



IABSE UK NEWS

Newsletter of the British Group of the
International Association for Bridge and Structural Engineering

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Media City Footbridge under construction, Salford Quays, October 2010

Image courtesy of Steve Thompson, Gifford

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IABSE British Group News

Editorial

Welcome to *IABSE UK News*, the newsletter of the British Group of IABSE.

I have recently been granted the honour of replacing Andrew Martin as editor of the newsletter. There has been considerable IABSE activity since the last newsletter, including two international IABSE conferences, the British study tour to Paris, and the Henderson Colloquium, Annual Lecture and Milne Medal Lecture.

I'd like to use this opportunity to ask readers what they would like to see in *IABSE UK News*. I am open to suggestions to ensure it remains informative, interesting, and a welcome presence amongst email overload.

The newsletter as ever will rely on the willingness of members to contribute, so please consider doing so!

Regards,

Brian Duguid, Editor

Events

<u>Date</u>	<u>Time</u>	<u>Event</u>
17 March 2011		<u>Young Researchers' Conference</u> Organised by the IStructE with IABSE support, young researchers should submit a synopsis of their work by 10 December 2010. See www.istructe.org/ycr11 for details.
20 – 23 September 2011		<u>Joint IABSE-IASS Symposium</u> QE2 Conference Centre, London – see www.iabse-iass-2011.com

Unless noted otherwise, all events take place at the Institution of Structural Engineers, 11, Upper Belgrave Street, London. Tea is usually served before evening lectures and meetings from 5.30pm.

IABSE on the Internet

The website of the British Group can be accessed at <http://www.iabse-uk.org/>, where proceedings of Henderson Colloquia and back editions of *IABSE News* are available in downloadable form. We remain grateful to the Institution of Structural Engineers for their continued generosity in hosting the website.

I am looking to add further papers or summaries from past Henderson Colloquia to the website, so if anyone can assist by supplying copies, please get in touch (brian.duguid@mottmac.com). I have recently added summary reports on the 2007 (Design Competitions) and 2010 (Structures for Energy) events.

The international website of IABSE at www.iabse.org contains comprehensive information on IABSE organisation, activities and publications. Recent additions include the first three Structural Engineering Documents, made available for free as they are now out-of-print (in the Members Area).

The views and opinions expressed in *IABSE UK News* are those of the respective authors and not those of either the Executive Committee of the IABSE British Group or the Editor. Whereas effort has been made to ensure the accuracy of statements and acknowledgements, we reserve the right to be as wrong as everyone else.

Structural Engineering International

The ongoing opportunity exists for all members to have articles published in *SEI*, the international journal of IABSE. Rules for publication are available through the IABSE website at www.iabse.org. David Doran is the UK Correspondent for *SEI* and can offer assistance to prospective authors (see Directory).



Report – IABSE 2010 Annual Lecture

Bill Baker – “Engineering an Idea”

David Nethercot writes:

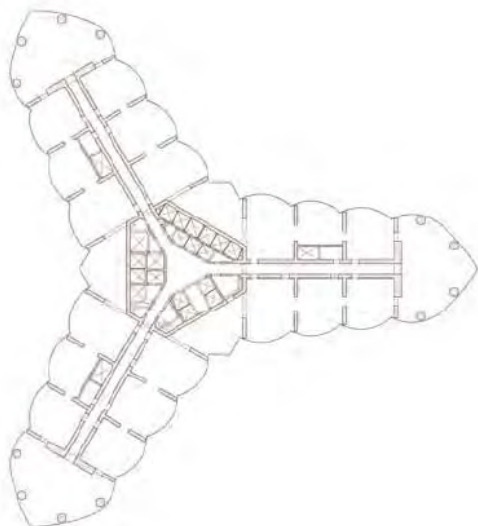
On 13th May 2010, Bill Baker delivered the Institution of Structural Engineers – Gold Medal Address; it was also the British Group of IABSE’s Annual Lecture. Interestingly, it was the British Group who had booked Bill first.

Those of us fortunate enough to be present were treated to several samples from Bill’s mercurial carrier as one of the world’s leading designers of tall buildings. The central theme was that structures should be based on sound structural ideas and not on contrived architectural features.

Starting with 19th Century examples from Telford, Brunel and Baker and progressing through his own innovative work on Exchange House and the John Hancock Centre he quickly arrived at the Burj Khalifa (pictured, right). As the world’s tallest building (by a significant margin) this was presented as “just a vertical cantilever”. But there is much more to it.

Based on a new concept called the “buttressed core”, the concrete Y-shaped core (pictured, below) acts with the corridor walls, cross walls, perimeter columns and floor plates to provide the necessary high torsional and lateral stiffnesses. By cleverly “manipulating” the wind loading, the usual limiting effects of catering for very high wind loads were minimised. Or, as Bill said, “*we confused the wind and managed gravity*” – a fine example of harnessing the great forces of nature for the benefit of mankind.

