



IABSE UK NEWS

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

No. 34

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Outstanding Structure Award 2013: London Olympic Velodrome



Design by Expedition Engineering and Hopkins Architects

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IABSE British Group News

Editorial

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

As ever, there has been a great deal to report from the last six months, and it looks like the same will be true for the rest of this year, judging by the calendar shown below!

As well as our usual reports on recent activities, including the IABSE conference in Rotterdam, and our annual lecture by Hanif Kara, there is a generally forward-looking theme to this issue of the newsletter. We preview the Future of Design conference and our October study tour. There are reports from the outgoing and incoming Chairmen of the British Group, and a feature on the IABSE's new "visionary strategy", which aims to modernise and re-energise the organisation.

We can also be very proud to feature two British winners of this year's IABSE awards!

Regards, Brian Duguid, Editor

Events

<u>Date</u>	<u>Time</u>	<u>Event</u>
21 June 2013	2pm to 4.30pm	<u>IABSE Guidelines for Design Competitions for Bridges</u> Featuring presentations by Naeem Hussain (Arup), Brian Duguid (Mott MacDonald), Cezary Bednarski (Studio Bednarski) and Martin Knight (Knight Architects)
3 July 2013	6.30pm	<u>Journey to Success</u> Career pathways forum featuring Anthony Oliver (NCE), Prof. David Nethercot (IABSE), Sarah Fray (IStructE), Roger Ridsdill-Smith (Foster & Partners). Central London venue t.b.c. See back cover
8-10 July 2013		<u>Henderson Colloquium</u> <i>Applying Lessons from Failures</i> By invitation, organiser Jonathan Wood
12 September 2013		<u>Future of Design Conference</u> University College of London, see page 8
24-27 September 2013		<u>IABSE Symposium – Kolkata</u> <i>Long Span Bridges and Roofs</i> Early bird registration opens 30 June 2013
12-13 October 2013		<u>Study Tour of North East England</u> See page 7
7 November 2013		<u>Milne Medal Lecture</u> Details to be announced
16-18 July 2014		<u>Footbridge 2014</u> <i>Footbridges: Past, Present & Future</i> London, co-sponsored by IABSE
3-5 September 2014		<u>IABSE Symposium – Madrid</u> <i>Engineering for Progress, Nature and People</i> Abstract deadline 31 August 2013

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.



Disclaimer

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.

Membership details

Members are reminded that they can modify their entries under "my account" after logon into the members' area. Having the correct contact data helps to ensure that you continue to receive your copy of SEI and other correspondence and emails from IABSE.

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. Brian Duguid is the UK Correspondent for *SEI* and can offer assistance to prospective authors (see Directory). Forthcoming issues are expected to include the following themes:

- February 2014 – Recent structures and research in Spain (*submissions closed*)
- May 2014 – IT in Design and Construction (*submissions closed*)
- August 2014 and November 2014 – General reports

News from our AGM, 15 May 2013

Report by Angus Low, Arup

The big news from the AGM is that Ian Firth was elected Chairman of the British Group. During his time as Vice Chairman he has had a major effect on the group, principally by having the vision to combine with IASS and bring the 2011 Annual Symposium to London, and then doing so much to make it such a success. Within the higher echelons of IABSE this has greatly raised the profile of the British Group and the commercial success of the event greatly strengthened our finances.

Elected (or re-elected) to the Executive Committee of the British Group were Jumana Al-Zubaidi, Lee Franck, Sarah Fray, Tony Harris, Ana Ruiz-Teran, Martin Kirk, Tony Oakhill and Stuart Alexander. The Executive now has a full complement of 20 members in addition to the three officers. It was decided that the office of Vice-Chairman would be left vacant at present. The current list of Executive Committee members can be found on the back page of this newsletter.

We gain one Chairman, but we do not really lose our previous Chairman because Prof. David Nethercot has stood down in order to take on the leadership of IABSE internationally as the President, for three years from November 2013.

The Annual Report for 2011-2012 was presented to the AGM. It was circulated to members before the AGM. It looks backwards, but it includes a brief section "Looking forwards". This reports on the : *"At the Congress in Seoul in September 2013 discussions on the future shape of IABSE were started. A structure with the National Groups taking a more central role was proposed. This was followed by a Workshop 3-5 May 2013 in Rotterdam, just before the spring conference. It was attended by representatives from 15 National Groups including 4 representatives from the UK. There was lots of enthusiasm and a fair degree of consensus. Decisions will be announced over the next year."*

It is clear that David is taking the helm of IABSE at a time of change, when decisions will be made which will affect IABSE for decades to come.



Reflections from our outgoing Chairman

The IABSE British Group's Chair departs this role to become international President of IABSE, and offers the following reflections on his time in the British Group.

I was really rather surprised when, about 15 years ago, David Quinion (our previous chair) approached me with the comment: “*I intend to give up being chairman of the British Group and, since you are quite seriously involved with IABSE, we thought that you might take over*”. Hardly a process that would stand scrutiny by the Parliamentary Conduct Committee (although their success is decidedly limited), but one which did not seem out of place in an organisation such as ours, which is, essentially, about a group of like-minded enthusiasts agreeing to do things which we enjoy and which we consider to be worthwhile – for that is, very much, the way I see the British Group of IABSE.

