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NSC

Vol 20 No. 2 February 2012

Hospital aims for Excellence

Steel scores for St Helens

Cable car a Thames first

Stadium regenerates Rotherham

New Premier Inn for Liverpool

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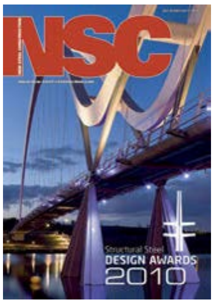

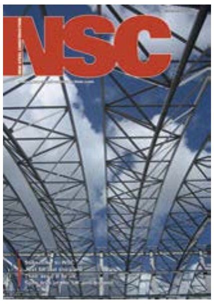

New Steel Construction keeps designers and contractors abreast of all major steel construction related developments and provides detailed technical information on key issues such as the introduction of the Eurocodes. NSC will be the first place most people hear about advances made by the extensive research and development efforts of the steel construction partners – Tata Steel, the British Constructional Steelwork Association, and the Steel Construction Institute, as well as other researchers.

Each issue of NSC is a blend of project reports and more in depth technical material. Taking up our free subscription offer is a guarantee that you will be alerted to significant developments in a sector that retains a commitment to continuous development in knowledge and techniques for timely delivery of cost effective, quality projects across all sectors of construction.

Each issue of NSC is typically 44 pages and contains five pages of news, developments related to Eurocodes, cutting edge project reports from site, and the latest technical updates from the Steel Construction Institute in its Advisory Desk Note series. Popular features are 50 Years Ago and 20 Years Ago, looking at key projects of the past by revisiting the pages of 'Building With Steel' and 'Steel Construction'.

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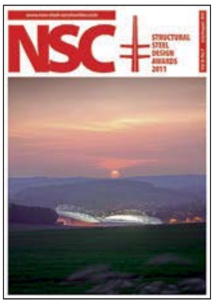

Cover Image
Saints Footbridge, St Helens
Main Client: St Helens Council
Architect: Moxon
Steelwork contractor:
Rowecord Engineering
Steel tonnage: 120t

February 2012 Vol 20 No 2

These and other steelwork articles can be downloaded from the New Steel Construction Website at *www.new-steel-construction.com*

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Steel creates its own legacy

Nick Barrett - Editor

The steel construction sector has always been able to boast about the high level of successful investment it makes in productivity and sustainability enhancing approaches to design, and in leading edge fabricating technology. Sceptics could have been excused for assuming that this commitment to making steel as easy as possible to design and build in would be run down during cash strapped times such as we have been through in the past few years.

But a look at our news section this month proves that investment backed effort is proceeding apace on a number of fronts that will ensure steel construction maintains its leading place in the thoughts of architects, engineers and clients when quality and cost effective solutions are demanded. For example, we have a story about investment in new plasma cutting machines at a fabricator; this is the sort of productivity and quality enhancing investment in which the BCSA's members lead the world.

On another page we see that the steel sector has invested in five new design guides, adding to the support already available for structural engineers designing to the new Eurocodes. The widest possible range of design guidance has always been available to designers from the steel sector, mostly just a quick telephone call to a free advisory hotline away, and these new guides mark a significant milestone along the UK design communities' way towards embracing Eurocodes design.

Many eyes in the world's engineering community will be on the Shard, Europe's tallest building, which is rapidly nearing topping out. The top was lost in mist on at least one day in mid January, no doubt providing an eerie environment for the workforce.

Fortunately, as it is a substantially steel framed structure workers on the 310m building are exposed to minimal risk whatever the weather as the pre assembled modules comprising the upper floors are lifted into place. Safety looks like being one of the great success stories surrounding the Shard's construction, which we hope to tell readers more about shortly.

London's Olympic structures are now 90% completed with around 200 days to go until the games begin, as we report. As well as being a construction success story for steel the 2012 Olympics will represent a legacy success that has eluded most Olympic games, helped substantially by the demountability that is easily designed and built into steel structures. There are success stories still to be told about the Olympic construction effort, and we look forward to bringing readers more about those related to steel during the year.

