Bridge
DESIGN & ENGINEERING

FOOTBRIDGE AWARDS 2014

INTRODUCTION

With the *Bridge design & engineering* Footbridge Awards now in their fifth cycle, the incredibly high standard of entries shows no sign of diminishing. The fact that this year also sees the Footbridge 2014 conference being hosted in London makes it a particularly special occasion for us. Once again our judging panel was faced with some very tough decisions, with some categories particularly strongly-contested.

This year also sees some changes to our award categories - new projects are now judged on both technical and aesthetic merits as one rather than in separate categories. We are also delighted to launch two additional categories, including the Jonathan Speirs Footbridge Lighting Award which has been created in memory of bridge lighting designer Jonathan Speirs. We have also launched a category to recognise excellence in footbridge renovation. Finally we welcome the Flint & Neill Footbridge Young Author Award which will be judged and presented during the Footbridge 2014 conference.

Helena Russell

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THE JURY

Helena Russell is editor of *Bridge design & engineering*, and has worked as a journalist and editor in the civil engineering sector for 22 years. After graduating from Imperial College, London, with a degree in civil engineering, she worked as an engineer for several years before taking a job as a writer on a weekly civil engineering magazine. She has been editor of *Bd&e* for 15 years and was responsible for launching the Footbridge Awards in 2002.

Dr Wasoodev Hoorpah graduated as a civil engineer in Paris in 1982 and has been involved in the design and construction of many different types of steel and composite bridges for motorways, high-speed railways and pedestrians. He served as editor of the French technical magazine on steel bridges *Bulletin Ponts Metalliques* and was the organiser of the first footbridge conference with OTUA in 2002 in Paris. Wasoodev chaired the French working group for the design rules for dynamics for footbridges. He is now a consultant working with large steel structures that require advanced analysis in dynamics and wind engineering.

Richard Fish is an independent consultant specialising in bridge maintenance and management, particularly for cable-supported bridges. He has almost 40 years of experience in bridge design and construction, mostly in the local government sector. Invited to join the County Surveyors' Society Bridges Group in 1992, Richard went on to chair the group between 2005 and 2008 when he was also the chairman of the UK Bridges Board. He is still a member of UKBB in his role as technical secretary of the Bridge Owners Forum, which promotes bridge-related research. From 1994 to 2002, Richard was the project manager for the award-winning strengthening and widening of the Tamar Suspension Bridge. More recent commissions have included work on the Humber Bridge, Auckland Harbour Bridge and Izmit Bay Bridge. He was a member of the judging panel for the Footbridge Awards in 2011 and has written and presented technical papers at many international bridge conferences. He is a Fellow of both the Institution of Civil Engineers and the Institution of Structural Engineers.

Brian Duguid is Mott MacDonald's practice leader for bridges responsible for all UK regional offices, leading the promotion of professional excellence across a wide variety of bridge projects. He has experience of all types of bridge engineering consultancy, including as lead engineer responsible for civil and multi-disciplinary engineering on the £700m Network Rail Northern Hub project, and lead structures engineer responsible for more than 30 light rail structures on phase two of the Nottingham Tram, including the landmark 105m long Nottingham Station Bridge. Brian has a keen interest in footbridge design, and bridge design competitions, having contributed to development of IABSE's *Guidelines for Bridge Design Competitions*. He was the opening keynote speaker at the Footbridge 2011 conference, where he spoke on the topic of 'Benchmarking cost and value in landmark footbridges'. Brian is an honorary lecturer in bridge engineering at University of Manchester, where he also acts as an industry mentor for student design groups.

Keith Brownlie is a chartered architect and director of the Anglo-Danish practice Brownlie Ernst & Marks, a specialist design firm involved in bridges and infrastructure projects worldwide. He is involved with bespoke design projects from Australia to the Arctic Circle and is busy in the burgeoning US design-bid-build market for major bridges. Prior to the formation of Beam, Keith was director of Wilkinson Eyre Architects where he oversaw a dedicated bridge design group delivering a range of work ranging from the Stirling Prize-winning Gateshead Millennium Bridge, to the 18km-long Fehmarnbelt Fixed Link between Germany and Denmark (to 2020).

Mark Major trained and practised as an architect prior to focusing on the unique relationship between light and architecture. A principal of Speirs & Major, he has worked on a wide range of award-winning lighting projects including the Millennium Dome, 30 St Mary Axe, Beijing International Airport, the refurbishment of Royal Festival Hall and the re-lighting of the interior of St Paul's Cathedral. He is a specialist in the field of urban lighting and was named as a key city advisor by Monocle in 2013. Mark acted as the lighting design advisor to the Olympic Delivery Authority for London 2012 and was appointed to the Mayor of London's special assistance team for the Outer London Fund in the same year. Mark is a corporate member of the Royal Institute of British Architects and the International Association of Lighting Designers and a fellow of the Royal Incorporation of Architects in Scotland. He was created a Royal Designer for Industry in 2012.

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Photo: Jean-Luc Deru

SMEDENPOORT TWIN BRIDGES

BRUGES, BELGIUM

WINNER

SHORT SPAN

The Smedenpoort, or Blacksmiths' Gate, is one of four historic gateways remaining in the city of Bruges. It was built in the 13th century and had become a bottleneck, as it was too narrow to allow cars, pedestrians and cyclists to flow smoothly through it. Traffic competed for space particularly in the rush hour since the Smedenpoort is one of the main entrances to the city centre. The city of Bruges decided, under the supervision of the Commission of Monuments & Landscapes, to add new footbridges on both sides of the existing gate.

By building two footbridges next to the existing gateway, the flow of pedestrians could be separated from that of cyclists and vehicles. Cyclists now pass through the sides of the old gateway and pedestrians enjoy a new promenade bridge crossing the old fortification canal next to the gateway.