It exists because we want it to exist, it identifies and organises things we want to do and it underpins this with the minimum of fuss and formality. Providing our activities are legal and we remain (approximately) solvent, then we go ahead.

It is this enthusiasm and informality that I find so attractive. If that makes us a club, then I see no problem – providing we see the term as providing an outlet for common interests and not some form of exclusivity. Over the years the British Group has identified several distinct, worthwhile and highly enjoyable activities. Some long predate my involvement, others are more recent but the common theme has been: technical justification and the simplest way of achieving the objective.

Thus from the long established Henderson Colloquia to the very new Future of Design we have developed a collection of activities that complement those provided by professional and industry bodies, reflect our international character but which make IABSE accessible to all structural engineers in the UK. Occasionally something much larger emerges – the obvious example was the September 2011 Conference and Annual Meetings held in London – but those British qualities of planning, resourcefulness, pragmatism and the mobilising of volunteers that underpin all our activities simply came to the fore in much greater volumes.

Thus both locally and internationally I believe the British Group to be highly regarded, to be in good shape and to have a secure future. Moreover, it has an energetic, enthusiastic and able new Chairman in Ian Firth so I am confident that it will continue to prosper. So, it's *Au revoir*, but not *Goodbye*.

Professor D A Nethercot OBE, FREng, FTSE Emeritus Professor of Civil Engineering Imperial College London, UK



Greetings from our new Chairman

It is a joy and a privilege to introduce myself to you as the new Chairman of the British Group of IABSE. Following in the footsteps of David Nethercot, my illustrious predecessor is never going to be easy, but I promise to give it a good shot and with your help we will build upon the excellent platform he has built and strengthen the British Group even further.

For those of you who don't already know me I am a Director of Flint & Neill and spend much of my time in the world of bridges. In my 33 or so years as a professional engineer, I have been fortunate enough to work on some interesting bridge designs covering a very wide range from major suspension bridges with names that people tend to know (like Messina, Tsing Ma, Severn and Humber for example) down to small footbridges that people generally don't know (Taunton Castle Green, Bridge of Aspiration and Lockmeadow for example). But it is not only bridges, because at Flint & Neill we do lots of other stuff too, and I am currently Directing our work on London's National





Theatre – a structure originally designed by us and on which we have worked ever since. The current project is a complex development known at NT Future involving a new production building and major re-structuring of the existing 1970's building internally.

I graduated from Bristol University in 1979, and were it not for a last minute invitation by Dr Flint (the co-founder and at that time Senior Partner of Flint & Neill) to attend an interview, I might have ended up working for Halcrow who had already offered me a place. So I joined F&N and immediately found myself working on interesting structural challenges; tall guyed masts, bridge aerodynamics, a steel building in East London and much more. After a year doing the Structural Steel Design MSC / DIC course at Imperial College I came back to F&N to embark upon the project to strengthen the Severn Crossing (now the M48 but back then the M4). My role was leading the team on the cable stayed Wye Bridge, the little brother of the famous suspension bridge. I don't think I realised at the time quite how significant that project was, but looking back at it now I can see that it was a game changer for many who have since been involved in the assessment and design of major steel bridges.

I have been involved in IABSE for many years, and usually manage to find a reason why it is essential for me to travel to the annual international conferences and some other events arranged by the Association around the world! As with so many engineers these days, my work is international in nature, and participating in these excellent and stimulating international events is an excellent way to learn from engineers from all over the world but also to build a network of like-minded friends and colleagues which is essential in this day and age.

I am also a Vice President of the Institution of Structural Engineers, with whom IABSE enjoys a close working relationship. I will therefore one day be simultaneously the President of IStructE and Chairman of the British Group of IABSE, if everything goes according to plan, and in this way will again be following in the footsteps of my predecessor who also held both these posts at the same time in 2003. I hope to be able to be able to encourage even closer links between the two organisations to their mutual benefit.

I believe that IABSE has a great deal to offer to all professionals engaged in designing and building structures, not just structural engineers but also clients, architects, constructors and others working in the built environment. I am delighted that our membership already reflects this diversity but it is important that we spread the word and encourage others to join. Ours is a club of like-minded enthusiasts, and I hope that together we will be able to swell our numbers, particularly among younger members, and engage in a wider range of activities to the benefit of all our members and the construction professions as a whole.

Ian Firth, FREng, FICE, FIStructE, Flint and Neill, UK

IABSE Conference – May 2013 – Rotterdam, Netherlands

Report by Mike Hackney, URS

At the beginning of May 2013 the modern, vibrant city of Rotterdam, the largest port in Europe, was the venue for the IABSE International Conference, whose subject was *"The Assessment, Upgrading and Refurbishment of Infrastructures"*.

