



IABSE NEWS

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

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Kogol Courtyard, Smithsonian National Museum of American Art, Washington D.C.

Image courtesy of Buro Happold

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IABSE British Group News

Editorial

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

This is the last edition of the newsletter under my editorship as my career is taking me away from the UK in the near future and so beyond the 'territory' of the British Group (though maybe not the long arm!). Preparing the newsletter has been an enjoyable task and I hope that you have enjoyed the mixture of reports and articles which numerous generous and willing contributors have produced.

One of the benefits of being a member of an international organisation such as IABSE is that, by definition, one is never too far away from fellow members wherever one may be around the world. This is the same in many instances for our major British engineering institutions but IABSE's membership covers areas which are perhaps less well represented, particularly in continental Europe and the Americas. I look forward to making the acquaintance of IABSE members in my new location and to joining in local and international events and meetings where our members come together – not least in London in 2011!

With best wishes,

Andrew Martin
Editor

Events

<u>Date</u>	<u>Time</u>	<u>Event</u>
Thursday 13 May 2010	5.00pm	<u>Annual General Meeting</u>
	6.00pm	<u>IABSE Annual Lecture 2010</u> Bill Baker , SOM, Chicago, USA
	8.00pm	<u>Annual Dinner</u> Pre-booking essential & fee payable.
Mon 5 – Weds 7 July 2010	Residential (fee payable)	<u>Henderson Colloquium</u> <i>The Energy Industry and its Structures</i> Magdalene College, Cambridge
Autumn 2010		<u>Young Engineers Conference</u> (To be confirmed)
18 – 23 September 2011		<u>IABSE Symposium</u> QE2 Conference Centre, London

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 www.iabse-uk.org, where proceedings of Henderson Colloquia and back editions of *IABSE News* are available in downloadable form. We are grateful to the Institution of Structural Engineers for their continued generosity in hosting the website.

The international website of IABSE at www.iabse.org contains comprehensive information on IABSE organisation, activities and publications.

The views and opinions expressed in *IABSE 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.



IABSE Annual Lecture – 13 May 2010

Bill Baker

The British Group is delighted that the 2010 IABSE Annual Lecture will be given by **Bill Baker** of Skidmore Owings & Merrill LLP, Chicago, USA.

After gaining degrees from the University of Missouri and the University of Illinois, Bill Baker joined SOM in 1981, since when he has worked on a broad range of engineering projects including designing structural systems for supertall buildings, smaller specialized structures and engineering collaborations with artists.

Bill Baker currently the partner in charge of Structural and Civil Engineering for the Chicago office of SOM.

Bill Baker's approach to structural engineering seeks to integrate form, function, and aesthetics. His recent projects have included the Burj Dubai (the world's tallest structure), the long span structure of the Virginia Beach Convention Center, the glass cable-net entrance pavilion of the General Motors Renaissance Center in Detroit and Chicago's Trump International Hotel and Tower.



Bill's expertise is frequently sought by institutions of higher learning as well as professional organizations. Amongst awards that he has received are the 2008 Fazlur Rahman Khan medal from the CTBUH and the 2009 Fritz Leonhardt Prize, of which he is the first American winner. He is a Fellow of both the American Society of Civil Engineers (ASCE) and the Institution of Structural Engineers (IStructE). He is on the Specifications Committee of the American Institute of Steel Construction (AISC) and also frequently lectures on a variety of structural engineering topics.

A fascinating lecture is in store.

British Group Study Tour – April 2010

Paris and its region

Angus Low (Study Tour Leader) writes:

Following the successful Study Tour to Switzerland in November 2008, the British Group of IABSE is now arranging a tour of bridges and some other structures in and around Paris. We will be based in Fontainebleau, south east of Paris, 35 minutes away by train.

Dates

- Arrive in Fontainebleau on the evening of Thursday 15th April.
- Friday and Saturday, coach tours to sites around Paris and the region.
- Sunday 18th is free for personal site seeing and returning home.
- Three nights in the hotel.

Programme

The tour looks at France's significant contribution to bridge engineering. There is a thread of rigour and daring that runs through the stone arches of Jean-Rodolphe Perronet (1708-1794), the invention of prestressed concrete in the 1940s by Eugene Freyssinet (1879-1962) and on through the development of match-cast segmental construction in the 1960s by Jean Muller (1925-2005). The mastery of the flow of forces through stone and then concrete goes back to the gothic cathedrals, and we will visit one that features in the sketchbooks of Villard de Honnecourt (active 1225-1250).