NSC

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Venues ready as final countdown to Olympics begins

More than 90% of the construction at the Olympic Park is now complete with less than 200 days to go before the London 2012 opening ceremony takes place on July 27.

The majority of the main venues are now ready for test events, with steel construction having played a key role in the completion of much of the infrastructure.

Olympic Delivery Authority Chairman John Armitt said: "It is thanks to the expertise of the construction industry that a run-down area has been transformed into the setting for the world's greatest sporting event."

During the next couple of months the final pieces of the overall construction project will be completed as the Olympic Village, Water Polo Arena - steelwork erected by Caunton Engineering - and the shooting venue at Woolwich are finished.

Major milestones involving structural steelwork have included the completion of the centrepiece Olympic Stadium in March 2011. Watson Steel Structures erected all of the 10,000t of steel for the project, a total which makes the venue 75% lighter in terms of steel than any Olympic Stadium to date.

The adjacent Aquatics Centre was unveiled during the '1 year to go' celebrations in July 2011 with Tom Daley making the first dive into the pool. Rowecord Engineering erected 2,800t of steel for the structure's signature wave-like roof.

The Velodrome (erected by Watson Steel) was the first Olympic Park venue completed in February 2011 followed by the BMX Track which held the UCI BMX Supercross World Cup test event in August.

Other vital structures built with structural steelwork include the temporary Basketball Arena (Watson Steel) Handball Centre (Watson Steel), International Broadcast Centre and Main Press Centre (Severfield-Reeve), Energy Centre (TAAG) and a host of road and pedestrian bridges, erected by Watson Steel, Rowecord and Mabey Bridge.

Steel completes healthy community frame

Construction work is underway on a £4M project to build a new library, health centre and children's centre in Pelsall, West Midlands, following the earlier demolition of the existing library building.

In a complex programme involving phased relocation of community services, the library has now moved into temporary premises to allow demolition of the old library building and construction of a new facility to house the library, a health centre and a children's centre. The new building is due to be handed over in the summer, at which point medical staff will move across from the existing doctors' surgery on site, which will then be demolished by main contractor ISG and replaced by car parking facilities.

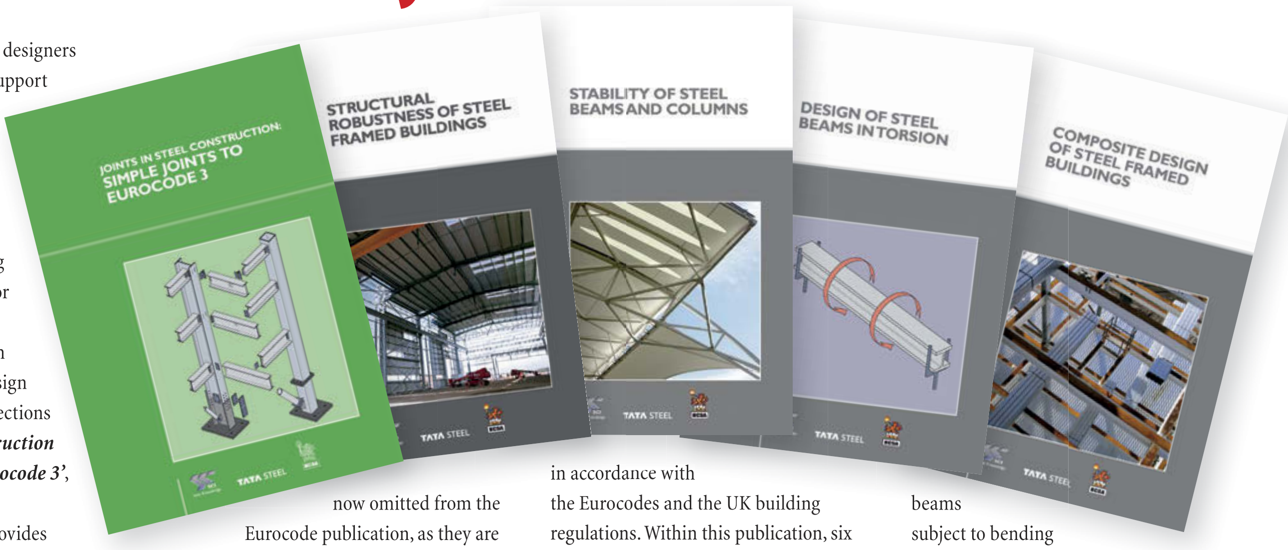
Designed by architects Baart Harries Newall, the two-storey building is a hybrid structure, with traditional brick and block work construction up to first floor level and a steel frame structure to the second floor sat on top of a pre-cast concrete floor.