Hosted by the Dutch and Belgian groups of IABSE in De Doelen Congress Centre, the conference was very topical, since viable infrastructure is now widely acknowledged as a fundamental requirement for the continued economic and social development of all countries. However, it is becoming increasingly evident that there is even more need for owners to focus on the maintenance of their assets and in many cases, upgrade their existing stock of structures as they continue to deteriorate with age, yet are being subjected to heavier and more frequent loading. Predictably therefore, the conference attracted great international interest, with over 260 papers from 40 countries selected for presentation from the 500 abstracts originally submitted for consideration by the Technical Committee.

This was the first time I had participated in an international conference organised by IABSE and I was eagerly anticipating the prospect of meeting engineers from around the world and learning about their latest research and listening to their experiences.

Following registration and a pleasant reception for the delegates and their partners on Sunday evening, it was "down to business" early next morning with the opening ceremony and keynote addresses by the President of IABSE, the Chairman of the Organising Committee and the Chairman of the Scientific Committee, who set



the objectives and the tone for the conference. The ceremony concluded with an unexpected but enjoyable musical interlude performed by students from a local academy.

During the next three days of hectic activity, each delegate made a short oral presentation of their paper in one of the four dedicated conference suites. The papers were presented in themed Sessions, entitled “*Load Carrying Capacity and Remaining Lifetime*”, “*Assessment of Structural Condition*”, “*Modernisation and Refurbishment*”, “*Materials and Products*” and “*Structural Verification*”.

The papers were a good mix of reports on the latest academic research and case studies of actual strengthening and refurbishment projects undertaken on bridges, buildings and marine works. My paper, entitled “*The Design of the Refurbishment of the M8 White Cart Viaduct, Glasgow*”, prepared in collaboration with Transport Scotland, was included in the Session on Load Carrying Capacity. As a practising bridge engineer, papers on this topic, especially those involving strengthening and refurbishment were of particular interest to me. As I had hoped, it was a fascinating and informative experience meeting with and listening to presenters from other countries, particularly those describing the design and procurement of a variety of strengthening and rehabilitation projects.

Very commendably, a number of good papers were presented by young engineers (those born after 1 January 1978), which IABSE had actively encouraged by offering participants a range of benefits, including the chance to compete for a prize for the two best papers.

On Monday evening, all the participants were invited to a reception at the magnificent Cityhall of Rotterdam, where they were formally welcomed by the Deputy Mayor. In her address the Deputy Mayor emphasised the economic case for governments to maintain their existing infrastructure, with direct reference to some of Rotterdam’s ageing structures.



Delegates enjoy the hospitality at Cityhall, Rotterdam

Also, during the conference, IABSE arranged several technical excursions including a visit to the project to upgrade the 70 year old Maastunnel, which was the first concrete immersed tunnel and is a vital piece of Rotterdam’s infrastructure.

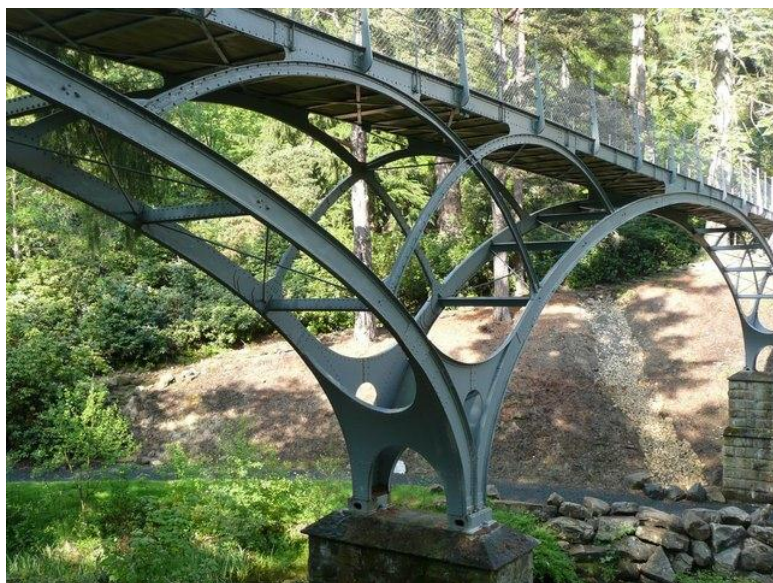
The last day of the conference arrived all too soon, and began with keynote lectures entitled “*Complexity, Ingenuity, Creativity*” and “*Assessment, Upgrading and Refurbishment – A Consolidated Approach*”. This was followed by the presentation of the remaining papers, which were completed on schedule, a triumph of organisation.

The closing ceremony included the presentation of the Young Engineers Awards and publicity for the next IABSE Conference in Calcutta later this year. In his closing remarks, the President declared that the conference had been a magnificent success, a sentiment with which I would heartily agree.

Technical tour of North East England – 12/13 October 2013

Preview by Martin Kirk, Arup

Previous study tours arranged by the IABSE British Group have taken us to Switzerland and Paris. This year, we will be visiting the slightly less exotic locale of the Tyne and Tees rivers in north-east England, however we expect those taking part to encounter a wide range of interesting and in many cases remarkable structures.



