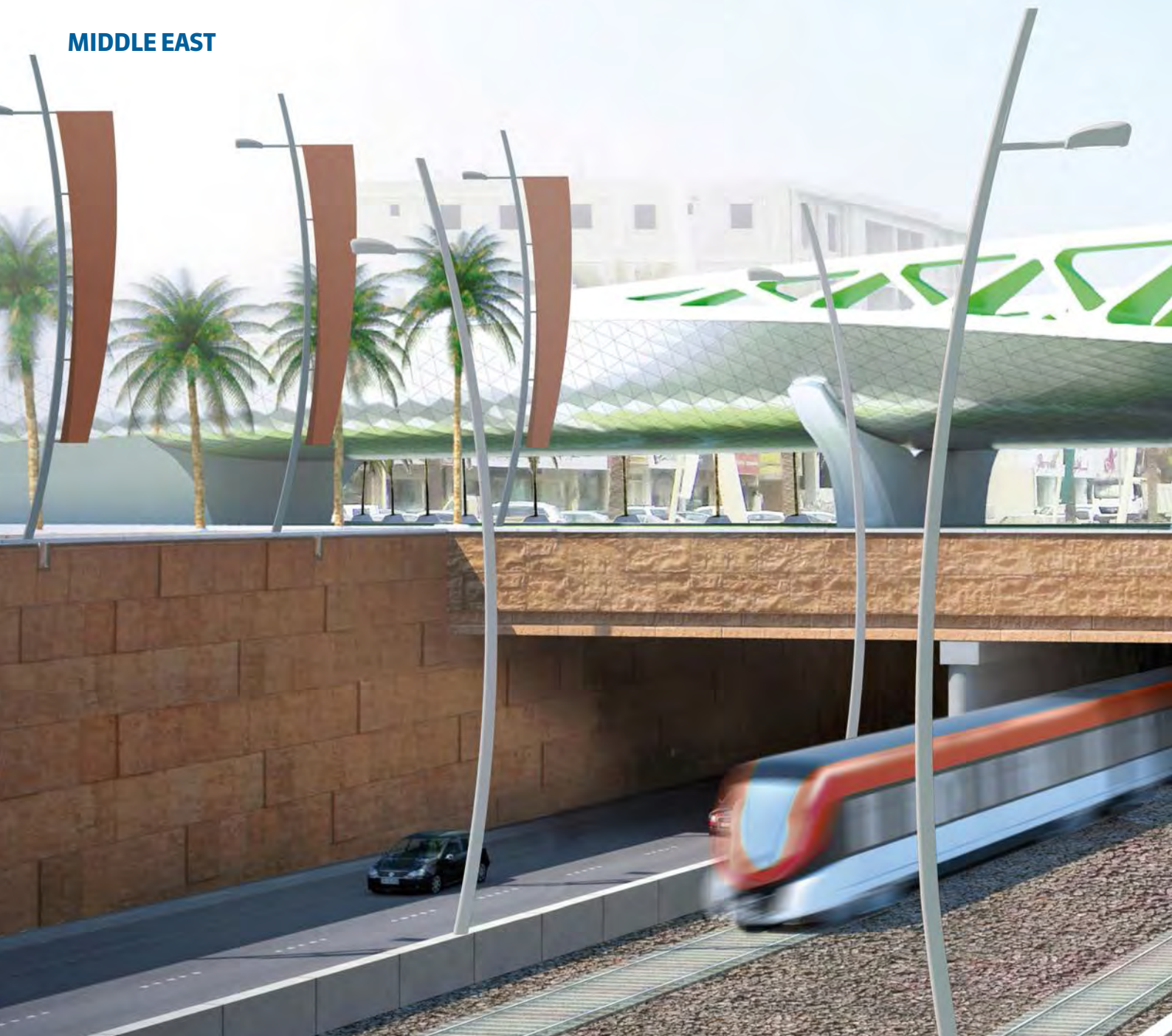
## DESIGN

Atkins is working on Package 3 (Lines 4, 5 & 6) of Riyadh Metro supporting the Design & Build Consortium FAST comprising FCC, Samsung C+T, Struckton, Freyssinet Saudi Arabia and Alstom Transport.