In order to respect the historical importance of the site, the footbridges were designed to be as slender and transparent as possible. They are intended to create something more akin to a promenade in the landscape than simply a crossing over water. The bridges are curved on plan, to 'embrace' the gateway, and the use of multiple small columns reduces the span length. The parapet is designed to act as part of the structural system, resulting in a more efficient use of material and enabling the dimensions of the elements to be reduced, creating a more transparent structure.

The structure consists of a weathering steel lattice construction with concrete tiles forming the bridge deck. The use of solid steel bars and the type of details chosen are intended to reference the heritage craftsmanship of the blacksmith. The southern footbridge is 62.7m long, and the northern one is slightly shorter at 57.2m long, but both are 2.5m wide and have a radius of 253.5m. Apart from the position of the abutments and bracing the two bridges are identical. The effective spans are reduced to just over 5m between each supporting column, which matches the spans of the existing bridge across the canal.

The structural system is a combination of a Warren truss and a Vierendeel truss, and the railing acts structurally to provide vertical stability. The handrail forms the upper member of the truss while a longitudinal beam forms the lower member. These take up the bending moments, respectively acting in compression and tension, while the uprights take the shear forces.

The pattern follows the distribution of internal forces and is adapted for each span length. Since the shear forces close to the supports will be higher, the bars will need to be larger and be inclined at a steeper angle than the ones in the middle of each span, for optimal material use. The entire structural railing, including all railing bars, longitudinal beams and handrails, was created by using a water jet to cut the pattern from a 30mm-thick steel plate, rather than by assembling numerous small elements. Using a water jet guarantees a nice straight cutting line; to prevent stress concentrations

JURY'S COMMENTS

"The slenderness of the top and bottom chords and of the pier legs is difficult to believe. The water-jetting cutting method is used to facilitate an exceptional engineering vision. Impressively simple and elegant; the historic gate retains its identity even when viewed from the side."


Photo: Jean-Luc Deru

where the railings meet the longitudinal beam and handrail, the cut was rounded.

This continuous truss is supported on slender columns of 60mm square cross-section at spacings of just over 5m. The columns are welded directly on to steel plates over the steel piles; with the exception of the supports at the abutments these columns and piles are only designed to support vertical loads. The horizontal stiffness of the structure is provided by the steel framework and concrete tiles which form an arched lattice in the horizontal plane. The concrete tiles act as compression struts. In the horizontal plane the structure is only supported at the abutments and the bracings next to them. Since the cross-beams are radially orientated, the concrete tiles and cross-beams are identical across the bridge deck, simplifying the fabrication procedure for the tiles.

Weathering steel is not rustproof in itself; if water is allowed to accumulate in pockets, those areas will experience higher corrosion rates, so provision for drainage must be made.

The supporting plates for the concrete tiles are slightly folded to provide a sloping surface, and the bottom plate of the supporting box at the abutments is also inclined. The upper surfaces of the concrete tiles have slopes of 2% towards the sides of the footbridge. The cross-beams have a corresponding slope on their upper surface which also helps them to support a bigger bending moment in the centre.

All connections between steel elements were welded, not bolted, since this is more appropriate for the durability of a weathering steel structure, and bolts made of weathering steel are rare. Moreover the use of bolts made of other steel alloys next to weathering steel could result in a difference of potential and could exacerbate corrosion

Commissioning authority: City of Bruges
Principal designer: Ney & Partners
Contractor: Depret
Steel contractor: Anmeco

CAMPUSBRÜCKE OPLADEN

OPLADEN, GERMANY

HIGHLY COMMENDED

SHORT SPAN

The Campüsbrucke, which opened in June 2013, is the first of two competition-winning bridges crossing a 100m wide high-speed railway corridor and links the town centre with a 40ha redevelopment of an historic train maintenance depot.

The bridge is a chain of five single-span weathering steel beams resting on concrete piers located in narrow margins between eight electrified rail tracks. With relatively short spans of 12m to 24m, each segment was able to be easily transported and installed, minimising traffic disruption and requiring comparatively modest structural depths.

The webs of each span's trough cross-section vary in height between 750mm at the bearings and 1200mm midspan, representing the prevailing bending moment diagram and providing a safe and impenetrable barrier above the overhead cables. Narrowly-spaced structural stiffeners on the outside of each beam are extended vertically beyond the top flange to a fixed height of 1800mm above deck level replacing regular parapet posts.

Each stiffener is cut in an individual geometry – constant on pedestrian side and variable on the outside – visually adding up to a sinusoidal curve reversing the geometry of the top flange. The louvre-like arrangement of the extended stiffeners, their width and their narrow 600mm spacing create a unique visual effect, overlapping in perspective to a solid enclosure and revealing the lightness of the bridge in elevation.

Flat wooden extensions of the lamellae within the pedestrian envelope, framed with narrow stainless steel edges, clearly distinguish public space from structure. Tubular stainless steel handrails provide space for the inset of energy-efficient LED lighting. The high quality of the finishes make clear that the bridge has been designed with a strong focus on its users, communicating its role as a gateway in a pleasantly-welcoming gesture ■

JURY'S COMMENTS

"Idiosyncratic yet logical. Lovely sinusoidal geometry giving complex shading from all angles. Good use of both timber and weathering steel to mix the human-centered with minimal maintenance."