Bill’s full paper can be found in the 18th May 2010 copy of *The Structural Engineer*.





Milne Medal Winner 2010

Chris Wise – “Enough is Enough”

Report by **Brian Duguid**:

At a packed meeting at the Institution of Structural Engineers on 18 November 2010, our Honorary Secretary presented Chris Wise of Expedition Engineering with the Milne Medal. The award is perhaps unique in the structural engineering field in that it recognises the recipient's achievements in design rather than in the more general realm of engineering.

Chris's lecture, titled “*Enough is Enough*” departed from the usual practice of using the speaker's past projects to illustrate a theme of their choosing, and focussed instead on the need for structural engineers to change the way in which they design relatively everyday structures.

Taking as its basic premise the ever-more urgent need for engineers to play their part in reducing the use of energy and resources, Chris identified three aspects of design work where there are obstacles to this goal, as well as opportunities to change habitual practice.

The first of these was the realm of “*practice*”, the processes and relationships that inform what designers deliver and how they do it. Figures for the embodied energy in the steelwork of four recent and different Olympic sports buildings were contrasted, with a factor of ten separating the worst performer (the Birds Nest Stadium) from the average structures, and a further factor of ten separating those from the best (the 2012 London Velodrome).

Chris's implication was that the difference might relate to the differing relationships between the various design parties involved (engineers, architects, project managers et al), and in particular to the engineer's interest in affecting the design solution, and their opportunity to do so.

The second area is the world of “*codes*”, and the way in which their lowest-common denominator conservatism obliges designers to incorporate substantial volumes of superfluous material into their structures. Examples included over-specification of office floor loads by developers and also by standards; unnecessarily onerous floor deflection limits; and safety factors which penalise projects with more accurate analytical modelling or better site quality control.

Chris suggested that designers could be obliged to calculate material not only to achieve the minimum required by codes, but also to remain within a maximum above the code requirement, reducing the prevalence of over-design.

In the third area, “*technology*”, the villains were the rolled steel section and the flat concrete slab with their uniformity ensuring that as much as 50% of the material present is doing nothing other than holding the structurally useful portions together. Developing a process whereby shaped beams could be more economically produced would have the potential to greatly reduce embodied energy.

There were many other examples where a relatively small effort to change could lead to large gains in efficiency, with Chris suggesting “*enough ... demolition*”, “*enough ... computing*”. He acknowledged with good humour that the real world was complex and these were not easy goals.

One general message was that engineering specialisation needed to be put back into a subservient role, with design led by synthesisers or integrators (or, as Ian Liddell noted from the floor, “*comprehensivists*”, as Buckminster Fuller had similarly sought to promote a half century before). Another was that change could only come about if someone could occupy the centre ground between academia, consultancy, contracting / manufacture, and the often-neglected users and project commissioners.

Without doubt, it was a thought-provoking lecture, a plea for a behavioural revolution in the face of institutional and institutionalised inertia.



Chris Wise receives the Milne Medal from Angus Low



Report

Joint IABSE-fib Symposium 2010, Dubrovnik 'Codes in Structural Engineering – Development and Needs for International Practice'

Report by **Stuart Alexander**:

This joint IABSE-fib symposium was held at Dubrovnik in Croatia on 3-5 May 2010, and attracted over 250 delegates. Over 160 papers were presented by authors from over 40 countries, triggered by the 'official' start of Eurocodes, but discussing many other approaches as well.

Your chairman David Nethercot delivered a keynote paper '*Adopting the structural Eurocodes: how to achieve the maximum benefit*', seeing through the problems of the transition to the long-term advantages. Roger Johnson compared the design of a vertical cantilever with a single top load (a 'bridge pylon') to three different Eurocode parts, finding differences and lacunas (lacunae?) in them all. Stuart Alexander complained that the UK National Annex to EN 1991-1-1 for imposed loading introduced material unnecessarily from BS 6399, although the EN needed a few more categories before full harmonisation would be possible.

Other UK contributors were Haig Gulvanessian, Stuart Matthews and Chris Hendy. The two volumes of proceedings are now in the IStructE library, while Stuart Alexander has hung on to the CD.

Report

IABSE Symposium 2010, Venice 'Large Structures and Infrastructures for Environmentally Constrained and Urbanised Areas'

Report by **Brian Duguid**:

The IABSE Symposium in Venice, held from 22-24 September, was attended by about 600 persons, the large attendance perhaps a result of the city's many attractions (and distractions) available to complement the conference itself. The only difficulty was finding time to balance the varied and interesting symposium sessions against the desire to enjoy the rest of the city.