Atkins was lead Consultant of a Design Joint Venture comprising Atkins, Typsa, Setec and Sand Consult for the full multidisciplinary design over the 75km stretch of the alignment of which 30km is on elevated viaducts, 27km is underground and 8km is in tunnels along with 15 underground stations, nine elevated stations, two depots and park and ride facilities.

Atkins value engineered the entire viaduct design resulting in significant savings to the consortium.

The viaduct's section is covered with either single cell box girders or twin-precast U-girders. A full span launching method is used for straight sections while a precast segmental method is used for the curved stretch of the alignment. Longer viaduct spans over 50m and up to 92m are erected by balanced cantilever or by cranes.



**DESIGN** DURRAT AL BAHRAIN BRIDGES, KINGDOM OF BAHRAIN

Design of 3.5 km of bridges to connect the man-made islands of Durrat Al Bahrain. Each 15m long simply supported voided deck slab was precast in two longitudinal sections, and connected by an insitu stitch.

Foundations were designed to provide frame action for strength and structural stability of the bridge against lateral loads, including ship collision.





## PRINCE TURKI BIN ABDULAZIZ ROAD BRIDGE, KINGDOM OF SAUDI ARABIA

DESIGN

Designed for the ArRiyadh Development Authority the Prince Turki Road bridge is a striking solution to one of the most congested intersections in the city. We have worked with Knight Architects to develop a number of concepts for the project and the selected option is a 210m long and 30m wide bridge, arranged in three spans of 60-90-60m.

The bridge deck is a steel through structure with two 3-dimensional side trusses as the main load-carrying elements. The side trusses also support the architectural cladding which fans out at mid span to provide shading to pedestrians coming out of the Metro station. Sculptural piers support the deck which seems to float on the substructures.

## DUBAI METRO VIADUCTS, UNITED ARAB EMIRATES

Design and technical construction support for 61km of precast segmental viaduct, including large diameter monopile foundations.

Time dependent studies, rail-structure interaction as well as seismic design were key considerations. Atkins introduced new precasting and launching technology to the UAE permitting construction with minimal traffic disruption.



DESIGN

# NORTH AMERICA



## DESIGN HAVEN AVENUE GRADE SEPARATION, UNITED STATES OF AMERICA

The Haven Avenue Grade Separation is a landmark bridge in Rancho Cucamonga that was built to ease traffic congestion caused by increased rail service in the area. Vehicle and train traffic were separated by lowering Haven Avenue 9m, and building an underpass bridge to support the Metrolink

commuter train and Burlington Northern Santa Fe freight trains.

Atkins provided the structural planning, design, and construction support services for the award-winning grade separation structure.



## DESIGN FIRST STREET WIDENING, UNITED STATES OF AMERICA

The Metro Gold Line extension required the 400m long First Street Viaduct in Los Angeles, California to be widened in order to accommodate two new light rail tracks. The historic bridge, built in 1929, crosses 18 major rail facilities and the Los Angeles River. It also required a full seismic retrofit to bring it up to Caltrans standards.

Preserving the architectural integrity of the bridge was a critical requirement. Precast

approach span girders were configured to match the existing girders and the cast-in-place arch sections were exactly matched to the existing ones, including the architectural mouldings on the columns and abutments.