The tour will be based in Newcastle-upon-Tyne, and will take in structural engineering highlights both old and new. These are expected to include Middlesbrough Transporter Bridge, Tees Newport Bridge, A19 Tees Viaduct, Stockton-on-Tees Infinity Bridge, Durham's Kingsgate Bridge, Durham Cathedral, Gateshead Millennium Bridge, the "Iron Bridge" at Craggside (pictured left), Byker Bridge, Ouseburn Viaduct, Tyne Bridge, Newcastle High Level Bridge, and more, although the final itinerary is subject to change. The range of structures dates from the 12th century up to the first decade of the 21st century.

Three very different forms of moving bridge are included: the transporter bridge which carries cars across the River Tees in a "gondola", a lifting bridge, and the unique Gateshead tilting bridge, which attendees should be able to see opening at its scheduled time on the evening of 12th October. The tour also takes in Durham Cathedral (pictured right), the first significant use in Britain of pointed arch and ribbed vault construction, and the nearby Kingsgate Footbridge, reputedly Ove Arup's personal favourite of all his designs.

The tour starts early on the morning of Saturday 12th, so attendees are requested to gather in Newcastle on the Friday evening. The tour is expected to conclude by 4pm on Sunday 13th.

The anticipated cost is between £70 for under 30 year olds and £100 for others, subject to numbers attending, which covers coach travel to and from Newcastle and mid-day meal on Saturday; attendees will be responsible for the costs of other meals (including a mid-day meal at Craggside available on a self-service basis) and for their accommodation (hotel suggestions will be provided).

Further details are available from Martin Kirk, martin.kirk@arup.com (telephone 0207 755 3870), who expects to provide final details by 15th July. Please contact Martin to register an interest in attending.





The Future of Design – 12 September 2013

Preview by Tom Osborne, Knight Architects

Following the great success of 2012's Future of Design conference (see newsletter 33), a fresh organising committee has been formed and a second instalment of the event will take place at UCL in London on 12th September 2013, aimed at promoting design and inspiring future generations.

The conference is organised by IABSE's British Group and the Ken Kemp Bequest Fund in collaboration with University College London (UCL) and the Institution of Structural Engineers (IStructE). It is the fifth conference for young engineers or designers organised by IABSE after Cambridge in 2001 and 2003, and London in 2006 and 2012.

This event is a unique platform for networking and to be inspired by the leading figures in the design world. It will include presentations on current cutting edge designs as well as discussions about the future challenges of our profession.

Young designers (35 years or less) are encouraged to submit a one-page paper of their innovative work for presentation during the conference. The paper deadline is **28th June 2013**. A prize for best presentation will be awarded to the young participants.

Chairs: Ian Firth, Flint & Neill Ltd; Ian Liddell, Buro Happold; David Nethercot, Imperial College London.

Scientific Committee: John Eyre, UCL; Ian Liddell, Buro Happold.

Organising Committee: Jeanette M Abela, Flint & Neill Ltd; Fernando Madrazo, Imperial College London; Tom Osborne, Knight Architects; Philip Goodall, WSP UK.

Sponsors: Arup, Flint and Neill, Halcrow, Mott MacDonald, WSP

Website: <http://www.iabsekempod.com/>

IABSE British Group and IStructE Kemp Bequest are delighted to invite you to the Future of Design 2013 - a one day conference at UCL followed by an evening dinner. The event will showcase innovative work by young designers, alongside inspirational presentations from some of the leading figures in engineering and architecture. Presentations on current cutting edge designs as well as discussions about the future challenges of our profession will be given by Mike Schlaich (*Schlaich Bergemann und Partner*), Roger Ridsdill Smith (*Fosters*), Jane Wernick (*Jane Wernick Associates*), and many more. Young designers are encouraged to submit a one-page summary of their work for presentation during the conference.

FUTURE OF DESIGN
12.09.2013

www.iabsekempod.com
enquiries@iabsekempod.com

Mott MacDonald **ARUP** **UCL** **the Institution of Structural Engineers** **WSP** **flint neill**
a COWI company