Photo: Wilfried Dechau

Commissioning authority: Neue Bahn Stadt Opladen
Principal designer: Knippers Helbig
Architect: Knight Architects
Contractor: Bauunternehmen Hofschröer
Steel fabrication: Müller Offenburg

BLEICHWIESENSTEG

BACKNANG, GERMANY

HIGHLY COMMENDED

SHORT SPAN

This new bridge in Backnang is the shortest connection from the train station to the redeveloped area of Bleichwiese. It is one of the most important public spaces in the town, connecting new and old. The old timber truss bridge had to be replaced by a barrier-free bridge with the foundation reused if possible.

Quick and easy installation was another major requirement, hence the bridge consists of two almost identical parts. These completely prefabricated parts could then be combined and assembled directly on site.

The single span steel beam over the Murr consists of two box girders with heights that increase towards the centre and also act as the parapet. At the highest point, the box girders are disconnected and split into upper and lower chord. The upper chord is an articulated compression rod; the lower chord is a joint that bears tensile loads. At the joint the height of the box girders is reduced to its minimum of around 30cm. Consequently the triangular recess at the bridge centre lends the bridge an air of lightness. The use of chrome coated bolts makes the joints stand out as a special feature.

At the top edge of the first cross section the box girders feature a sharp bend at the outer face which lends the bridge another dimension through the shape's interplay of light and shadow. A lightweight orthotropic slab is suspended between the box girders. Cross ribs integrated in the slab generate a frame effect that prevents the box girders from tilting ■

JURY'S COMMENTS

"Sensitively elegant structure, very discreet - good integration in its surroundings. Clever twin box girder with pinned fixings at mid span giving an unusual appearance."

Photo: Michael Zimmermann

Commissioning authority: Stadtbauamt Backnang
Principal designer: Schlaich Bergermann & Partner
Contractor: Müller Offenburg

FOOTBRIDGEAWARDS2014

VLUCHTHAVEN BRIDGE

AMSTERDAM, THE NETHERLANDS

HIGHLY COMMENDED

SHORT SPAN

The Vluchthaven movable footbridge will connect a new artificial peninsula near Amsterdam Central Station with the Westerdoksdijk, while also giving access to the new IJ Dock marina.

The aim of the Vluchthaven Footbridge designers was to create a graceful, unified structure. In a departure from classical engineering, the concept focussed on limiting the hierarchy of the elements by merging several functions together.

The deck, cross members, main beam and finish are one unit; the bridge is formed from a continuous beam created from a single curved and cutout plate. Inspired by the movement of a heron's wing during flight, the plate is slightly twisted around its axis, representing the backbone of the bridge. As a result, the form of the bridge evolves: the cross-section at midspan is concave while this reverses above the supports, where the cross-section is convex, to achieve the necessary construction depth at the supports.

Shaping the deck also enables better drainage, with a series of openings on both sides of the bridge. These perforations make a subtle link to the presence of the water beneath the bridge and reinforce the relationship between the pedestrian and the bridge.

The perforations also allow subtle lighting to be integrated in the railing. LEDs are embedded in resin over a height of 15cm at the base of each of the more than 1000 balusters.

One of the client requirements was a design that prevents bikes being fixed to the parapet. To enable this, each of the balusters is independent and there is no horizontal hand rail. The movable part of the bridge was designed to be integral with the bridge and while closed it is hardly visible. The piers positions were chosen so that the movable part corresponds with the minimum bending moment values for the bridge.

The detailing of the piers is such that they are all identical, but over the course of the bridge they slowly rise from the water ■

JURY'S COMMENTS

"Brilliant bridge; use of single steel plate deck is sublime, parapets are fantastic. Elegant and well thought-out form and attention to detail."

Photo: Stijn Bollaert

Client: Ontwikkelingsbedrijf Gemeente Amsterdam
Principal designer: Ney & Partners
Contractor: Van Der Made

JARROLD BRIDGE
NORWICH, UK

WINNER
MEDIUM SPAN

The essence of the concept was for a bridge that touched the ground lightly and traced a smooth, uninterrupted arc over the water. Just over 80m in length, the bridge's sweeping curves are derived from the features of the site itself and the clearances imposed on the structure. The two best landing points were determined at an early stage, and the smooth curvilinear 3D geometry developed to follow the optimal path between these points. The path had to accommodate all required clearances, without ever being steeper than 1 in 20.

Fixed by concrete abutments at each end and propped by two slender pin-jointed stainless steel columns, the bridge acts as two mutually-stabilising, propped cantilevers with a central span over the river of approximately 40m.

A trapezoidal steel box girder forms the spine of the bridge, with all loads from the deck and balustrade transferred via cross-beams which cantilever from the spine. This applies torsion and bending to the girder, the torsion in one arm of the bridge being resisted by the bending capacity of the other.

At each abutment a fixed uplift bearing under the box girder, and a sliding guided bearing under the outer end of each bearing beam, provide vertical, lateral and torsional restraint.

The bridge thus resists horizontal loading by acting as an arch in plan, supported by cross-bracing which ties the structure together. Thermal

JURY'S COMMENTS
"Lovely bridge, sensible layout, nice knife-edge to the leading edge, good use of different parapets on each side. Excellent form and use of materials."

expansion is realised as bending in the corresponding perpendicular 'arm' with pin-jointed columns providing vertical support while allowing rotation and lateral movement as the beam flexes.

The primary beam incorporates a simple detail where adjacent weathering steel plates over-sail one another. This creates a cleaner, sharper profile, breaks up the mass of the beam and conceals the welds at junctions. It also has the practical benefit of creating a continuous drip detail that avoids uneven staining.

Just three complementary hard-wearing materials were used. The main structure is fabricated from weathering steel which was chosen for its aesthetics and its long-term maintenance benefits; it should require no maintenance over its lifetime of 120 years.

The deck surface is Cumaru, an untreated renewable hardwood specified for its density, strength and durability. A hidden clamp system fixes the strips invisibly to bearers, bolted to the steel structure and with inset carborundum strips to ensure slip-resistance.