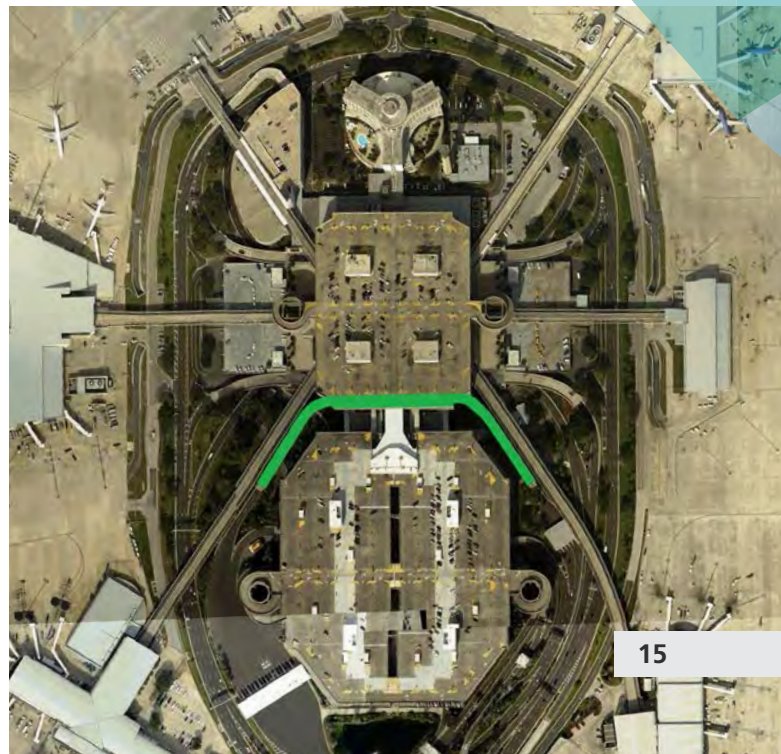
At the request of the State Historic Preservation Officer (SHPO), five pylons on the original bridge were salvaged and re-placed on the new one.

# TAMPA INTERNATIONAL AIRPORT DEPARTURE PARKING GARAGE, UNITED STATES OF AMERICA

ENABLE

The entry and exit ramps to the airport car park, 21m above the main passenger levels required careful reconstruction around the working terminal without compromise to safety or passenger experience. As part of the design and build team Atkins designed the new ramps and the mobile work platform needed to fit within

the 1.8m available headroom. The work platform created a safe working area and screened the pedestrian areas below. Access to the car park was maintained during airport operating hours through careful phasing and screening.









## I-4 SELMON EXPRESSWAY, UNITED STATES OF AMERICA

### DESIGN

Improving heavy goods vehicle access to the Port of Tampa and providing better hurricane evacuation between the I-4 and the Selmon Expressway required a new connecting link road. This relatively short length of highway involved a significant number of structures, including 23 different bridge ramps, 104 balanced cantilever spans and 210 standard spans.

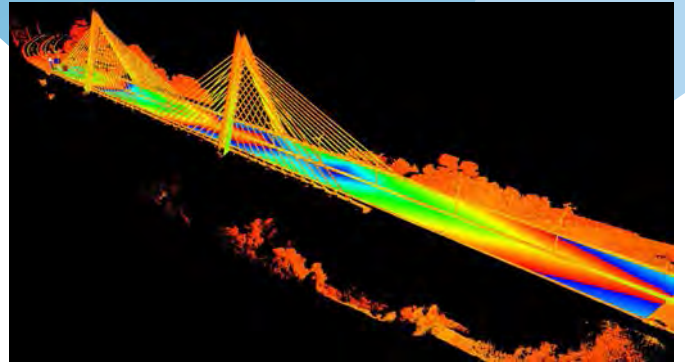
Significant cost reductions were achieved through the effective use of post-tensioning, allowing a reduction in the principal stresses, shear reinforcement and web thickness in the decks. Standardisation of the precast segmental units also allowed greater repetition for pier construction and early completion of the design work.

**ENABLE LA PLATA,  
PUERTO RICO**

Highway 148 crosses over the La Plata River, carried on a 320m cable-stayed bridge with a main span of 160m supported on two diamond-shaped pylons. The superstructure consists of a post-tensioned deck slab with longitudinal post-tensioned edge girders.

Shortly after opening the bridge the Puerto Rico Highway & Transportation Authority noted signs of distress and an irregular deck profile in the cable stay span. Atkins was employed to investigate and assess the bridge.

A highly sensitive laser-scan survey of the entire cable-stay structure was conducted using a maximum grid size of 50mm. Dynamic testing was also used to verify stay forces in the cables. Calibrating the 3D analytical model with the field observations enabled the client to understand how the problems had arisen and what corrective action was required. A derogation from AASHTO standards was justified to increase the live load rating using time-history analysis of vehicles running on the modelled deck profile.