The venue was the Palazzo del Casino, on Venice Lido, an island about 15 minutes by *vaporetto* from the heart of Venice itself. The conference opening sessions and keynote speeches got the red carpet treatment (literally) next door at the Palazzo del Cinema, which had hosted the Venice International Film Festival only two weeks beforehand.



Venetian distraction: Footbridge by Calatrava

I was in Venice a day early, to attend a (hopefully final) meeting of the IABSE Working Group on Guidelines for International Design Competitions (chaired by Naeem Hussain and also with our Honorary Secretary in attendance). The draft guidelines have now nearly had every 'i' dotted and 't' crossed, and the intention is for IABSE to publish them as a Structural Engineering Document in 2011. Then the real hard work can begin, of 'consciousness-raising' amongst clients.

The symposium as a whole was generally interesting, always amiable, and occasionally provocative. For my taste, there was too little of the latter, with the tight timetable (typically about 8 minutes per presentation) squeezing out opportunities for discussion and debate. The social and networking side of things made up for that to some extent, but there was little space for criticism or challenge, which in many cases would have been appropriate.



Attendance from the UK was healthy, with, by my count, some 22 papers prepared by at least one UK-based author. 16 of these were from design or engineering consultants (mostly engineers, but with an honourable mention for one architect), 5 from academia, and 2 from a client (joint papers are responsible for the numbers not adding up!). Are academics in Britain under-represented in IABSE's British Group? Will the imbalance be corrected next year in London?

The Symposium did have its imperfections, often relating to the packed timetable, and no doubt the organisers of our London event in 2012 will have taken note and be keen to provide a better experience. This will be a particular challenge in view of the numbers expected to attend and the many parallel sessions to be scheduled.

Report by John Corney:

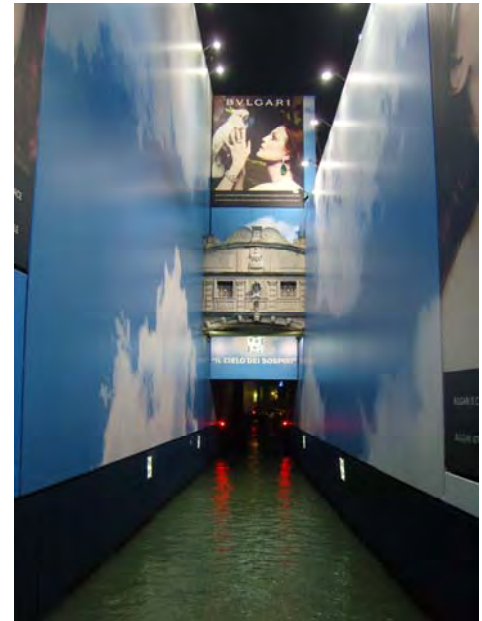
The attendance at the symposium was of course dominated by the civil engineering fraternity. However my perspective was that of an aeronautical engineer, which gave me the opportunity to appreciate both the similarities and the differences between these two disciplines. While there is so much to be said about the superb venue, the beauty of the Venetian environment and the efficient organisation of the event, I would like to confine my comments to one or two technical observations, which unfortunately may seem a trifle negative.

My particular interest is in the read-across from the world of aerospace to that of civil engineering (my paper specifically addressed the topic of active aerofoil stabilisation of long span bridge decks). Perhaps it is because of the tremendously long history of civil engineering, that the 'tried and trusted' approach appears to be the preferred response to technical challenges, and this may explain why I did not exactly find universal enthusiasm for what was probably seen as *avoidable* innovations from an unfamiliar world. I would no doubt have a similar attitude if someone tried to point out the benefits to aircraft stability of tuned mass dampers say, although, to be fair, I believe I would give such suggestions a fair hearing.

My other strong impression was the dominance of architectural influence on major structures. We see supremely elegant (and expensive) technical solutions to meet what seem to me to be arbitrary and self-inflicted architectural constraints. For example I was surprised to learn that the deck of the Akashi Kaikyo Bridge was of the traditional trussed design rather than the now almost universal box girder was to 'give it a massive and substantial appearance', rather than to meet (say) cost and performance requirements. Broadly similar comments apply to many of the new Chinese structures described in detail in the Ding Jiemin keynote paper.

In aerospace, aesthetic inputs are invariably confined to commercial aircraft paint jobs and internal décor, with no impact on performance, and relatively little impact on cost. I know of no cases where the customer has specified an unusual aircraft *design* for aesthetic reasons.

On the positive side, I look back to my few days in Venice with considerable pleasure. I don't think I have ever seen so much food and wine and so much genuine *camaraderie*; it could be described as nostalgia in the making!