Stainless steel top rails accommodate long-life LED strip lighting and a lightweight stainless steel mesh encloses the deck, allowing full visibility along the river.

This combination of materials is intended to weather and improve with age. With no applied finishes anywhere on the bridge, maintenance requirements and lifetime costs are reduced to a minimum.

An emphasis on off-site manufacture delivered significant benefits with site welds minimised so welding and dimensional requirements could be controlled in workshop conditions.

Bridge component size and weight were controlled to minimise transport and lifting operations, and environmental impact was reduced by limiting the number of deliveries to site and significantly reducing site works and their potential impact on the public and wildlife.

A bolted splice connection was developed for the mid-span, eliminating any need for temporary works in the river during installation.

Successful installation of the whole bridge was completed over two days and the bridge was delivered on time and to budget.

Despite the focus on quality of materials and finishes, benchmarking against similar landmark bridges confirmed the final cost, at less than £4,000/m², represents excellent value for money.

Jarrold Bridge is primarily a pedestrian link, secondly a cycle way, but also a meeting place in its own right. The form of the bridge encourages people to linger and take in views of the cathedral, the river and the surrounding areas. ■

Commissioning authority: Jarrold (St James) Ltd
Principal designer: Ramboll
Contractor: RG Carter
Steelwork contractor: SH Structures
Timber contractor: EWP

MEDIA CITY FOOTBRIDGE
SALFORD, UK

HIGHLY COMMENDED
MEDIUM SPAN

The Media City Footbridge spans the Manchester Ship Canal as a signature element in the redevelopment of the region; former industrial docks located along the canal now provide a new home for the BBC.

The £9.5 million bridge provides pedestrian access into the heart of the fast-expanding Media City development.

The structure is an asymmetric, cable-stayed swing bridge, the whole of which moves as the crossing opens to allow vessels along the ship canal. The weight of the bridge's rotating 'piazza' is used to balance the bridge as it opens and to prevent overturning. In order to minimise the height above the water of the bridge deck and consequently to alleviate the gradients and length of approach ramps, the curved edge of the deck is supported from above by stay cables. The structure beneath the walking surface of the deck is minimised in order to create an elegant, lightweight appearance. The cable-stayed solution is also a cost-effective structural form for the length of crossing. The centre-piece of the space is a distinctive structure created by the fanned array of individual masts which support the stay cables.

These masts are up to 30m tall and converge at the base atop a steel pedestal, forming a highly visible and distinctive focal point above the pivot of the bridge. Although the masts are a direct functional response to the forces flowing through it from the stays above, their shape is emblematic and instantly memorable. The bridge was completed significantly under the original budget and by the scheduled date ■

JURY'S COMMENTS
"Excellent form and function with an innovative take on the cable stayed arrangement with multiple masts - superb details."


Photo: Daniel Hopkinson

Commissioning authority: Peel Holdings
Principal designer: Wilkinson Eyre Architects
Structural engineer: Ramboll
Contractor: Balfour Beatty Civil Engineering

'SLINKY SPRINGS TO FAME'
OBERHAUSEN, GERMANY

HIGHLY COMMENDED
MEDIUM SPAN

Artist Tobias Rehberger created a footbridge across the Rhein-Herne canal as part of the art project 'EmscherKunst 2010'. His vision was a colourful ribbon wrapped in a monumental spiral, undulating over the canal like a rope flung across the water. But the spiral could not act as support structure, so the proposed solution was to build a stress ribbon bridge. The spiral could be bolted to the bridge and – being independent of the supporting structure – would only have to support itself.

The 406m-long sculptural bridge had to be carefully fitted into the sensitive surroundings and crosses the ship canal at a height of 10m. Accessibility was important, and the bridge has ramps with a 6% gradient on both sides. In order to achieve this they have curved forms; 170m long in S-form on the south and 130m in U-shape on the north. To keep the span across the canal to a minimum the main bridge was designed as a lightweight three span stress ribbon bridge. Two ribbons made of high-strength steel S690, each one only 46cm wide and 30mm thick, run across columns inclined towards the canal and are anchored on columns inclined away from it. The resulting tension force is transferred into strong abutments through the outer vertical tension rods. The saddles on the heads of the steel columns are rounded out to reduce bending stress. The walkway has 2.67m wide and 12cm thick precast concrete panels bolted to the stress ribbon, to which railings, steel posts and steel tubing, as well as the spiral, are attached ■

JURY'S COMMENTS
"Artistic concept has been neatly and effectively translated into an attractive and unusual bridge – its lightness is surprising on a bridge of this scale."

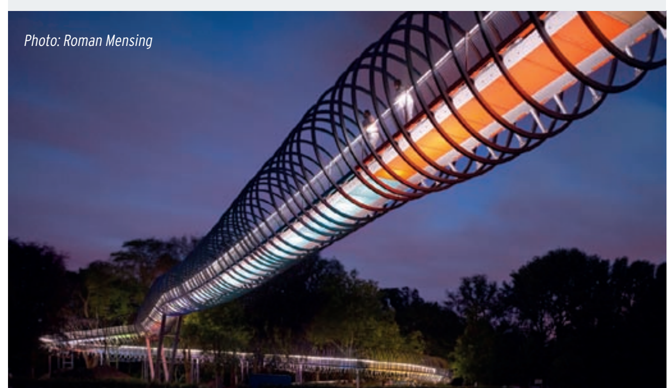


Photo: Roman Mensing

Commissioning authority: Emschergenossenschaft
Principal designer: Schlaich Bergermann & Partner
Contractor: Arge Stahlbau Raulf - IHT Bochum
Artistic concept: Studio Tobias Rehberger
Landscape architect: Davids Terfrüchte & Partner

FOOTBRIDGEAWARDS2014

GENIEDIJK BRIDGE
AMSTERDAM, THE NETHERLANDS

HIGHLY COMMENDED
MEDIUM SPAN

The Geniedijk is part of the Stelling van Amsterdam, a 135km-long circular defence system consisting of 42 forts and bunkers which was built between 1880 and 1920. In 1996 Unesco officially recognised this historical Dutch defence system by including it on the list of World Heritage sites. Re-evaluation of the Stelling as a recreation route around the city led to the proposal for a new bridge over the A-4 highway, which cuts through the Geniedijk. The new bridge is 12m away to keep a respectful distance.