## SADDLE ROAD, UNITED STATES OF AMERICA

ENABLE

The Saddle Road Military Underpass Bridge is a significant advance in designing for sustainability in a remote area. Located on Big Island, Hawaii, between two active volcanoes, the new underpass was required for the US Army at the Pohakaloa Training area. The aim of the project was to develop a less costly, low maintenance and more sustainable bridge in a high seismic zone. The solution was a design that could

be built with simple equipment and materials, that could be easily adapted to suit other sites and constructed in inclement weather. The Geosynthetic Reinforced Soil modular abutments and integral bridge deck helped reduce costs by 50% compared to a standard bridge, reduced construction time and the structure is expected to be low maintenance.



## TEVYAR'AQ RAILWAY TRAM, UNITED STATES OF AMERICA

ENABLE

Tevyar'aq Railway Tram project had our bridge engineering teams help solve an unusual problem to upgrade an important boat portage that connects several Alaskan tundra villages on the Johnson River.

The new 130m long timber portage will contribute to continuing a way of life that has existed for hundreds of years in a very remote and environmentally sensitive area by providing easier and safer boat transfer.



# NORTHERN EUROPE

## PLAN VALLEY BRIDGE, DENMARK

A new motorway section between Aarhus and Herning in Jutland required a new valley bridge through the forest of Nordskoven near the city of Silkeborg. The bridge is built with a twin deck structure which has a total length of more than 500m, 21 spans in each

twin deck, and a height of 10m. Due to the length of the bridge, each twin deck has been constructed in four parts each approximately 150m long. Atkins designed the sound barrier and prepared documentation for the supporting scaffolding on the bridge.



## ENABLE BRIDGE ASSESSMENTS, SWEDEN

Atkins carried out inspections of a mixed group of 27 large road and rail bridge structures for the Swedish Transport Authority, Trafikverket. Using our in house roped access team we made detailed inspections and surveyed the bridges to recreate original design drawings. The inspection was backed up by detailed assessments to understand the structural behaviour and obtain the highest capacity rating.





Photo from 1920

## EXCAVATION OF HISTORIC STEEL TRUSS BRIDGE, DENMARK

**ENABLE**

Restoration of a historic water course in Denmark led to an unusual project to restore a 120 year old bridge that had been buried since 1925. When the steel bridge was built in 1897 it was the tallest railway bridge in Scandinavia. When the track gauge was changed widening was too costly, so it was decided to bury the structure in a new embankment and culvert the river. It was with some trepidation that the top part of the bridge was excavated in the spring of 2014. The steel turned out to be in surprisingly good condition and only a few pieces of steel needed to be replaced. The bridge was cleaned, sandblasted and repainted to its original colours. The wooden deck was replaced and the bridge reopened as a scenic nature trail.



The embankment before excavation work commenced.



The opening ceremony was held in December 2014 and was attended by around 600 people.

## PLAN



### FUNDER ÅDAL, DENMARK

The new motorway section between Herning and Aarhus in Jutland crosses Funder Ådal on a 742m long viaduct, thereby making it the largest onshore bridge in Denmark to date. The bridge was built using incremental launching to construct the two decks in 28m sections launched gradually across the valley. This ensured minimal disturbance to the rare wildlife which inhabits the area.



### ENABLE VEJLE FJORD BRIDGE, DENMARK

Vejle Fjord Bridge is one of the largest and most iconic bridges in Denmark. Since 2008, Atkins has worked closely with the Danish Road Directorate on the operation and maintenance of the Vejle Fjord Bridge. Twice a year, Atkins performs a routine inspection and every fifth year, we perform a detailed inspection, which includes all parts of the bridge and pillars. Special Inspections are required for selected components such as bearings and shear lock mechanisms.





## M50 WIDENING, IRELAND

### DESIGN

As lead consultant, Atkins carried out the detailed design and site construction supervision of 23km of motorway widening including seven interchanges on the existing M50 Dublin orbital ring motorway – one of the most congested sections in Ireland.

Our alternative approach to take the motorway over (rather than under) the railway line and canal at the N3 Interchange reduced cost, construction risk and the impact of the work on the environment.