Traditional Structures erected 96t of structural steelwork for the project during a four week programme.

The library, pharmacy, children's centre and a number of health offices and treatment rooms are located to the ground floor. The first floor health centre features a large central open plan waiting area, with treatment and consultation rooms around the perimeter.

The new development is targeting a BREEAM 'Very Good' environmental performance rating and incorporates highly efficient mechanical and electrical services, as well as a number of roof lights to maximise the volume of natural light entering into the first floor waiting area.

Five new steel guides published for Eurocode conformity



Helping to ensure that designers have comprehensive support when using the Eurocodes, the BCSA, SCI and Tata Steel have made available five new design guides covering structural steelwork for buildings.

A Eurocode version of the 'Green Book' design guide for simple connections ***'Joints in Steel Construction - Simple Joints to Eurocode 3'***, is now available.

The publication provides guidance for nominally pinned joints that primarily carry vertical shear designed in accordance with Eurocode 3 and it UK National Annex.

The new guide is cited in the UK National Annex and joints designed in accordance with the principles of this publication can be classed as nominally pinned without further calculation.

Major changes in the guide's scope are threefold. Double angle cleats are now omitted from the Eurocode publication, as they are not commonly used in the UK. A new full depth end plate has been introduced, which offers a significantly increased tying resistance compared to a partial depth end plate. The tying resistance of partial depth end plate is calculated using Eurocode provisions and this revision results in an increase tying resistance compared to the BS 5950 version.

'Structural Robustness of Steel Framed Buildings' provides guidance in accordance with the Eurocodes and the UK building regulations. Within this publication, six examples demonstrate the application of robustness strategies to different classes of building.

'Stability of Steel Beams and Columns' explains the structural mechanics of buckling and provides immediate practical guidance for both common and non-standard restraint conditions.

'Design of Steel Beams in Torsion' explains the physics of the design of beams subject to bending with the addition of torsion and provides section properties needed for design.

'Composite Design of Steel Framed Buildings' is a comprehensive guide to Eurocode 4, covering slabs and beams during construction and in the final stage, including design for the serviceability limit state.

Copies of the guides can be purchased from the BCSA or SCI.

SCI leads engineering workshop in China

SCI has led the first workshop in China for civil and structural engineers on the specification and design of stainless steel as a load bearing material. Held in Beijing, the workshop was attended by 170 local engineers.

The event was arranged by the Nickel Institute, an organisation which promotes the use of nickel worldwide. About 65% of all nickel produced is used to make stainless steel and China is now the largest producer of stainless steel in the world.

This year SCI and the Nickel Institute will begin on the first phase of the development of an on-line tool for designing structural stainless steel components aimed at the Chinese market. A variety of structural applications are featured in a series of case studies at *www.stainlessconstruction.com*

Europe's tallest building nears summit

The final steel elements for the Shard, the European Union's tallest building, will be erected this month. Topping out at a final height of 310m, London's newest landmark is on course for its May completion date.