The tour will also include a number of more recent works. We will be joined part-time by Serge Montens of Systra, author of "Les plus beaux ponts de France", who worked previously with Jean Muller, and others (to be arranged). They will show examples of their own work.



Nemours. Perronet. 1795-1804



Luzancy. Freyssinet. 1946

Accommodation

- The Ibis Hotel, next to the chateau in the historic centre of Fontainebleau.

Costs

- Delegate Fee (to be confirmed): Members £110. Non members £160. This is payable in advance to cover the coaches, Friday and Saturday lunch and administration costs.
- Hotel. €85 per room per night. Breakfast and tax €8.20 per person.
- Eurostar, London to Paris. Indicative. €108 return, depending on when you book.

Booking

Please book a place, express interest or request more information by e-mailing angus.low@arup.com. Phone contact during office hours: Angus Low on 020 7755 2463.

State how many participants, how many hotel rooms and any special requirements. Give names, an address and an e-mail address for the contact.

Milne Medal 2009 – Winner

Mike Cook

The 2009 Milne Medal for excellence in structural design has been won by **Dr Mike Cook** of Buro Happold. The medal was presented to him on 19 November at the Institution of Structural Engineers in London, after which he gave his Milne Medal Lecture entitled 'Natural Design?'.

After graduating from Cambridge in 1977, Mike Cook worked with Ted Happold and Frei Otto on a variety of membrane and cable net structures, undertaking R&D into air-supported structures. In 1982 he joined Buro Happold, becoming a Partner in 1995, and has worked on many noted projects in the UK, USA, Europe, Middle East and Far East.

His particular speciality is in the design of buildings where the architectural expression is borne of the engineering solution. This is particularly evident in the structures for which he was awarded the Milne Medal, which were:

- Smithsonian National Museum of Art, Kogol Courtyard, Washington D.C., USA.



Mike Cook (r) being presented with the Milne Medal by Professor David Nethercot



- SAGE Music Centre Roof Enclosure, Gateshead, UK
- Khan Shatyr Entertainment Centre, Astana, Kazakhstan

In his lecture, Mike Cook reflected on his roles as a consulting engineer, a teacher (at Imperial College, London) and as a member of the IStructE Education Panel under the headings ‘How did I get here?’, ‘Design Approach?’ and ‘What Next?’. The lecture will be published in due course in *The Structural Engineer*.



Smithsonian National Museum of Art, Kogol Courtyard, Washington D.C



SAGE Music Centre Roof Enclosure, Gateshead, UK (during construction)



Khan Shatyr Entertainment Centre, Astana, Kazakhstan (during construction)

(All images courtesy Buro Happold)



London 2011 Update

IABSE Symposium 2011 – ‘Taller, Longer, Lighter’

By Ian Firth.



Image: www.nickwoodphoto.com

Plans are progressing well and work is now beginning to accelerate for the IABSE British Group event of the decade! In September 2011, just under two years away, about 700 to 800 of the world's bridge and structural engineers will descend on London for the annual IABSE symposium. It will be a joint event with the International Association for Shell and Spatial Structures (IASS) and will also incorporate the International Conference on Space Structures (ICSS) normally held at the University of Surrey, hence the larger number of expected delegates than normal.

Incidentally, I always used to think that this latter event, the ICSS, which only occurs every 5 or 6 years, was concerned with structures in space – a somewhat specialist field of engineering – but that was probably because I remember a brilliant lecture by Professor Len Stevens years ago about deployable satellite structures, but that's another story.

The strap line topic we are currently working with is “Taller, Longer, Lighter – balancing growing demand with limited resources”. However, the Scientific Committee is still deliberating on this and feeling the need to improve the words to properly reflect what we are trying to achieve. Watch this space. However, whatever the final wording, the intention is that the symposium will be an excellent opportunity for engineers, architects and other construction professionals to come together to share knowledge and information on a wide range of topics. It is ever thus, and this will be no exception.

London as a venue is, of course, second to none. (Well we have to say that, don't we!) We confidently predict that delegates will come not only because of the subject matter and the opportunity to meet with like minded professionals from all over the world, but also because of the draw of the big city. With the London Olympics just around the corner in 2012 (we hope to be able to see the structures at close range, in spite of predicted security controls) and with everything else the city has to offer, it should be a great event.