## DESIGN

### WALTON BRIDGE, UNITED KINGDOM

The new Thames Bridge at Walton, which replaces two life expired structures, is already creating a local identity attracted to the graceful arch form. Atkins developed the proposal through a complicated planning process, detailed design and site support. With Surrey County Council and Costain as partners, the project won the British Construction Industry Award Best Practice Award 2014 and the ICE London Community Award 2014.





# UNITED KINGDOM



## **ENABLE** CHURCH ROAD BRIDGE FRP DECK REPLACEMENT, UNITED KINGDOM

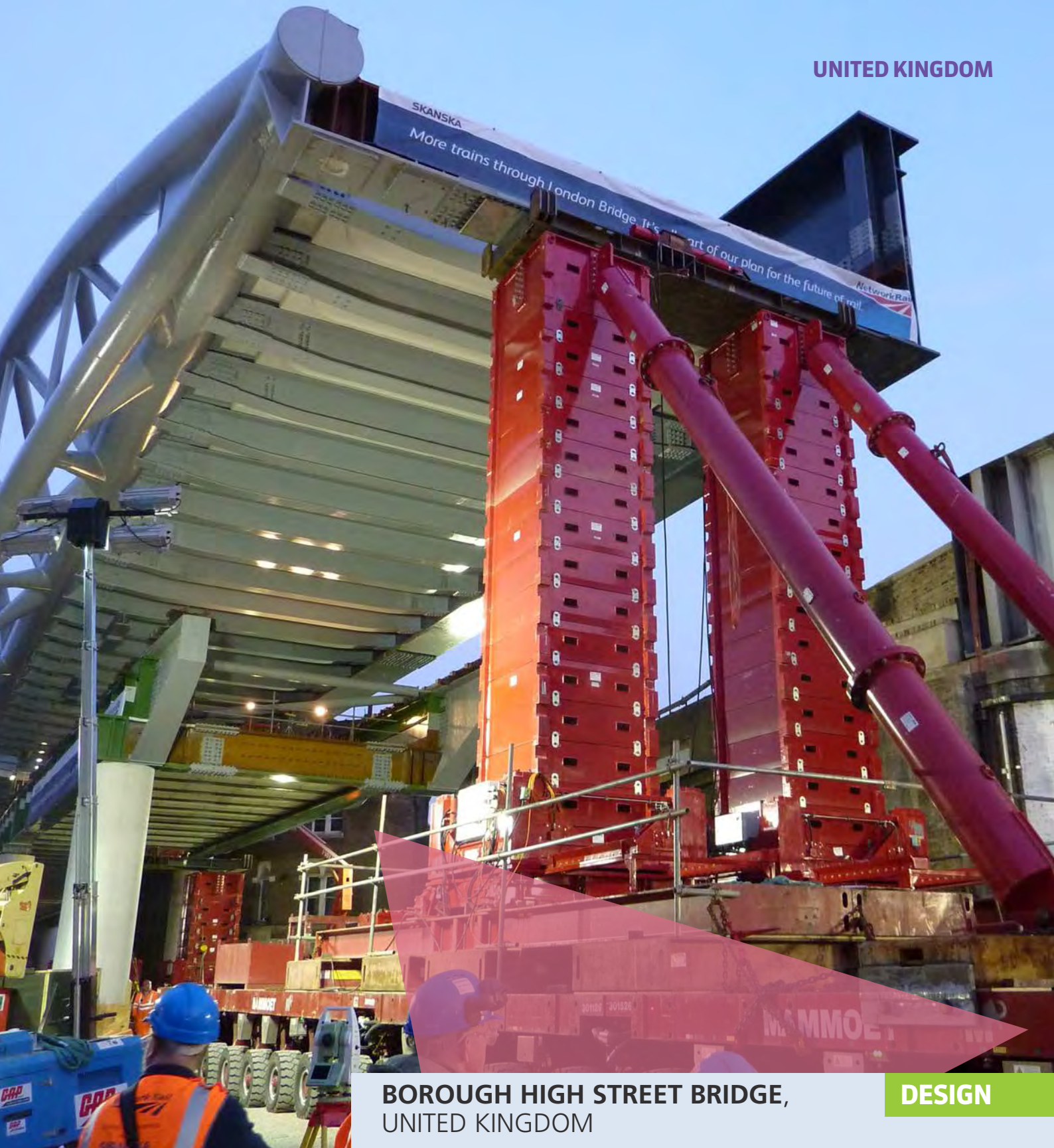
Fibre Reinforced Polymer Deck was chosen for the replacement of the existing bridge over the River Frome in Frampton Cotterell specifically to maximise off-site fabrication. Construction within the six week school holiday period was key for the client and Atkins' innovation helped achieve this. The deck plate complete with service bay is built up of modular pultruded triangular sections and blends well with the traditional stone clad reinforced concrete parapets.