The ramps to the bridge shift orientation repeatedly, creating a variety of views onto the immediate surroundings of the Haarlemmermeer polder and the Geniedijk. It is designed to be a contemporary addition to the Geniedijk where the military senses of 'strong' and 'tough' are reflected in the use of materials and its simple and readable detailing.

The main structure over the highway consists of four beam-elements each 31m span, and 18 ramp elements of 16m span over the canals; both have a width of 5m. V-shaped steel piers carry the beam elements over the highway, and the support structure of the ramps is made of steel pipes which are placed in the canals. The primary section of the bridge is a V-shape; this continues in the screens behind the railings, which give a feeling of safety because the bridge 'opens up'. The entire bridge is made of Corten weathering steel which blends in well with the historical and military atmosphere of the Geniedijk and requires hardly any maintenance. All details are carefully designed so no water or moisture can accumulate which otherwise could cause serious corrosion even to weathering steel. The tilted 3m-high fences are filled with a stainless steel mesh to prevent objects to be thrown onto the highway A-4. Stainless steel handrails are mounted on both sides in front of the mesh as the finishing touch ■

JURY'S COMMENTS
"Careful thought has gone into the details and unity of visual appearance on this bridge – themes are repeated throughout the structure, care has been taken where the steel piers join the concrete foundations, and the result is a delightfully singular structure."

Client: Provincie Noord-holland
Principal designer: Verburg Hoogendijk Architekten
Structural engineer: DHV Amersfoort
Contractor: Staalbouw Weelde International/MNO Vervat

BOW RIVER BRIDGE

BANFF, CANADA

WINNER

LONG SPAN

Photo: Paul Ziska

The historical town of Banff, set in the beautiful Canadian Rockies, is one of the most visited tourist destinations in North America. The town sought a new crossing which would not only be functional, but would also enhance the stunning mountain and river setting and create an important community link, encouraging walking, jogging, and cycling.

The material choices are in keeping with the local area; timber as primary structure, stone, and well-detailed galvanised steel. An additional, and fundamental consideration, was that sewerage pipes under the river which had been installed some fifty years earlier were at risk of failing, spilling raw sewage into the river.

Hence the bridge also needed to carry new pipes as well as provide a secondary access for emergency vehicles. The project had to meet stringent environmental requirements of Canada's oldest national park. The design features an 80m-long clear span, which combined with its extremely slender curved profile, created the primary design challenge for the bridge: its dynamic behaviour due to pedestrian excitation.

The structural system is simple: 40m-long haunched glulam girders propped by drilled piers just outside the normal river channel, cantilever from each side to support a 34m suspended span.

The cross-section consists of twin sets of glulam girders ranging in depth from 2.6m at the piers to 0.9m at the suspended span. The girders are stepped to follow the flow of forces,.

The 4m-wide deck is made of prestressed solid timber panels, removable to provide access to the service pipes below. The concrete abutments at each end of the crossing tie down the haunch ends, and also house the pump station, eliminating the need for any additional above-grade structures.

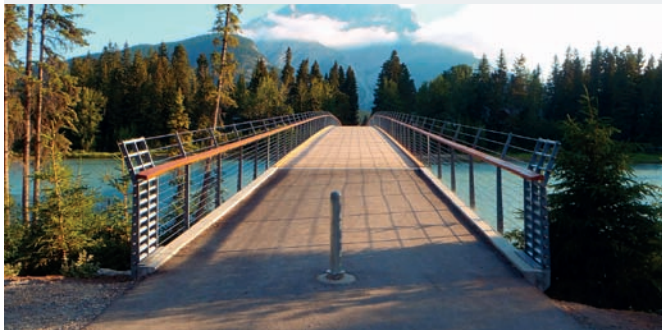
The horizontal steel truss provides both the diaphragm and support for the service pipes just below the bridge deck, and it is configured such that only the timber is continuous, resulting in very little length expansion.

The central drop span sits on neoprene bearing pads on notches in the receiving ends of the cantilevered glulam girders. This detail is achieved by using long screws which invisibly reinforce the notch, forming an elegant connection leaving plenty of tolerance during erection.

The guardrail system uses 135m-long continuous cables, which required fine-tuned pretension analysis to ensure adequate tension in the summer, and avoid overtension in the winter. Durability was a topic of significant interest to the client, and great care was taken in detailing to ensure a 75-year design life.

JURY'S COMMENTS

"A bold span for timber construction. The use of materials to solve some challenging load requirements is inspiring and fitting to its site. Simple lines keep it clean and elegant."



Spacing between the paired glulams allows full ventilation, and the shingled heavy gauge flashing creates a strong drip edge protecting the beam faces.

All steel components are hot-dip galvanised or stainless steel, and rubber spacers separate the two where they interface. The guardrail system is anchored through the flashing to the beams in a way that eliminates penetrations.

The glulam is coated with a system intended to behave like a breathable membrane and one which can be easily re-coated. While the primary behaviour is simple, the internal behaviour of the stepped beams is not; it required finite element modelling, and special grading and selection of the beam laminations.