Bridge of Sighs - refurbishment of heritage structures in Venice is often funded by the sponsorship of advertisers



Ponte de Rialto, Venice



Structures for energy – challenges and opportunities

Magdalene College, Cambridge, 5th to 7th July 2010.

Report by **Ian Liddell**

The theme for 2010 was selected because of the uncertainties surrounding the Government's stated aim to reduce carbon emissions by 20% by 2020 and 80% by 2050. How these are to be achieved has yet to unfold but it is clear that there will be implications for Structural and Civil engineers yet to be defined.

A distinguished group of engineers gathered at Magdalene College, Cambridge on the 5th July to discuss the implications of the stated aims to decarbonise energy. Experts from various sectors representing most energy technologies reported on the situation in their field. This gave us a picture of the technologies that were likely to be adopted in the next 10 to 20 years. Opportunities for the involvement of civil and structural engineers were noted and areas where they could help with enabling the construction of new facilities were highlighted. It was noted that there were many areas where there were skills gaps caused by lack of recent experience on active projects.

The list of participants is set out below with the titles of their presentations and the key conclusions are also added. The full record of the papers and presentations will be made available shortly.

- Chairman **Richard Snell FREng, Visiting Professor, Oxford**
Engineering for Oil and Gas industries
- Organiser **Ian Liddell CBE FREng, Visiting Professor, Cambridge**
Power from the Oceans
- Rapporteur **Andrew Jackson, PhD student, Cambridge**
Carbon Capture and Storage
- **John Roberts, Director, Energy Strategy, Arup**
Setting the Scene – UK Future Energy
- **Andy Limbrick, Association of Energy Producers**
Electricity Supply Options for the Low Carbon
- **Graham Bootham, Director, Jacobs UK**
Overview of UK power and energy generating plant.
- **Chris Bolton, Principal Engineer, Sellafield Ltd**
Nuclear new build; Nuclear Fuel Cycle
- **Allan Mann, FREng, Jacobs UK**
Design standards: Challenges and Risks
- **Tony Yates, Principal, SLR consulting**
The Future of Energy from Waste in the UK
- **Adrian Fox, Supply Chain Manager, The Crown Estate**
Large Scale Offshore Wind Systems
- **Thomas Dahlgren, Engineer, COWI Denmark**
Wind turbine tower and foundation structural requirements
- **David MacKenzie, Director, Flint and Neill**
From A to B – Generation to Delivery
- **John Powell, Associate Principal, Arup energy, Houston**
LNG Storage and Transportation: why does innovation get lost
- **David Fisk BP/RAEng, Chair in Sustainable Development, Imperial College**
Urban Energy Infrastructure: too little for too much?
- **Bill Addis, Sustainability Engineer, Buro Happold**
Solar Power; Environmental impacts of energy structures



- **Norman Haste, Laing O'Rourke**
A Construction Industry Perspective.

Key Conclusions

To meet the emission reduction targets we all need to learn to live with less energy. To do this energy and building physics should be a compulsory subject for GCSE.

Electrification of cars should be facilitated and encouraged where appropriate (e.g. for commuting).

The UK needs a strategy for national energy, which must include a mix of low carbon generation technologies. Under the current plan of coal and nuclear power station closures the government must be aware of the imminent danger of power cuts.

To enable private companies to construct nuclear and renewable power facilities they need certainty on long-term (30 years) future energy, carbon prices and regulations.

The National Grid will need to be modified to accept intermittent power from new sources. This needs a generation strategy and a long lead-in time.

Peaks and troughs of electricity demand should be controlled by offering price variations in a similar way to the current off peak pricing structure but meter controlled by the National Grid.

Gas CCGT plant will have to fill the energy gap and to buy time to develop nuclear. Since this is the low cost option it may slow down the drive to reduce emissions.

Carbon capture and storage will never be energy efficient or financially economic



Some of the Henderson Colloquium participants



The offshore wind sector is not at all well integrated and operates inefficiently which will probably mean many of round 3 wind farms will not get built unless Govt intervenes to subsidise the sector.

Govt should push flat out for new nuclear on a large scale to de carbonise the economy and investigate coal gasification technology to feed syngas to modern CCGT Power Plants.

Tidal power would be a small contributor. The Severn Barrage would be a bad buy. A series of tidal lagoons up the Irish Sea would be a useful asset especially if linked with wind turbines.

EfW plants should be constructed as quickly as possible before landfill sites are full up.

Engineers need to learn how to talk to the government (MPs and civil servants) about developing and implementing energy policy based on rational argument and a long-term view – led by institutions working together.

The key engineering workload for future energy is:

- Retrofitting buildings and industry to reduce demand
- Electrification of transport
- Development of low-carbon generation capability as noted above

Industry has to address design to meet the challenges of building better structures to cost and to programme. The engineering talent is available in the UK but those with experience of the power sector are ageing. To address the skills gap it needs a planned sequence of projects to enable young engineers to gain the necessary knowledge and experience.