## **PLAN** GALLIONS REACH CROSSING OPTIONS STUDY, UNITED KINGDOM

Atkins was commissioned by TfL to develop preliminary designs for a new road crossing of the River Thames at Gallions Reach in East London. Constraints included a 50m clearance to the river, a main span of 287m to allow large vessels to pass and a limitation on maximum height due to the approach flight path to London City Airport. An arch bridge was one of the few bridge types possible that fitted the constraints and that would give an elegant solution.





## BOROUGH HIGH STREET BRIDGE, UNITED KINGDOM

### DESIGN

Atkins carried out feasibility and detailed design of the Borough Market viaduct along with the associated modifications to the surrounding buildings and LUL underground tunnels. The viaduct comprises four sections which include the Borough High Street Bridge.

The highly constrained and architecturally important site challenged the design and construction teams to achieve a low impact solution that was safe to construct. The use of Self-Propelled Modular Transporter (SPMT) technology and the space available on the approach viaduct enabled the bridge to be transported into position with just a weekend closure of the arterial Borough High Street.

**DESIGN** FRIARGATE BRIDGE,  
UNITED KINGDOM

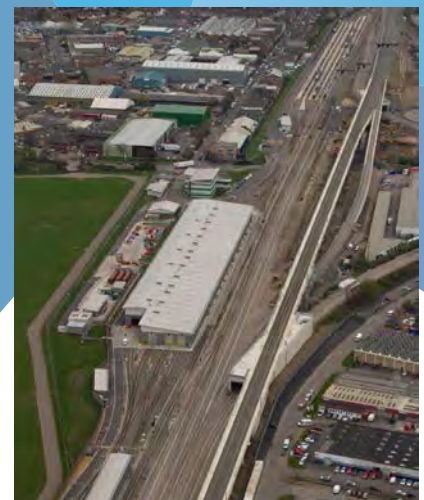
Improvement to city spaces, provision for pedestrians and cyclists as well as reduced severance, are increasingly sought after for urban areas, but can be expensive. Working together with Coventry City Council and Costain, we designed a 100m wide bridge deck over the city ring road to open up links between the city centre and the main railway station. With fixed funding deadlines the design had to be phased to dovetail with construction.



**DESIGN** READING VIADUCT,  
UNITED KINGDOM

The Reading Viaduct is part of the Reading Station Area Redevelopment Programme aimed at boosting station capacity on the Western Mainline by grade separating the junction. A key innovation was to use advanced track-structure interaction analysis

to improve the design. Working collaboratively with Network Rail the result was a more buildable design, with material and construction process efficiencies valued at £18M – an overall cost reduction of 25%.





## OLYMPIC PARK BRIDGES, UNITED KINGDOM **DESIGN**

Over 30 bridges and 20km of new road were built to connect Olympic Park venues and facilities. They also had to be adaptable to create new community links as a legacy of the games.

L01 footbridge is typical of the architecturally led solutions to create an exceptionally slender 42m span arch bridge as a gateway to the Olympic Park. The arch is formed by a single plate rib 90mm thick, restrained with a dense distribution of steel plate hangers.

### DESIGN CLIFFSEND UNDERPASS, UNITED KINGDOM

Cliffsend Underpass is believed to be the largest bridge in the world installed using a jacking technique. Prepared as an alternative design for Volker Fitzpatrick / Hochtief JV, the 126m long and 23m wide structure was designed as a single span inverted U shaped RC Deck. Three tiers of small jacked boxes were used as pilot tunnels to create the full height abutments. The multidisciplinary experience of the team in designing moveable bridges was used to engineer the low friction slide path.