The long span and slender profile of the bridge, while enhancing aesthetics and minimising material and erection weights, make it susceptible to both vertical and lateral excitation from human traffic on the bridge.

Two cable-suspended masses were installed, made visible for honesty, to act as tuned-mass dampers to address footstep and jogging excitation respectively. Response reduction was verified through field-testing of actual frequencies and accelerations.

A parametric 3D model of the entire bridge was created early, allowing rapid investigation of a multitude of design decisions, providing visual feedback to both designer and client.

A tight site and harsh winter, coupled with a desire to complete the lifts

before spring thaw, made ease and accuracy of assembly in the field critical.

The main structural elements of the bridge were too large to be transported to the site; and fitting up the pieces over the river with a smaller crane would have presented significant environmental and safety challenges. Thus individual elements were prefabricated in the shop and shipped to site as a kit of parts. All cutting, drilling, sanding and finishing was performed indoors under controlled conditions. Jigs were built to ensure accurate assembly of the main bridge components on the riverbanks. In all, the entire bridge superstructure was erected in three lifts over two days, with the heaviest assemblies weighing in at over 50t

Commissioning authority: Town of Banff
Principal designer: Structurecraft Builders
Structural engineer: Fast & Epp Structural Engineers
Contractor: Structurecraft Builders

PEACE BRIDGE

DERRY-LONDONDERRY, NORTHERN IRELAND

HIGHLY-COMMENDED

LONG SPAN

The Peace Bridge was conceived as a landmark structure across the River Foyle in Derry-Londonderry linking Ebrington on the east bank to the city centre on the west bank. The bridge is named for its significance in connecting two historically-divided communities and is funded by EU Peace III funding under the Shared Space programme.

The bridge is the centre-piece of a wider regeneration plan, and is designed to provide an aesthetically-pleasing physical expression of the unification of the city.

The client, Ilex Urban Regeneration Company was set up with a remit to plan, develop and sustain the economic, physical and social regeneration of the Derry City Council area. In 2008, following selection of a shortlist through the OJEU process, a design and build tender for the delivery of the bridge was launched.

The tender requirements required a 'bridge of the highest design quality - iconic, modern and elegant' to be built within budget using low maintenance materials. The winning project team of main contractor Graham Construction, structural engineer Aecom, architect Wilkinson Eyre and steelwork fabricator Rowecord worked closely during both tender and detailed design periods to develop an economical solution that fulfilled the client's requirements. The contract value was £8.7 million.

The bridge is a self-anchored suspension bridge for the use of pedestrians and cyclists. The serpentine plan form of the deck is symbolic. The bridge deck is divided into two curved halves, each supported by the suspension system from a single inclined steel tower. At the centre of the river, the structural systems overlap to form a 'structural handshake'.

The form of the structure is believed to be the first of its kind in the UK. The 312m long bridge has six spans in total, three of which are supported from the cables. The main river span is 96m, with a minimum clearance of 4.3m for navigation. On the eastern bank, the end span crosses over the Derry-Londonderry to Belfast railway.

During the design process, an environmental assessment was undertaken to identify and minimise ecological risks. As a result, the long-term approach to materials selection sometimes led to the specification of components which required a higher initial capital outlay than other less robust alternatives, but which will require less maintenance and therefore reduce the whole-life cost.

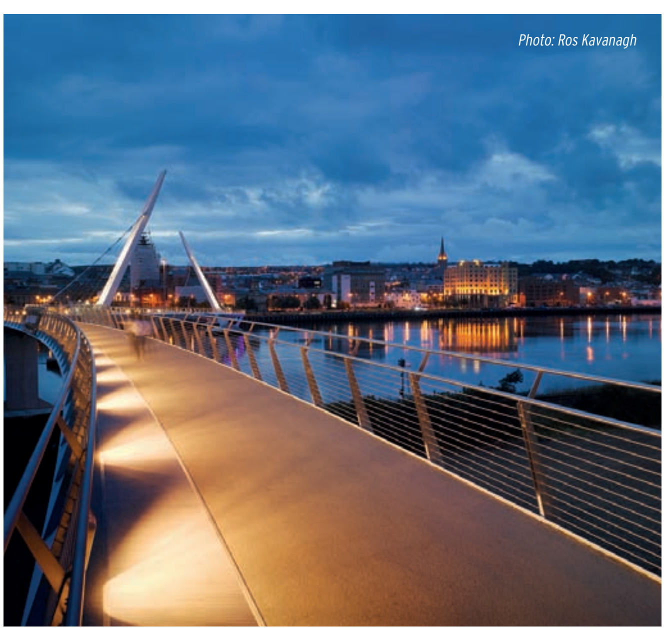


Photo: Ros Kavanagh

JURY'S COMMENTS

"Dramatic yet simple, the choice of the overlapping suspension system rather than the more obvious cable-stayed option is particularly admired. Its structural form will clearly have been a major challenge to design. Well thought-out in terms of form and detailing."

Photo: Ros Kavanagh

Commissioning authority: Ilex URC
Principal designer: Wilkinson Eyre Architects
Structural engineer: Aecom
Contractor: Graham Construction

The sinusoidal horizontal alignment of the bridge was conceived to resolve the misalignment of strong physical axes on the opposing banks of the River Foyle. In addition, it was also important that the bridge should not be seen to be visually allied to a particular bank of the river. The design of the bridge is therefore sensitive to these issues through symmetry. It was a requirement that the bridge celebrate the connection and reunion of the two banks, visually and boldly – belonging to neither but serving both. From the overall arrangement of forms, to the visual resolution of small details, the engineering and architecture of the bridge are seamlessly integrated.