IABSE Annual Lecture – May 2013 – Hanif Kara: Engineering Attitudes

Report by David Knight, Flint and Neill

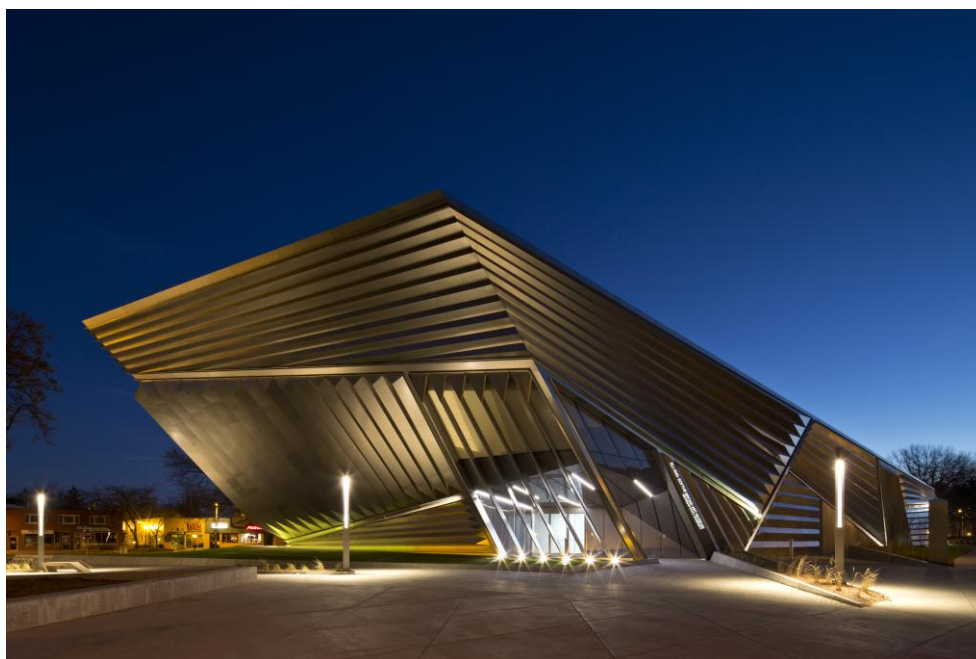
“*Engineering Attitudes*” are, in the title of Hanif Kara’s lecture, a way of identifying why we continue to design as we do and how to change it. In a wide ranging lecture, he set about challenging the preconception of an industry consisting of “Cambridge educated, Arup nurtured” engineers by describing how AKT II approaches the challenges that construction throws us. It provided a clear lesson in the benefits of thinking somewhat outside the prevailing orthodoxy.

Using AKT II’s varied portfolio of projects he demonstrated how the use of modern geometrical tools, parametric working and the right members of staff have allowed the firm to remain closely aligned to modern architecture practices. By ensuring that design remains a group activity, we can make the necessary compromises between structural and technical efficiency and create buildings that delight and yet are cheap to construct. However, Mr Kara noted his frustration that the construction industry can be slow to adopt new ideas or materials - for example, the idea that recycled running trainers could be used as the surfacing of a major temporary bridge in the Olympic Park (in a pleasing attempt to create a site specific link) did not make it to site on cost grounds.

In addition to work in the Olympic park, Mr Kara also examined several projects that demonstrated an unusual attitude to structural geometry. These included the Eli and Edythe Broad Art Museum, designed to be structurally dependant on the folded stainless steel plates that make up the facade; and the Heydar Aliyev Cultural Centre in Azerbaijan, where the irregular external skin required complex modelling to determine the optimum tiling pattern. Without a complete understanding of modern computational design tools, these projects would be very difficult to realise and the interplay between structure and architecture is evident in the necessary compromises.

Mr Kara was asked afterward how these designs were checked, given the level of computational involvement. The answer was about rigour, and a healthy dose of engineering experience and judgement - skills that are developed through long experience with the processes used.

An engineering attitude that involves every designer working closely with the rest of the team through the non-linear process of a project can allow us to maintain a strong identity as a structural engineer, while not becoming the people that just say “no” to challenging designs. Hanif Kara demonstrated that AKT II have managed to create some stunning structures using this attitude, and encouraged us to think again about our relationship with design.



Eli and Edythe Broad Art Museum, structural engineers AKT II

IABSE Prize 2013 – Mauro Overend

Dr Mauro Overend was announced in June as the winner of the IABSE Prize, the first candidate from Britain to receive this prestigious award. The IABSE Prize was established to honour and encourage a member early in his or her career for an outstanding achievement in structural engineering. The Award is conferred on an individual member, forty years of age or younger. The following is adapted from the award citation.

Dr Overend has a leading, international reputation in the field of structural glass. He leads a research group at the University of Cambridge and he uses his knowledge as a designer of “cutting-edge” façades and other glass structures.

Mauro is a lecturer in Building Engineering Design at the Department of Engineering in Cambridge and a Fellow of Christ’s College. After working as a structural and façade engineer on a number of notable buildings he returned to full-time teaching and research and he set up the Glass and Façade Technology Research Group (<http://www.gft.eu.com/>) that he currently leads.

Mauro’s work is rooted in structural engineering but is interdisciplinary in nature and is at the interface of engineering design and research. For example, during his former roles in consulting engineering he established the Research & Development Task Group at Ramboll UK (formerly Whitbybird) and he worked on projects that involved prototype testing and development to push the boundaries of glass and façade engineering.

The Yauatcha store in London (pictured, right), with its extensive use of adhesive bonding of glass elements, and the glass structure and connections specially developed for the Breathing Sculpture located on top of BBC Broadcasting House are two such examples. Similarly, in his current role at the University of Cambridge he collaborates very closely with industrial partners to steer the fundamental research of his group towards solving real-world problems in glass and façade engineering. This approach is evident in his research collaborations that range from specialist SMEs across Europe where he is leading the development of adhesive and soldered connections for glass elements that can outperform the conventional bolted glass connections, to large multi-national companies where his work on composite glass structures, post-fracture performance and multi-objective optimisation of facades is leading to structurally efficient, safer and thermally efficient facades.