UK engineering experience with offshore oil platforms can be adapted for the needs of Round 3 wind farms. Structural engineers need to move between sectors – oil, nuclear, wind, naval architectural, etc.

Engineers should develop a better understanding of market mechanisms in the power sector.

Ian's comprehensive 25-page report on the Colloquium is available online at www.iabse-uk.org.

British Group Study Tour – April 2010

Paris and its region

Report by Lee Franck (Arup), with Elisabeth Stuetzel & Alex Morris (Arup)

On the 16th April 2010, sixteen people from the UK, Italy and Greece got together in Fontainebleau embarking on the IABSE British Group's Study Tour to Paris and its region. The first day of the trip would be spent outside the city visiting some of the oldest stone arch bridges of the famous architect and structural engineer Jean-Rodolphe Perronet and the first prestressed bridges in France by Eugène Freyssinet. The second day of the tour would take place in Paris itself to discover more recent works mostly evolving around the theme of "big footbridges". The group comprised a mix of engineers, architects, academics and companions all of whom received excellent guidance from Serge Montens of Systra, author of "*Les Plus Beaux Ponts de France*", Henry Bardsley of RFR and the tour leader Angus Low of Arup.

On the first day the group boarded their minibus heading towards the south-east of the Ile de France with a first stop in Nemours. Here the group visited the cable-stayed bridge over the Loing river by Jean Muller with Marchal as architect. Whilst not to everyone's excitement at first, Serge Montens who had previously worked with Jean Muller, drew the group's attention towards the carefully chosen details of the bridge: the flower-like cable saddle atop the pylon, the structural purity of the inverted V-shaped pylon that does not touch the deck and the decorative cable anchorages in the deck.

It was with great anticipation that we then had the chance to see the first of three remaining bridges by Jean-Rodolphe Perronet, the leading French bridge designer of the 18th century. The shallowness of the arches is immediately striking as is the narrowness of the piers. These attributes represent a departure from the medieval semi-circular arch towards a span to depth ratio comparable to that of a modern prestressed deck. I found it particularly interesting to understand how this innovative design of the time was made possible by two coincidences: the financing of infrastructure projects by the cash-rich French state rather than individual towns and the urge of the Enlightenment for scientific reasoning over tradition. Perronet understood that by



reducing the width of the piers, the force exerted on the bridge by floodwaters would also decrease making the narrower piers feasible. Furthermore, the state's new financing system allowed a bridge to be built in much shorter time; spans could balance the horizontal thrust of the adjacent spans further reducing the need for large piers.

After a delicious lunch in the boulangerie of the town we then got to see Eugène Freyssinet's masterpiece, the Luzancy Bridge. Freyssinet had spent many years thinking about and conducting experiments to investigate how to improve reinforced concrete. This resulted in the construction of the first prestressed bridge of significant span (55m) in 1947. With the Luzancy bridge he pushed the technology to its limits by prestressing 1016 precast elements in three different ways and using such a small percentage of passive reinforcement that no one would dare to attempt today. It was the jacking system at the abutments used to push the bridge deck upwards after shrinkage that particularly aroused the group's curiosity. One by one we were able to climb up into one of the abutments to catch a glimpse into the interior of the bridge and understand how it works and how it was constructed.

It was in the morning of the second day that we then visited a second masterpiece of prestressed concrete at La Défense. The CNIT, built in 1958 by Nicolas Esquillan in collaboration with Pier Luigi Nervi, is a thin double shell structure with internal ribs supported on only three points. It is still today the world's largest concrete shell in terms of surface covered per support. Standing right next to it and of similar impressive scale is another example of a prestressed frame, La Grande Arche by Danish engineer Erik Reitzel with its lightweight tension canopy, Les nuages de la Grande Arche.

The next stop on our tour of France's significant contribution to bridge engineering lead us to the outskirts of Paris to visit the Choisy-le-Roi bridge by Jean Muller when he was still with Campenon-Bernard. Although visually not very appealing, this bridge hides the secret of having been the first in the world to be built using match-cast segments, a technique which has since been applied all over the world.

My personal highlight of the second day was the Simone de Beauvoir footbridge designed by RFR with Feichtinger Architectes. I particularly enjoyed listening to the explanations of our guide Henry Bardsley of RFR who gave us an insight into the different themes that governed the design solution. Being the most recent bridge to be built over the Seine in Paris, the Simone de Beauvoir footbridge needed to harmonize with the existing arch bridges over the Seine whilst the theme of inhabited bridges received increasing interest in Paris' courtyards at the time. The challenge for RFR was to find the right balance between traditionalism and modernism. I believe they greatly succeeded in achieving this balance by designing a combined tension and compression structure which provides two alternative pedestrian routes as well as a central covered space which can house art performances.