The conference venue will be the Queen Elizabeth II Conference Centre in Westminster, right opposite Westminster Abbey, and there will be lots of opportunities for interesting technical visits as well as tours to occupy spouses, partners and other accompanying persons during the day. As with all IABSE symposia these days, there will be a special Young Engineers' programme, which will include a prize for the best paper written and presented by an author under 35.



I am chair of the Organising Committee, together with my Co-Chair, Brian Smith who represents the IASS. We will be looking for some volunteers to assist us and serve on the committee. We particularly need people with energy and enthusiasm for the event, some time on their hands (the chance would be a fine thing!) and possibly some useful connections to help us with some of the many administrative and organisational tasks ahead. If you are interested, I am looking forward to hearing from you.

One of the major challenges ahead is to raise sufficient funds through sponsorship to make the event a success. To this end we have engaged a specialist sponsorship consultant, recognising that without substantial sponsorship the event will fail. I particularly want to hear from you if you think you can help in this vital aspect or if you know someone who can.

The Scientific Committee is chaired by Professor David Nethercot, and co-chaired by Professor Sergio Pellegrino of the IASS. Theirs is an international committee, and their task is to agree the topics, invite and review abstracts from potential authors, review and select the final papers, and agree the technical programme. You can expect a preliminary announcement and call for papers in the new year, so please all of you, get your thinking caps on – we need some really good papers to be submitted from the home team.

Finally, if any of you are involved in some interesting projects which will be on site in London during September 2011 which you think might make an interesting site visit for a small group of delegates, please let me know. We need to start building a list of such projects so as to decide on the technical visits for the Symposium.

If you have any queries or would like to get involved, please do not hesitate to contact me.

Report – IABSE Annual Lecture 2009

John Armitt – ‘Engineering at the 2012 Olympics’



John Armitt (centre) pictured with Dr Graham Owens (IStructE President 2009)(l) and Ian Firth (Vice-Chairman, British Group).

On Thursday 21 May 2009 **John Armitt**, Chairman of the Olympic Delivery Authority, presented the IABSE Annual Lecture to an attentive audience at the Institution of Structural Engineers in London.

In his lecture Mr Armitt gave insights into some of the engineering challenges faced during the fast-paced development of the 2012 Olympic Park site in East London, from the diversion of overhead power transmission lines to the innovative construction methodology used for the aquatics centre roof.

All present appreciated hearing about planning and engineering aspects of this high profile project from the perspective of such an experienced engineer who has led the successful progress of this major undertaking.



Report

IABSE Symposium 2009, Bangkok 'Sustainable Infrastructure'

Personal reflections by Angus Low.

I spent September 7th to 11th in Bangkok. In recent years I have followed the annual IABSE Symposium to many different World Cities. Having just jotted down their names I realise that I had not visited any of them before. Why do I go? Different people have different reasons and they all involve some degree of networking. For me it is the need to feel in touch. What are other people designing? Why? What are the academics researching? And what do people really think on key topics of current interest? It is very noticeable how relaxed everyone is. Even in the world of Blackberries we all feel we have stepped out of our usual roles and over the many coffee breaks, canapé receptions and grand dinners you will hear all sorts of insights, heart-felt opinions and disclosures you may not have been expecting.

Each year Monday and Tuesday is for the Annual Meetings and is restricted to members of the Working Commissions, Working Groups, Scientific Committees for future symposia and the various organisational committees of IABSE. This year it was held in the recently restored historic buildings of Chulalongkorn University whose characterful cloisters provided welcome shelter against the Monsoon showers. It was a 20 minute walk from the main venue, and I managed to miss the showers for three of my four commutes.

The Symposium starts on Wednesday and there is a full programme of presentations of papers. For most of the time there are three parallel sessions with each paper being allocated about 12 minutes. There is usually time for one or two questions, but if you really want the answer it is best to catch the speaker at the next coffee break. The quality of presentation is varied, often being hampered by a lack of fluency in English, but my programme has "good" jotted several times in the margins although not opposite the names of the Keynote Speakers who are meant to be the recognised experts. The theme was "Sustainable infrastructure" there were many sub-themes. Each year the breadth of topics is intentionally wide so everyone can find an angle for their favourite subject. You spend your time slipping from room to room to listen to the people you want to hear. With the papers, coffee breaks, exhibits, receptions, dinners and, yes, sneaking a look at your Blackberry it is all quite intensive.