Mauro has more than 40 peer-reviewed publications on structural glass and façade engineering to his credit. His research on structural glass, particularly on glass strength models, fragmentation and connections has a significant impact in this field. For example the IABSE Structural Engineering Document (SED 10) that he co-authored in 2008 is a reference text in several universities and design offices and his paper on the “*Recent developments in design methods for glass*” was awarded the IStructE’s Guthrie Brown Medal in 2011. The impact of his research however extends beyond the built environment as seen in his recent collaborations on monolithic fire resistant glass for marine applications with Trend Marine Ltd, and his on-going work on window pane testing for the manned spacecraft with Magna Parva and the European Space Agency.

Mauro has several active research collaborations internationally. For example together with colleagues from Austria, Germany and Belgium he secured funding for a European Research Network on Structural Glass (COST Action TU0905 – <http://www.glassnetwork.org/>). The network currently has more than 80 active members in 21 European countries and Mauro chairs one of the four working groups; Working Group 3 – Post fracture Performance. In addition Mauro has project-specific collaborations with several other Universities (IIT, LBNL, Sydney, EPFL, Pisa, Turin, TU Delft and TU Denmark). In addition to publishing in peer reviewed journals and conferences, Mauro serves on the editorial board of two international journals and is an



active peer reviewer in nine other journals. He also reviews research grants for the Swiss and Belgian national engineering and science research agencies. In the last 3 years he has served on the scientific committees of seven international conferences. Mauro has also served on the Institution of Structural Engineers Research Panel and the international panel of technical experts convened by the EC Joint Research Centre to advise on the Eurocode for glass in buildings. He currently serves on the British Standards Committee for 'Glass and Glazing in Buildings', the IABSE working group on Glass Structures and he is the convenor of the Façade Engineering Study Group at the Institution of Structural Engineers.

Since returning to full time teaching and research Mauro has also contributed to the devolvement of challenging real-world projects notably the numerical form finding work for the Grand Theatre in Rabat, Morocco designed by Zaha Hadid Architects; and the experimental and analytical work on the stability of perforated brickwork façade on Tate Modern, London designed by Herzog & de Meuron Architects.



Experimental investigations on post-fracture performance of laminated glass

IABSE Outstanding Structure Award – London Olympic Velodrome

The 2012 London Olympic Velodrome was announced in June as the winner of IABSE's Outstanding Structure Award, only the second UK structure to achieve this honour. The structure was designed by Expedition Engineering and Hopkins Architects, and built by contractor ISG. The following is adapted from the award citation.

The Velodrome is a world-class venue which intelligently answers questions of function, beauty, sustainability, buildability and value. Inspired by the dynamism and geometry of the track and the engineering rigour of high performance bikes, the truly integrated design and construction team set out to design a building that makes no distinction between architecture and engineering.

The Velodrome has been very well received by the Client and also by the legacy operator and cyclists. With cycling at its core, the building is a combination of simple technologies which cumulatively have produced an exciting, elegant and innovative building.

It starts with the cycling...

The 6000 seat London 2012 Velodrome will serve as an Olympic and Paralympic stadium for track cycling during the Games. In legacy use, it will take its place as the centrepiece of the VeloPark, a unique community cycling venue that will provide pleasure and employment to generations of Londoners and visitors from all over the world.

Responding to the seating below, the roof is lifted gently over the seats and pulled down elsewhere, forming an elegant and ultra-efficient curved roof. Around the sides, the facades are pulled in around the seating bowl, creating a dynamic timber-clad façade. This ensemble appears to float over a glazed band splitting the upper and lower tiers - flooding the stadium with natural light and providing dramatic views inside and out.



...and develops principled curves...

The 13,000m² roof is supported by a doubly curved cable net, formed from 36mm diameter cables stressed between a perimeter ring beam. Unusually for a cable roof, the perimeter ring beam is integral with the curved steel supporting 'bowl' in order to take advantage of the strength and stiffness of the whole structure: much of the cable forces are transferred around the bowl and down to a series of posttensioned concrete piers, these resisted by the concourse ring slab, foundations and cross-propped through the infield slab.

This integral approach generated savings of approximately 1,000 tonnes of steel worth some £4m and some 3,000 tonnes embodied CO₂.

To achieve these savings, much more was required from the structural engineers. Being a fully integrated structure – from roof to foundations – the building is structurally indeterminate and so the interplay of stiffnesses was critical for example, in determining the roof shape and cable tensions. Many structural variables were carefully investigated, leading to an upper and lower bound stiffness analysis for the building. We were suitably humbled when the centre of the roof was surveyed as being within a few millimetres of our estimated position: pure luck obviously!

...created through innovation...

A number of innovations run through the design and many of these relate to the structure.

The Velodrome required a highly insulated roof leading to the need for rigid supporting roof panels. We developed a novel articulated roof cladding system based on prefabricated timber cassettes, ensuring that all 1,050 cassettes had appropriate tolerances to deal with the flexing of the roof under a wide range of loadings. Rationalising the individual panel shapes into 13 primary panel groups was one of many challenges along the way.

The phenomenon of crowd induced vibrations is well known and usual practice is to keep relevant frequencies above 3.5Hz. To comply would have required 400 tonnes of additional steelwork to raise the fundamental frequency from 2.3Hz. Instead, we were one of the first to use the IStructE's recently published guidance on human-structure interaction to justify the performance of the building: again showing that engineering innovation can save materials and cost.