For the rest of one of the first sunny spring afternoons we would take a long walk along the Seine visiting the intensively decorated Pont Alexandre III, Pont de la Concorde (another of Perronet's remaining arch bridges), the Passerelle Solferino (the French example of a "wobbly" bridge) and not to mention the Pont des Arts where in the early evening hours crowds of young people would gather to enjoy a glass of wine together and the stunning view of Ile de la Cité.

With a perfect balance between historic masterpieces, technical innovations and modern designs in both rural and urban environments, the tour was a unique opportunity to learn about the biography of some of the most outstanding bridge designers. It also provided an insight into the importance of good detailing and the excitement of discovering the interior of a bridge. My colleagues, Elisabeth and Alex, and I agree that what made the trip so enjoyable was the engaging group dynamic: a product of expert guides and an interesting mix of people of different ages and backgrounds. As young Engineers of the British Group of IABSE we would like to encourage other young Engineers to participate in such events. It is not only great learning experience, but a fantastic opportunity to meet people of different disciplines and share experiences, thoughts and good memories.



Pont haubané sur le Loing, Nemours
Jean Muller / Marchal, 1997



Le Grand Arche, La Defense, Paris
Erik Reitzel, 1989



Pont sur le Loing, Nemours
Jean-Rodolphe Perronet, 1804



Pont sur la Marne, Luzancy
Freyssinet, 1947



CNIT, La Defense, Paris
Nicolas Esquillan, 1958
(All photos by Elisabeth Stuetzel)



Passerelle Simone de Beauvoir, Paris
RFR / Feichtinger, 2006



Project feature

Media City Footbridge, Salford Quays

*The following article is an abridged version of the paper presented to the IABSE Symposium in Venice in September 2010, by **Peter Curran** and **Steve Thompson** of Gifford:*

Introduction

Peel Holdings appointed Gifford, Wilkinson Eyre Architects and Bennett Associates to design a new opening pedestrian footbridge across the Manchester Ship Canal at Salford Quays. The new bridge will link the Media City development on the North Quay with the South Quay, adjacent to the Imperial War Museum North.

The function of bridges extends beyond mere utility. Bridges have an inherent significance and symbolism as connectors and conduits, gateways and meeting places, landmarks and icons. The new Media City Footbridge is only a small component of the ongoing development of Salford Quays, yet will assume strategic importance as a symbolic marker for Media City and for Trafford Wharf.



Aerial view of footbridge location

Project Background

The Manchester Ship Canal was opened by Queen Victoria in 1894, and enabled vessels of up to 12,500 tonnes to sail into the heart of Manchester. However, by the late 1960s, the Salford Quays were suffering a serious decline in use and in 1982 they were closed to commercial traffic. They are nevertheless an important legacy of the region's industrial heritage and the Canal represents a potentially important asset into the future.

The area now boasts a selection of residential, office, retail, cultural and leisure activities. The opening of the Lowry arts centre and the coming of Metrolink have given a renewed impetus to the area, generating high rise residential schemes and a second round of commercial office development. The development process is continuing with great success and now Media City stands out as the greatest opportunity for determining the future of Salford Quays.

The footbridge will link the Media City development site with the Imperial War Museum and areas to the south west, significant zones of which are identified for redevelopment.

The Requirement for an Opening Bridge

A fundamental decision in developing the design of the bridge was to determine whether the bridge needed to open for passing vessels, and if so what clearances are needed.

At present there is a public right of navigation over the Port of Manchester, with the Port being defined as that area downstream of Eastham and Upstream to Hunts Bank, Manchester. Any interference with the public right of navigation, such as a fixed bridge, would require statutory authority, by, for example, seeking of permissions under the Harbours Act 1964.

For an opening bridge it is believed that such issues do not arise. As a precedent, they did not arise in connection with the construction of the Lowry Centre Bridge, the necessary permissions being secured through planning permissions in the usual way. As a result of the above it has been agreed that an opening bridge is the most appropriate solution.

Client Aspirations

Peel Holdings felt that the bridge should be considered a “destination”. It has the potential to be a highly visible landmark that will become synonymous with the area. In order to achieve this, the design should be unique and memorable and as such should grasp people's imaginations.

Whilst complying with these aspirations however, the design should still be appropriate for its context and sensitive to its surroundings. The bridge should enhance connectivity between the two development sites on



each side of the Canal. In addition it should make good use of the site and should maximise connectivity with the Canal edge.