My paper had been allocated to a poster session, which is seen as an inferior form of presentation, but I felt I got a good deal. The posters are on display all three days in the coffee-and-cakes area and I engaged in many useful chats standing in front of my paper, and the posters get equal billing with the oral presentations in the conference book.

If you tire of the many presentations you can sign up for Technical Visits to recently completed local projects, and there is also a series of cultural visits for "accompanying persons".

Because I was staying in the hotel above the conference centre I realised as I left on Friday that for three days I had never been lower than the 18th floor. My deprivation of views of Bangkok street life was however fully compensated by my three hour taxi ride to the airport. I had been warned, and I had left sufficient time. The good news is that the viaduct for the airport Metro is complete and it will be in use soon.

Next year Venice and in 2011 it comes to London. During the dinners and receptions there are always displays of local music and dancing. As the small British contingent watched the various oriental delights, many performed by the students, we wondered how we could best display London's rich but very different culture in two year's time.

The small British contingent. It has been noticeable in recent years that Britain has been under-represented at these Symposia. Give it a try. And we should all be encouraging our under 35s to submit papers. There are two prizes of €1000 for them and all young participants get free IABSE membership for a year.

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 - Henderson Colloquium 2009

Performance Based Design – Benefits and Challenges

Magdalene College, Cambridge, 6th to 8th July 2009.

Report by **Jeff Young**.

In the keeping with the established tradition this year's annual Henderson Colloquium attracted a diverse group of practitioners from across the profession to consider this year's theme of 'Performance Based Design' with attendees from the UK, Netherlands and Denmark.

The presentations and lively discussions explored the subject from various perspectives that included the views of delegates from transport authorities, code developers, university engineering departments, engineering consultants and architects. It was clear from the contributions over the two days that performance based design is relevant to both policy objectives and detailed design, with a strong interaction between performance requirements and prescriptive specifications.

The benefits and challenges of performance based design were explored for new and traditional materials with a broader view of the subject being provided by presentations that dealt with societal aspects such as aesthetics, sustainability and the environmental that are likely to become increasingly important in the future. Projects described included examples of performance challenges posed by extreme environments in Antarctica and the Middle East.

The themes that emerged strongly over the course of the colloquium included,

- Performance based design requires full understanding of the required project outcomes and outputs.
- Definition, recognition and allocation of risks explicitly in performance and implicitly in prescriptive specifications.
- Need for technical competency and alignment of objectives throughout the supply chain.
- Successful application of performance based design depends on knowledge management and continuous improvement throughout the project cycle and supply chain.
- Performance that is achieved often depends on design details and workmanship.

The Colloquium papers are to be collated and then made available electronically as .pdf file downloads via the British Group website at www.iabse-uk.org.

Participants and Papers

- **Jeff Young** (*Mott MacDonald*)
Performance feedback – closing the loop
- **Suresh Kumar** (*Scott Wilson*)
Role of Fire Modelling in Performance-Based Fire Safety Design and Assessment of Buildings
- **Jim Moriarty** (*London Underground Ltd*)
Performance based infrastructure management – LUL's PPP
- **Jonathan Wood** (*Structural Studies & Design*)
Specifying and Achieving Durable Structures
- **Martin Lynch** (*Highways Agency*)
Performance Specifications: An elusive goal, even for the Highways Agency!
- **Richard Harris** (*Buro Happold/University of Bath*)
Prescriptive rules for timber – right and wrong applications
- **Peter Walker** (*University of Bath*)
Masonry flexural strength and the problems with performance based design
- **Jens S Jensen** (*COWI A/S*)
Ensuring adequate performance of railway bridges throughout their service life