The result is a bridge that has become a landmark, is cherished by locals and has enhanced tourism. It is a safe and inviting environment that is well lit at night, thereby encouraging the use of the bridge as not just a thoroughfare but a destination from which users can view the city and the river in comfort. The structure is deliberately highly visible as it crosses the open water of the River Foyle, having a simple but unusual silhouette of centrally overlapping catenaries to give the structure a form that is distinctive yet aesthetically appropriate.

Although considered an 'iconic' structure, significant cost savings were achieved by the joint venture of design and construction professionals, and a desire to innovate with a clearly-defined purpose. As a result, the bridge was delivered to the satisfaction of the client and community at low out-turn costs for this type of structure ■

CASTLE GREEN BRIDGE

TAUNTON, UK

WINNER

JONATHAN SPEIRS FOOTBRIDGE LIGHTING AWARD

The lighting concept for this bridge is an intrinsic part of the overall conceptual approach to the design. The bridge is a key component of the Taunton Cultural Quarter masterplan, a project that streamlines the pedestrian routes from the Castle Green and through the adjacent Goodland Gardens; in doing so increasing legibility of the site for pedestrians, improving the quality of public space, and linking the castle and river to nearby retail and redevelopment. The bridge spans a Scheduled Ancient Monument and is bounded by Taunton Castle, a Grade 1 listed building.

Given the sensitive location the principal approach adopted in the design is one of reticence; the curve of the bridge yields to the main tower of the Castle while the deck taper sets up a subtle false perspective – apparently prolonging the walk to the town square while shortening the journey towards the gardens. The lighting design is critical in maintaining this posture of subtlety and elegance – the lighting must perform a functional role in providing way marking while also complementing the historic context. As such, and in contrast to the norm, the lighting design played a very large part in determining the form of the bridge.

The cross-sectional form of the bridge was developed specifically with the lighting design in mind. The design is developed from a cross-sectional principle whereby a flat soffit is combined with a shallow inverted 'V' to describe a concrete structure with a very narrow edge profile. This in turn carries the deck surfacing of stone and glazing, with glass parapets contained within a protective band of steel on all exposed edges. The sides of the bridge are formed by glass on the deck surface and on the lower portion of the parapet edge – creating a translucent 'volume' of glass specifically to contain the bridge lighting system.

While the glass volume helps to lessen the visual mass of the bridge during the day it is at night that its functional purpose becomes apparent. Continual longitudinal runs of low-power LED lights illuminate the volume, at a stroke fulfilling both the functional lighting requirement and providing the night-time identity to the structure. The laminated glass deck and edge panels contain translucent interlayers that diffuse the light and give the appearance of solid 'blocks' of light running along the deck edges.

The Surelight 'Orion' LED fittings selected are paired – to shine upwards through the walking surface and outwards through the deck edge – and run in discrete sections of approximately 450mm in length. Lighting power units are installed for every six strips [three bays] with the control panel for the system being centrally located off the bridge alongside the lighting control for the whole public realm in the area, which is primarily triggered by a daylight sensor but features a manual override.

Maintenance of the fittings is achieved through the removal of a series of tamperproof fixings and the careful lifting of deck panels ■

JURY'S COMMENTS

'A beautiful and well executed project. A worthy winner of the inaugural Jonathan Speirs Award.'

Commissioning authority: Project Taunton/Taunton Dean Borough Council
Principal designer: Flint & Neill
Architect: Moxon Architects
Contractor: Britannia Construction
Lighting design: LDA Design

'SLINKY SPRINGS TO FAME'

OBERHAUSEN, GERMANY

HIGHLY COMMENDED

JONATHAN SPEIRS FOOTBRIDGE LIGHTING AWARD

Artist Tobias Rehberger envisioned a colourful ribbon wrapped in a spiral connecting the parks over the Rhein-Herne canal like a rope flung across the water. The cooperation between artist and the structural engineers created a mesmerising vision in daylight. The artist developed a lighting concept for the accessible sculpture; at night, the dark spiral vanishes into the background, and the superstructure takes its place, meandering through the park in a radiant and colourful way.

LED lamps were used consistently and incorporated into the structure: on top of the bridge in the railings, and underneath at the low points of the spiral. Shining in 'daylight white', the highly efficient lamps are mounted almost invisibly and guide pedestrians across the colourful paving.

The bridge was designed as an elegant and lightweight three-span stress ribbon bridge wrapped in an undulating spiral made of an aluminium hollow section. The lighting alters with seasonal variation of sunrise and sunset and the system features a dimmer switch. One of the two handrails was continously equipped with Ledlux-LH-LED lamps by Insta over a structure length of 406m. The 'daylight white' lamps are mounted almost invisibly and guide passers-by over the colourful floor. Narrow spot angles and careful orientation of the lamps avoid glare to the shipping traffic. From a distance, the bridge itself seems to radiate light ■

JURY'S COMMENTS

'This magical footbridge looks every bit as good by night as it does by day. It deserves to be highly commended.'

Photo: Roman Mensing

Commissioning authority: Emschergenossenschaft
Principal designer: Schlaich Bergermann & Partner
Contractor: ARGE Stahlbau Raulf - IHT Bochum
Landscape architect: Davids Terfrüchte & Partner

MALA PANEW RIVER BRIDGE
OZIMEK, POLAND

WINNER
RENOVATION/REUSE

In 2008, ownership of the historic iron suspension bridge over the Mala Panew River in Ozimek, Poland, was taken over by the city authorities, who wanted to reopen the bridge to the public. Work on the structure by Malapane, which at the time was one of the leading ironworks of Europe, originally began at the end of the 18th century, but it was not until the technology of cast and wrought iron prefabication had been proven that the bridge was built and it opened to traffic in 1827. The bridge has a small span of just 28.5m long and 6m wide, suspended on wrought iron chains supported on two cast iron towers.