Geometric Constraints

Consultations were held with the Manchester Ship Canal Company (MSCC) who advised the following:

- Navigation width at the bridge site needs to permit the desire to manoeuvre and turn the largest permitted vessels on the Canal (161.54m x 19.35m) into the Dock 9 entrance without restriction.
- Clearance between the underside of bridge deck and the normal water level (N.W.L), with the bridge in the closed to vessels position, is to be 4.77m, as the existing Lowry Bridge.
- Clearance in the open to vessels position is not an issue with a swing bridge.

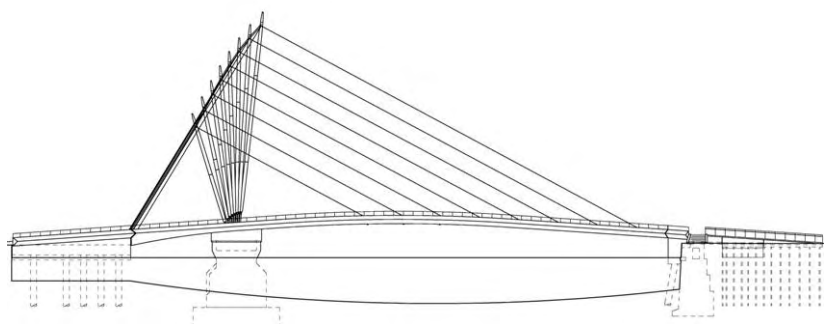
Geotechnical

Site investigations have shown the ground conditions to comprise Made Ground and Drift deposits overlying the Wilmslow Sandstone Formation. The overlying Made Ground consists of gravelly clay, comprising brick fragments, concrete, clinker and glass, with occasional fragments of tar macadam. The alluvial deposits comprise sandy clay with occasional sandstone gravel. The Made Ground is underlain by between 1.0 and 5.0 metres of soft organic silt below which are loose sands over dense gravels overlaying moderately weak sandstone bedrock at around 13m below ground level.

The site investigations also indicated that the ground within the area of the proposed footbridge had been impacted by inorganic and organic compounds. Concentrations of organic compounds were generally found to be highest within the made ground in the upper 1m as a result of the industrial heritage of the region. Canal sediments showed similar chemistry to the soils, indicating that care was required to minimise disturbance of the ground and the canal silts.

Built Context

The area's extensive regeneration is strongly expressed with two monumental and architecturally expressive neighbours - the Lowry Centre and Imperial War Museum North. Also nearby, the Lowry Bridge makes an equally strong visual impact on its environment. The banks of the Canal were once lined with warehouses and animated with movable cranes. These distinctive structures provide a strong visual precedent for any new edifice at the Canal edge. The proposal for the new Media City Footbridge takes visual and symbolic cues from these other landmarks, whilst retaining an identity of its own. Both views and pedestrian movements have helped to define the final design proposal.



Bridge elevation

navigation in the closed position determined the profile of the pedestrian deck for the new footbridge, set to a height of 4.77m above water level, as for the existing Lowry Footbridge.

One of the Client's original aspirations was to minimise or even eliminate the requirement for any ramp structure at the quayside at the northern abutment. It was felt that such a ramp would create a physical and visual barrier for pedestrians wishing to use the promenade walkway at the Canal edge. By contrast, a ramp springing from the quay edge would not pose such an obstacle and would provide unhindered access onto the bridge deck.

To meet these constraints, it was agreed to accept a footway gradient of 1:15, which remained within the acceptable limits of the design standards.

Vertical Alignment

The vertical alignment of the bridge was primarily dictated by the navigation requirements of the Manchester Ship Canal Company (MSCC). The bridge must satisfy dual head-room requirements by providing a navigable channel for large vessels when open and for smaller boats when in the closed position. The requirement for



Structural Form

The structure is a cable stayed bridge, a cost effective structural form for the required span as well as a dramatic landmark. The bridge comprises a main span spanning approximately 65m across the shipping channel of the Canal, with a short back span of approximately 18m at the south end that flares to meet with pedestrian desire lines for pedestrians walking eastward or westward along the South quayside. The back span structure forms the counterweight to balance the asymmetric spans during opening.

The asymmetric form of the deck span utilizes a fanned array of eight shaped hollow steel masts up to 30m tall converging at their bases atop a sculpted pedestal to create a highly visible and distinctive form located toward the south end of the bridge over the main pier pivot location. These masts support the bridge deck utilising high tensile steel cables anchored to the east side of the deck edge on the main span and a fanned array of anchors to the deck of the back span. The entire bridge rotates about this pivot in order to allow passage of large vessels along the Canal.

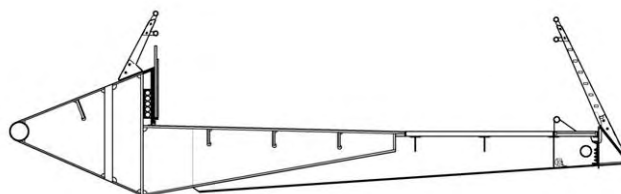
Foundations

Based upon the geotechnical ground investigation information the bridge is supported upon a large diameter caisson foundation for the main pier and tubular steel driven piles for the abutments.