### DESIGN



### USK FOOTBRIDGE, UNITED KINGDOM

Atkins provided the design for the bridge over the River Usk, linking a retail park to residential areas. The crane-like mast structures of the bridge were designed to reflect the city's industrial past. Dampers were concealed within the bridge to prevent vibration caused by pedestrian traffic. Atkins' approach ensured that no construction work was carried out within the tidal range of the river, thus avoiding impact on the important local river ecology.



## RIVER DEE CROSSING, UNITED KINGDOM

DESIGN

The River Dee Crossing is part of the 58km Aberdeen Western Peripheral Route. The three-span balanced cantilever bridge will be 270m long with a 120m main span and will have very tight limitations imposed on the span to depth ratios at the piers and at mid-span. It was only possible to fit within the limitations through close liaison with the prestressing suppliers, efficient design and working to the limits of the design codes.



## HEADS OF THE VALLEYS BRIDGES, UNITED KINGDOM

DESIGN

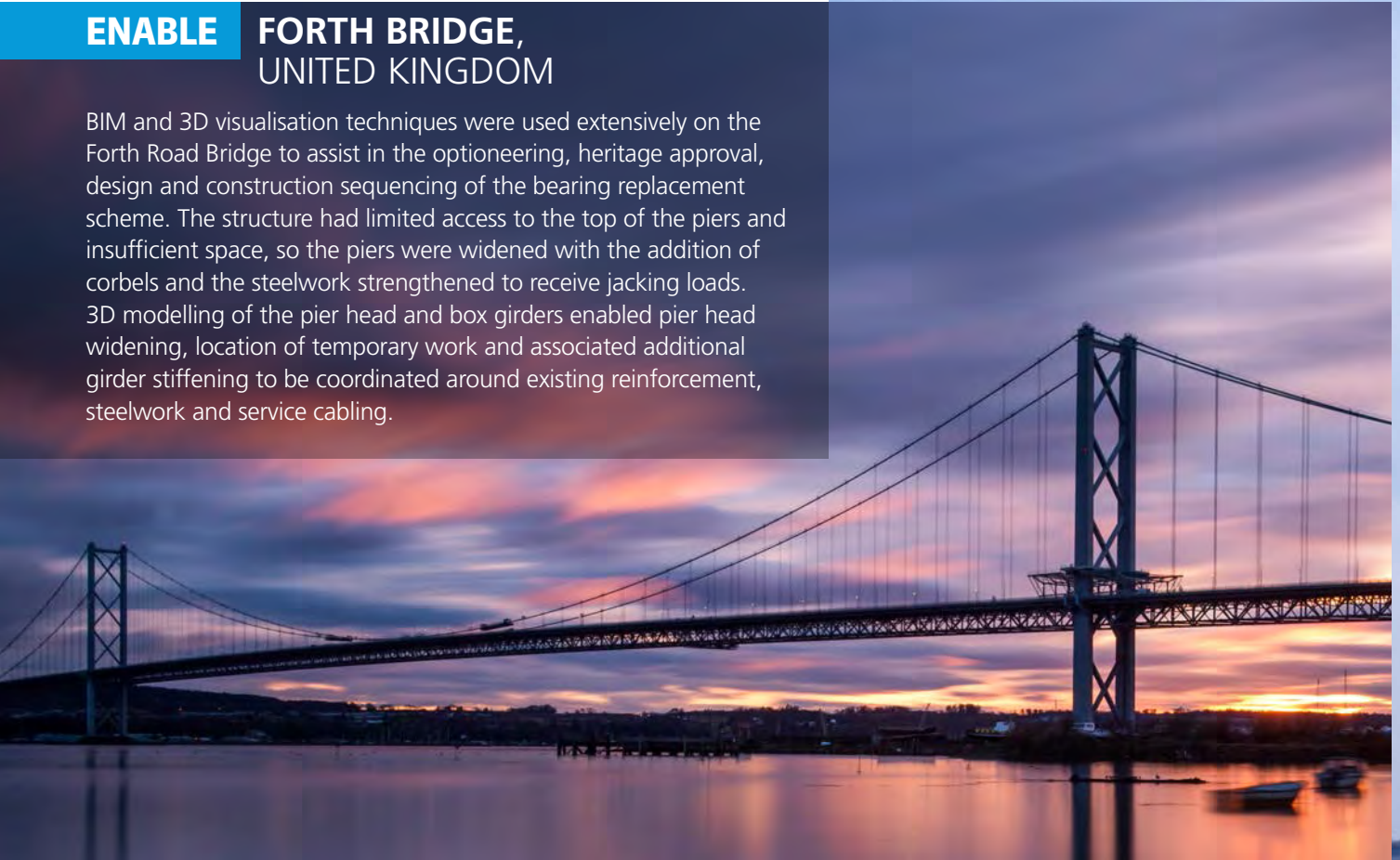
The Heads of the Valleys (Section 2) project widens the existing road through the Clydach Gorge in the Brecon Beacons National Park. The weathering steel bridges are designed to fit into the challenging topography, reduce length and open up stunning views of the valley. Torsion box beam bridges and a 118m span arch will create stunning views of the post-industrial landscape.