- **David Edwards** (*Mott MacDonald*)
Performance challenges for the future
- **Toby Mottram** (*University of Warwick*)
Does Performance Based Design with Fibre Reinforced Polymer Components and structures pose any new benefits and challenges?
- **Peter Ayers** (*Aecom*)
British Antarctic Survey, Haley VI, Antarctica
- **Jon Knights** (*Halcrow Group Ltd*)
Performance-based specification for the durability design of concrete in extremis: overview and introduction
- **Ton Vrouwenvelder** (*TNO*)
Performance Based Design from a Probabilistic Point of View
- **Ron Yee** (*Yee Associates*)
Can Aesthetics Be Codified?
- **Gerard Canisius** (*Scott Wilson*)
Performance Based Design and Eurocodes, especially in relation to EN 1990: Basis of Design
- **Oliver Caroe** (*Caroe Architecture*)
The Old Refectory: Negotiating troubled waters – Policy conflicts between PPS 25 & PPG15
- **Mark Bulmer** (*Aecom*)
Prolonging the life of the Forth Road Bridge main cables through dehumidification



[Jeff Young was assisted by Jonathan Wood and Gerard Canisius in the organisation of the Colloquium and they would like to thank all those who contributed to a very successful event.]



Project Feature

Heathrow Terminal 5

By *Dervilla Mitchell (Arup)*.

Terminal 5 at Heathrow is a major new transport interchange for London. The client, BAA, wanted to create a building that would have a place amongst the great interchanges of the world and provide a memorable experience for travellers. As a result, the main terminal, T5A, is characterised by open space, natural light, simplified passenger circulation, shorter walking distances and spectacular airfield views.

T5 Agreement

The T5 project was of such importance to BAA, that the firm was willing to bear all the financial risk of the project, ensuring its suppliers were able to work together in integrated teams – essential for delivering a project of this size, on time and on budget. The T5 Agreement, a bespoke partnering contract, was fundamental in allowing the project team to tackle the technical challenges involved.

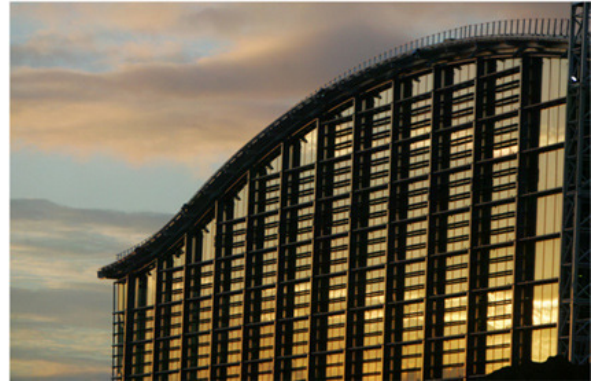
Design

All aspects of T5 were planned and designed for every stage of construction to ensure maximum safety and minimal site risk. However, neither the visual quality nor usability of the building was compromised. The architects used this focus as an opportunity to express the building's engineering. The structure and its connections and details became sculptural objects in themselves. Exposed welds, as-cast steel surfaces, and visible bolts create a feeling of scale and a grain to the building.

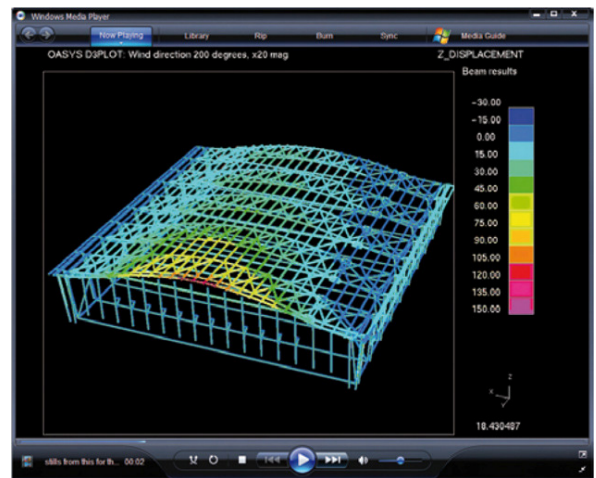
Structure

The 157m clear span roof encloses 3 million square feet of floor space framed in steel over 4 storeys. A 5-storey basement houses the rail station and plant spaces. The unconventional height of the building was in response to the challenge of having to build within the constraints of two runways and the greenbelt beyond them.