...without excess baggage...

According to London 2012's "Learning Legacy", the Velodrome is an excellent example of a building that has optimised the use of materials, and minimised the environmental and social impact of the materials that were used.

The venue is recognised as being the most sustainable on the Olympic Park, and has been described by the ODA Head of Sustainability Dan Epstein as *"the shining beacon of sustainability. It is incredibly resource and energy efficient"*.

...delivered safely by design...

Health and safety considerations were paramount during design and construction with buildability very much on the agenda during the design stage. All elements above the in-situ concrete floor slab were prefabricated to improve speed, cut down on waste, and improve quality.

The desire to reduce working at height was a significant reason for opting for a cable net roof. The cables were laid out at ground level, clamped together and safety netted. Only then were the cables jacked up into position: without any temporary works and completed in just three weeks.

The results of good design and a well-managed project have been recognised through several health and safety accolades and in achieving over 900,000 hours on site without a reportable accident.

... And ends with the team

The Velodrome is testament to the success of Client, Design Team and Main Contractor collaboration and has been delivered on time and on budget. Hailed as an exemplary project with innovation at its core, the building is a combination of simple technologies and cutting-edge analysis which cumulatively have produced an exciting building with cycling at its centre.

Structurally, the key lesson the team has taken on board for subsequent projects is when working in the realm of innovation make use of testing, prototyping and specialist experts as appropriate to give confidence and reduce risk. This approach led us to consult with specialists in the fields of dynamics, cable net analysis and undertake hydraulic prototyping and testing. This contributed to producing a seamlessly integrated building, innovative in its structural and environmental performance.

In awarding the Velodrome the IStructE Supreme Award the judges commented that the Velodrome has *"a sense of rightness that is a rare but undeniable quality. A gem that demonstrates outstanding creativity and uniqueness in its combination of the art and science of engineering"*.

Ultimately, the building would have been very different had it not been designed and built in a truly collaborative team with all designers and contractors providing suggestions and solutions to all hurdles. For the structure, the relationship between architect and engineer was never so strong or so excitingly blurred, a bit like Sir Chris Hoy on his final approach to the line in July 2012.



A new visionary strategy for IABSE

Report by Lee Franck, Arup

From the 3rd to the 5th of May 2013, delegates from the Executive Committee of around 15 National Groups (NG) came together in Rotterdam for the IABSE Strategy Workshop. The workshop was to be the next key step in the development and implementation of a new strategy to create a more attractive, open and vibrant IABSE of the future. During the International Conference in London in 2011 the imminent need was recognised to realign the association with the new challenges and opportunities of the 21st century in order to secure its future long-term survival and success. A Task Group (TG) was created to take up this challenge and during the International Conference in Seoul in 2012 presented a new strategy for IABSE. The vision for the future was greater involvement and independence of each NG which form a global network supported by the headquarters (HQ) or renamed central function (CF) in Switzerland who provide the support required to facilitate the activities of the NGs.



Strategy workshop participants

The new strategy recognises that the members within each country are closest to the needs and opportunities within their region and are therefore best placed to identify the activities required to make IABSE the must-join association for each structural engineer in the future. Building on this key idea of decentralisation and greater autonomy of the NG, the purpose of the meeting in Rotterdam was to give each NG the opportunity to define a vision for the future IABSE and shape its own local action plan for the near future to take home and implement.

Every NG had previously been tasked with identifying three individuals to attend the meeting, including one younger member of the association who would be actively involved in reshaping IABSE of the future. The workshop opened on Friday night with an introduction session given by Klaus Ostfeld, the chair of the association's strategy Task Group (TG). The session set the scene for the weekend in terms of bringing all participants up to speed on the work the TG had done previously. Klaus invited each participant to take on a "proactive approach" when defining a new vision for IABSE. We were encouraged not to start with the status quo and think about what could be improved, but instead to, in our minds, jump all the hurdles and focus on the outcome, the association of our dreams. This way of thinking really stimulated our imagination and freed us from all boundaries of thought throughout the coming days. To further reinforce this idea of "everything is possible" we were shown a taster of *Alegria*, one of Cirque du Soleil's most prominent productions, who have succeeded in reinventing their company from the cliffs of decline in 1990.

The heart of the work started early morning on the second day. In three parallel running workshops, we were encouraged to apply analysis tools common to business consulting to carry out a SWOT and Value Analysis



of IABSE. Working in even smaller groups of only 5 people, within the individual workshops, created an informal, inviting environment where ideas were easily shared. Emphasis was put on summarising the ideas developed during the parallel running workshops so they could be shared, challenged or used for inspiration by all other workshop participants during plenary sessions.

Participants agreed that the key strength of IABSE lies in its international reach and global network of people who can engage in high level discussions about wide reaching topics which include all areas of expertise and structural typologies. However, it was felt that there was a lack of visibility towards the outside of the association in terms of what IABSE is, how it works and the benefits it can provide. It was also felt that membership activity was too low in the NGs, that there was generally a lack of dynamism, and that 'old-fashioned' administration and bureaucracy often hindered responsiveness. The need to review the membership structure in terms of corporate membership and e-membership was identified together with the requirement to undertake regular membership surveys to monitor the performance of the association.