# ASSET MANAGEMENT

## ENABLE FORTH BRIDGE, UNITED KINGDOM

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, 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, location of temporary work and associated additional girder stiffening to be coordinated around existing reinforcement, steelwork and service cabling.



## ENABLE BOSTON MANOR VIADUCT, UNITED KINGDOM

Emergency repairs to cracked welds on the M4 Boston Manor Viaduct were necessary to keep the structure open for Olympic traffic in 2012. Further work to identify hidden defects revealed a number of misaligned roller bearings. Designing the repairs so it could be executed safely involved a joint approach from the whole project team considering "what if" situations.

The result was a detailed set of plans, methodology and decision-points along with the necessary spare components to replace the bearings using just night closures.







**ENABLE**

**SEVERN BRIDGE,  
UNITED KINGDOM**

Atkins is working with Highways England to provide 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.

# MOVEABLE STRUCTURES

## DESIGN

### FALKIRK WHEEL, UNITED KINGDOM

The world's first rotating boat lift – this 35m high 1,500T machine transports canal barges between the Forth and Clyde Canal and the Union Canal. Atkins produced the scheme design and details of the operating and rotating mechanisms for the complex wheel structure. Each gondola contains 25,000 litres of water and can carry eight boats at a time. Winner of the Structural Steel Award.

We are the leading UK company in the design of mechanical and electrical engineering of moveable bridges.

Atkins has provided the motive force and control on most signature moveable bridges built recently in the UK.



## DESIGN

### POOLE HARBOUR TWIN SAILS BRIDGE, UNITED KINGDOM

Designed as a landmark structure that would alleviate congestion across the existing bridge and aid regeneration of the surrounding area, Atkins produced exemplar designs and detailed specifications for the mechanical, electrical and hydraulic elements of this unique twin triangular bascule bridge.



## THE KELPIES, UNITED KINGDOM

Standing at around 30m high, the monumental Kelpie horses are sculpted as impressive gateway to the Forth and Clyde canal system.

Developed with the artist Andy Scott, Atkins designed the structure to support the external skin of the sculptures against severe wind conditions and for vertical movement linked to the hydraulic operation of the canal lock. Although the movement of the statues was not implemented, the internal structure of the frame had to be shaped to match the Kelpies as it is visible through the skin.

Since their inauguration The Kelpies have received significant recognition including the UK National Structural Steel Award, the Saltire Award for Civil Engineering, and officially recognised as a National Treasure by the UK Lottery.



DESIGN



## MEDIA CITY SWING BRIDGE, UNITED KINGDOM

Atkins was part of the team designing this distinctive swing bridge in Salford Quays. The design brief was to provide a landmark structure that would be a destination in its own right and provide access to the Media City Development. The bridge is 83m long in total and slews through 71 degrees to provide access for shipping.

Atkins produced exemplar designs and detailed specifications for the mechanical, electrical and hydraulic elements followed by technical support through the design, manufacture, installation and commissioning.

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