The abutment structures are constructed on the canal side of the existing quay structures. This minimizes any detrimental effect on, and ensures no additional loading is imparted on the existing quay side structures.

Deck

The deck is fabricated as a shaped internally stiffened orthotropic steel box, with the pedestrians walking on the epoxy aggregate waterproofing/non-slip coating to the upper surface of the box itself. The root of the box is more substantial than the body of it, and encompasses the anchorages for the cable



Deck cross-section

stays along the eastern edge of the box. In addition, open mesh aluminium decking panels are provided along the west side of the deck to form a contrasting surfacing along the entire length of the bridge deck. These are supported from a grid of discrete cantilever beams springing from the box. This provides a degree of transparency to the structure and provides opportunity to light both the upper surface and soffit of the deck element.

The flared back span comprises a steel trough structure between the steel edge box and steel cantilever edge sections. This central trough structure is filled with concrete providing the counterweight for balancing the bridge during opening cycles.

Parapets

West side parapets comprise inclined stainless steel parapet posts rising from the longitudinal edge beams, modulated with the transverse cantilever beams. The parapet posts support horizontal stainless steel flat bars and handrail.

East side parapets comprise vertical solid glass panels with stainless steel handrail. As with the decking the glass panels are modulated with the west side parapets and cantilever and comprise laminated glass throughout for safety.

Stay Cables

The bridge deck main span is supported at 6m centres using high tensile spiral strand steel cables. The stays are set to precise lengths by design but provision for adjustment is incorporated in the stay's lower anchorage with the deck to facilitate future maintenance and replacement; removal of any unwanted deformations; and accommodate any tolerances during the construction stages.

Masts

The masts vary in length (up to 30m) and inclination and comprise elongated tapering steel hollow sections formed from bending, cutting and welding steel circular hollow sections in a pattern to form the desired



Footbridge under construction, October 2010

elongated tapered shape. The upper and lower sections of masts will comprise steel tapered hollow tubes. As the masts converge towards their base they are supported on spherical bearings atop a sculpted fabricated steel pedestal. By fabricating the masts from circular hollow sections the possibility of lateral torsional buckling is eliminated and the majority of the masts can be made from readily available standard section, albeit with sections requiring some bending, cutting and re-welding treatment to achieve the desired profile.

Substructure

The deck is supported from, and pivots about, the central point of the main pier support which comprises a 9m diameter solid reinforced concrete shaft founded on rock. The main pier support incorporates a plant room above water level in which is housed the slewing bearing and associated Mechanical and Electrical equipment necessary for operating the bridge.

The abutment structures are formed from in-situ reinforced concrete beam and slab elements with participating permanent formwork, supported off the piled foundations.

Bridge Operation

The pivot for the bridge comprises a large steel casting welded into the pivot zone of the steelwork deck mounted on a slewing bearing which in turn is supported on a fabricated steel stool structure stressed down to the plant room floor in the main pier. This arrangement provides vertical support; resists the overturning moment generated about the horizontal axes and also provides horizontal restraint during bridge rotation.

The supports at the nose and tail incorporate a jacking mechanism at the main span deck nose and horizontal locking pins at both nose and tail. The mechanical and electrical equipment to drive the nose and tail pins and jacks is located on the bridge with the static reaction points mounted on the associated abutments. The jacking mechanisms lift the bridge deck to the correct height to remove any deflection associated with the dead load during the bridge opening. The support locking pins are then inserted and the deck jacks released to ensure that the load of the deck is not resting on hydraulic actuators.

Operating Equipment

Due to the relatively narrow central pier the mechanism to rotate the bridge is mounted on the bridge deck slewing ring support stool and reacts against the fixed pier. The mechanism will consist of multiple hydraulic planetary pinion gears equally spaced around the support stool. The gears are driven by individual hydraulic motors which rotate the bridge on the slewing bearing.

The electro-hydraulic power packs that provide the pressurized oil to the motors are also located in the plant room housed within the central pier, along with the electrical control equipment.

Control

The bridge is controlled from the south abutment. The control interface is a simple pendant control panel that has the required buttons for normal operation. The pendant is stored securely behind finishes that form the barriers when the bridge is opened for vessels; access to the pendant is only possible once the barriers are in place, closing off the bridge to pedestrians.

The barriers on both the north and south abutments are manually operated by appropriately trained members of staff. The personnel responsible for the north abutment barriers have contact with the bridge operator on the south (operations) side with a wireless interlock to the operating system to confirm that it is safe to operate the bridge.



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