Participants agreed that there was a huge potential for IABSE to engage in innovation on a global scale by tackling challenges of the 21st century such as climate change, structural resilience or the development of new higher performing materials. This would include engaging with local decision makers on defining future needs and providing tailored knowledge on-time and shared at high level conferences or in well-designed documentation. A more dynamic, transparent and fun IABSE of the future would also capture the interest of younger engineers and, in turn, alleviate the threat that IABSE may increasingly become an inward looking club of 'old men'.

It was felt, by some NGs, that by making IABSE more attractive and accessible to a large number of people it would lose its sense of exclusivity and potentially technical excellence. I personally believe that the threat of diluting the prestigious nature of IABSE by increased membership is far smaller than the opportunity arising from capturing the immense talent which is yet to be introduced to IABSE.

Drawing on the outcome of their SWOT analysis, participants were then asked to produce a vision of IABSE for the future. Whilst most of us as engineers felt comfortable with carrying out an analysis of the current state of our association, defining a visionary statement which accurately described the IABSE of our dreams was much more challenging. However, astonishingly, the visions presented in the plenary session following another round of parallel running workshops were very much aligned and the same concepts recurred again and again even if expressed in different terms. Many of the keywords of the vision can also be recognised as the strengths, weaknesses, opportunities or threats previously identified.

The vision statement for IABSE developed during the workshop called for IABSE to be:

- The **pre-eminent** global association of **structural engineering**
- An association where members **actively** share a common aim of meeting **society's needs**
- Acknowledge the responsibility of developing the **next generation** of structural engineers

Whilst the strategy and vision for IABSE is a global concept shared by all NGs, the conversion of this vision into future goals very much depends on the local opportunities, constraints and aspirations of the different regions. For this reason, on the morning of the second day, the participants regrouped within their NG to define a set of goals for 2015 specifically tailored to the needs of their regions, but in line with the outcome of the SWOT analysis and vision defined on the previous day. Many of these targets were only achievable if actions were taken immediately and through the years running up to 2015. Hence a detailed game plan spanning from 2013 to 2015 needed to be defined including well defined, measurable targets along the way. Naturally some of these goals can only be achieved with the right support functions in place to facilitate them. Hence each NG was also tasked with producing a list of requests to Central Functions which would be collated after the workshop for further development and implementation.

Each NG continued developing their strategy throughout the rest of the day with plenty of interaction between the groups to challenge, inspire and 'steal' the best ideas from each other. A detailed report on the British Group's goals for 2013 - 2015 is to follow, but without giving too much away, a strong focus will be on increased membership and activity, the development of a global portal to facilitate debate and discussions at a truly international level, and a redesign of the website.

The outcome of the reporting sessions on Tuesday afternoon was simply stunning. Within only three days, the National Groups had been able to develop well-defined strategies that were aligned with each other and that



could be taken back to their respective countries. The importance now for all of us is to not lose the momentum, but to build on the inspiration we received from each other during the workshop and to maybe even challenge each other about who will get there first!



British Group members at the strategy workshop. Left to right: Lee Franck, Angus Low, Jeff Young

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→ Journey to Success

Join the IABSE British Group for an evening of discussion and debate about how to make a successful career in Civil and Structural Engineering.

This is an opportunity to hear leading figures of our industry reflecting back on their career and sharing their own personal story about their journey to success.

The panel discussion will be followed by a Q&A session open to the audience. This is your chance to find out everything you want to know about building a better career but were afraid to ask!

Our panel:

Wednesday 3rd July 2013
Debate: 6.30pm - 7.30pm
Drinks and networking: 7.30pm - 9pm
Location: Central London Venue (TBC)



Prof David Nethercote
David has more than thirty years experience in research and was, until 2011,

the Head of the Department of Civil and Environmental Engineering at Imperial College. He was president of the Institution of Structural Engineers in 2003-2004 and in 2006 he was awarded an OBE for services to Structural Engineering. In 2013 David became president of IABSE International.



Sarah Fray
Sarah is currently the director for engineering and technical services at the Institution of

Structural Engineers. Her career began as a trainee civil engineering technician engineer before returning back to university. After graduation, Sarah has worked in both private and public sectors achieving the position of Associate Director with two award winning consultancies.



Roger Ridsdill Smith
Roger leads Foster + Partners' Structural Engineering team. He has previously been a director at Arup

where he has lead multidisciplinary design teams on major projects around the world including the Faudino Winery in Spain and the Millennium Bridge in London. He has won several prizes for his engineering work, including the Royal Academy of Engineering 2010 Silver Medal.

Chair



Chaired by Antony Oliver, editor of the New Civil Engineer who has started his career as a civil engineer with Owen Williams and Ballour Beatty before joining the NCE as a journalist.

The event is open to members and non-members of IABSE, free of charge. Spaces are limited and will be allocated on a first come, first served basis.



To reserve your place please email:
iabse_bg_youngdesigners@yahoo.co.uk