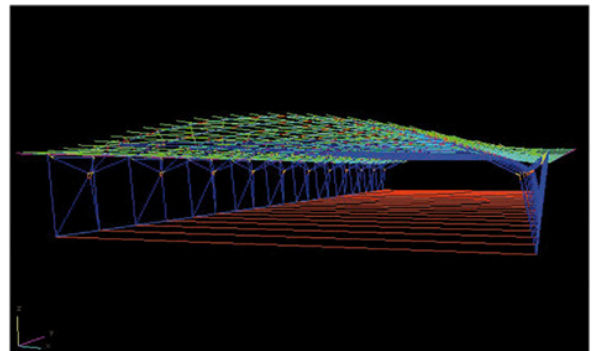
The roof and facades forming the building envelope are completely separate from the four floors of accommodation they enclose. As well as providing open spaces all round the perimeter and across the top of the building, this has a significant practical long-term purpose; it provides the ultimate in flexibility, as the floors can be completely demolished and rebuilt in a different configuration without touching the perimeter walls and roof. The structural form moves most under asymmetrical or uneven wind loading, so the project team had to protect the façade and roofing from damage by excessive movement.



1. Terminal 5



2. Dynamic time history wind analysis



3. 3D model



4. First section of the roof erected



It was uneconomical to make highly pessimistic assumptions about how wind pressures might be distributed so 'Dynamic Time History Wind Analysis' allowed the team to apply data to a computer model of the roof to understand the movements, taking into account the varying wind pressures, the building's structural behaviour, and its inertia. This ground-breaking technique gave a more accurate estimate of deflections in service, resulting in the saving of 800 tonnes of steel by reducing the rafter flange thickness from 85mm to 70mm.

Roof

The T5A roof is an awe-inspiring structure that arches over the terminal building. The roof carries huge compression forces which are essential to prevent the buckling of its individual parts and of the structure as a whole. One of the pioneering analysis techniques employed on this project was Modal Buckling Analysis. This calculated the effective reduction in lateral stiffness that is caused by compression forces within the structure and used Eigenvector Analysis to predict the most critical possible buckling modes. The mode shape data was then processed to give sets of design forces, ensuring a consistent reserve of strength against buckling, without providing extra strength where it was not needed.

However, the clear-span roof could only be realised if there was an erection method that would make the structure fast and efficient to build. The solution involved constructing the central arched section of the roof, including cladding, at ground level before prestressing and lifting into position using strand jacks. This creative approach was vital to ensure that the whole operation could be carried out below the airport radar ceiling and that the risk from working at height would be reduced. This idea became an integral part of the building design and construction planning of the whole terminal. The critical path went straight from completion of the basement slab to roofing and facades, resulting in an early watertight date and notable time reduction in the overall programme.

Rafters

The massive steel rafters fly for 175m over check-in, security, and the gate seating. They define the direction of travel from land-side to air-side, diffusing daylight into the space. They are the primary structural elements of the 157m span. The central sections, where primary forces are compressive, are fabricated box sections up to 3.8m deep. Over the abutments where forces were tensile, and lateral torsional buckling was not an issue, I sections were used. The central section became a self contained element in the temporary state once it had been pre-stressed by the high level tie cables. This allowed the central section of the roof to



5. *Roof under construction*



6. *'Departures' with rafters above*



7. *Connecting torso node to arms*



8. *Torso node as seen from 'Arrivals'*



Health and Safety

The size and complexity of T5 a significant challenge in terms of health and safety and it was recognised from the outset that safety leadership was going to be an important factor in the success of the programme. This was addressed in both design and construction. T5 directed its efforts towards treating safety as a ‘core value’ and created a people based regime rather than one based solely on statutory compliance; it has since gained widespread recognition for its excellent health and safety performance, which exceeded industry norms.



12. Rafter trial assembly and tolerance check



13. Roof structure under construction, furthest section complete, central section being jacked, near section assembled ready for lifting.

Key Dates

Planning and design started:	February 1988
Public Inquiry:	May 1995 – March 1999
T5 construction started:	September 2002
T5A roof construction:	October 2003 – February 2005
Heathrow T5A opens:	27th March 2008

Project Credits

Owner:	BAA Airports Ltd	Contractor:	Laing O’Rourke
Architects:	Rogers Stirk Harbour Pascall + Watson Chapman Taylor (retail) HOK (Stations)		Mace Amec Rowan Watson Schmidlen Hathaway Roofing Spie Matthew Hall Services
Structural Design:	Above apron level: Arup Below Apron level: Mott Macdonald		

Image Credits

Arup: 1, 2, 3, 7, 9, 10, 12 & 13. David J. Osborn: 4, 5, 6, 8 & 11.



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