A series of severe floods and World War II damage left the structure weak and unsafe; in 1969 it was recognised in the register of Polish monuments. Despite its modest span, the bridge is of great value, both for its historic, industrial and architectural aspects and because of its cultural heritage and its structural uniqueness.

Renovation work was designed by an experienced team from the Department of Roads & Bridges at Opole University of Technology. As well as adapting the bridge for pedestrian use, the renovation design was also aimed at showing off the magnificence of the original architecture of the bridge.

Refurbishment or strengthening of the abutments, deck and substructure walls of the anchorages and towers was carried out, however the balustrades, as non-structural elements, did not meet the basic safety criteria and had to be replaced. Special attention was focussed on the corrosion protection of the iron structure, hence the bridge had to be completely dismantled. Many elements, for example the timber fittings on the anchorages, had to be reconstructed using old pictures or paintings for reference.

The designer and contractor had to resolve many problems during the renovation works which had been impossible to predict during the design stage, as the structural members had to be separately tested. Determining the original material characteristics was a very important part of the restoration process, and as the properties of these materials are widely divergent, it was necessary to carry chemical, radiographic, ultrasound and tensile testing, for example, to obtain full information on the quality of the iron. This information made it possible to identify the weakest parts of the bridge, and the analysis showed that the iron structure was full of cracks, mostly in the towers and chain rods. Thanks to detailed numerical analysis, most of the original elements were able to be saved but the superstructure had to be strengthened. Only a few members out of a total of more than 1,600 were in too poor a condition to be rescued.

The cast iron cracks were repaired using an innovative method which

JURY'S COMMENTS
"A lovely bridge which seems to have benefitted from very thorough refurbishment work, and from care taken to minimise the intrusive impact of the physical works."

does not cause thermal stresses, ensuring durability and reliability. The design of the deck stiffening, which is invisible to pedestrians, enabled the original depth of deck to be retained while increasing the bending and torsional natural frequencies of the deck from 1.2Hz to 4.3Hz and from 2.1Hz to 5.2Hz accordingly.

The bridge was strengthened by use of a light steel suspension structure consisting of wire ropes, which are fitted to the same geometry as the original chains and hangers to retain the visual aesthetics. As a result the bridge capacity was increased from 3t to 22t.

Another positive effect of the finite element model calculations was that it allowed the efficient use of materials. The total weight of high grade structural steel is 25kg/m^2 over the total bridge area. Another successful material parameter was the minimal increase in the deck weight before and after renovation, which increased to just 2.9kg/m^2. The bridge life should increase to 100 years and maintenance costs be minimised due to the use of triple-layer iron coating, Galfan steel rope coating and monitoring system.

The price of the renovation work, including the rebuilding work, material tests and advanced technology was approximately €4,660 per m^2, which is considered a mid-range cost for such specialist restoration work ■

Commissioning authority: Wudimeks
Principal designer: Opole University of Technology
Contractor: Rekonsbud
Lighting design: Business Design

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Like any great enterprise, the construction industry needs to attract, motivate, train and encourage young people to enable them to take on positions of responsibility and leadership. Talented young engineers and architects are the life-blood of our profession and we rely on them for a healthy future. The Flint & Neill Footbridge Young Author Award celebrates these young people and seeks to recognise and reward emerging talent.

There are many young people all over the world involved in a huge variety of footbridges and footbridge-related technologies, whether in research, design, construction, maintenance or other aspects. Every three years since 2002, the world's footbridge professionals have gathered to share their knowledge and experience, and this well-established and popular event now attracts a growing number of young people. This year 23 of the papers accepted by the scientific committee for publication have been written or co-written by authors under 30; 14% of the total number. It is wonderful to have so many young people attending and contributing to this event, and encouraging to see the high quality of their work and the diversity of topics.

All of these young authors are eligible for the Flint & Neill Footbridge Young Author Award. The judges are all members of the scientific committee and are chaired by Joanne McCall from Canada. They have already reviewed the written papers and during the conference they will assess the quality of the young authors' presentations, whether by poster or Powerpoint, in order to select the winner(s). The judges will assess the originality and potential significance of the technical content as well as the clarity of the written material and presentations. The award will be presented during the closing session on the last day of the conference

FOOTBRIDGE YOUNG AUTHOR AWARD 2014: CANDIDATES

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As used by Parsons Brinckerhoff to assist with its design of Redhayes Bridge to Eurocodes on behalf of Devon County Council.
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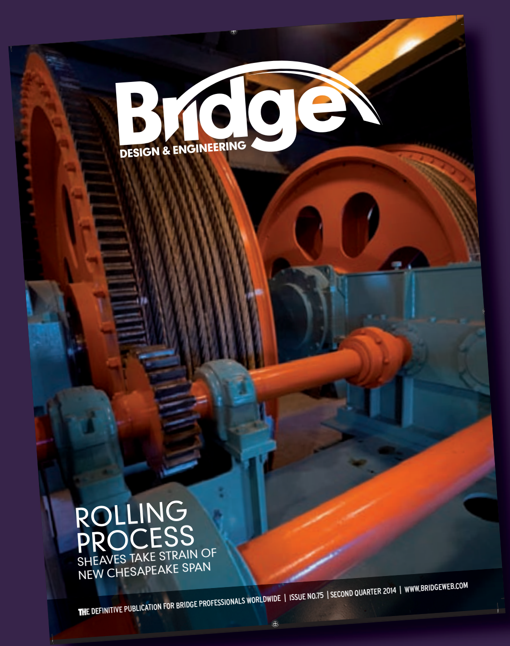

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