Structurally the building is a hybrid, with structural steelwork forming the initial 40 floors with a concrete frame then extending up to level 69. Above this it reverts back to steel with the top 23 floors, known as the Spire, now being erected.

In order to make the erection of the final steel element as efficient as possible, the entire Spire was previously trial erected (right) at steelwork contractor Severfield-Reeve's Dalton facility in North Yorkshire.

All of the Spire's steelwork is being delivered to site in pre-assembled modules which is reducing the amount of work at height. The modules are all transportable sized pieces measuring up to 3m × 7m for horizontals and 3m × 7.8m for vertical sections.

AROUND THE PRESS

RIBA Journal
December 2011
100 Years Ago - The possibilities of steel
A very interesting lecture was delivered by Sir William Richmond at the Armstrong College of Science. "In my opinion (he says) steel is a material which has in it somewhere and somehow great though different possibilities of beauty from those of wood and stone. Perhaps a new beauty.....

New Civil Engineer
15 December 2011
A view from the top
(The Shard) "We are now at the high risk stage of the project," explains Mace chief operating officer for construction Gareth Lewis. "Pre-assembling sections of the spire has reduced the amount of work at height, making the installation as efficient as possible and providing greater certainty prior to lifting that the correct fit will be achieved."

Construction News
15 December 2011
Making it happen
(Building Information Modelling) Images of the new Leeds Arena, which will be complete in 2013, show a bird's nest of intricate steelwork and panelling that the contractors say would have been impossible to design and build without building information modelling.

The Structural Engineer
January 2012
Cairo Expo City- a free-form spatial roof structure
The structural scheme uses a continuous roof space (steel) truss to create large column free spaces that provide greatest flexibility to the exhibition hall below.

Building Magazine
6 January 2012
London 2012 - High points
(Handball Arena) Construction started in July 2009 and the foundations were complete within just five months. A 1,000-tonne steel frame makes up the main structure of the arena - fabricated in Bolton, it was lifted into place in July 2012.

A century of stainless steel celebrated with website

It is 100 years since stainless steels were first created, patented and produced and in order to celebrate this centenary a new website has been launched by the International Stainless Steel Forum (ISSF).

Developed by SCI, the website is dedicated to the history of stainless steel and its innovative applications, including articles with images from the past century.

Rick Sims of SCI Technology Services said: "ISSF is a long standing client of SCI's, and we are delighted to have collaborated with them to deliver this latest project. The site is visually exciting and technically it offers a first class content management system."

Stainless steel production has increased from 19.2M metric tonnes in 2001 to a record 31M metric tonnes in 2010. As the sustainability benefits of stainless steel become better known, that growth is likely to increase, as the material has a low carbon footprint and is 100% recyclable.

More information is available on the website: *www.stainlesssteelcentenary.info*

School reflects with steel

Steelwork erection will be completed this month on a new school building for the University Church of England Academy at Ellesmere Port near Chester.

The new building occupies a prominent site and has been designed for 1,350 students including a 300-place sixth form. The school will vacate its current nearby premises during the summer and move into its new Academy in time for the autumn term.

Working on behalf of main contractor Kier Northern, The AA Group (TAAG) is fabricating, supplying and erecting 790t of structural steelwork for the building's main frame. In a contract worth more than £1M, TAAG is also installing some feature glulam columns, supplying and installing all metal decking, and fitting edge protection.

The building's main frame has a maximum of four levels and consists of two main interlinked, but structurally independent, blocks - a Learning block and a Community block.

The project also includes a centrepiece reflection pod formed with 20t of facetted and tubular steelwork. The structure sits in the middle of the school and will be used as a contemplation area for students.

Academy Principal Kevin McDermott said: "The new building will be more than a school; it will be an icon for our community."

Steelwork contractor helps boost renewable energy sector

The UK's renewable energy sector has received a major boost as Mabey Bridge has announced the second phase of its recruitment drive. The Chepstow-based firm will create an additional 45 skilled jobs at its £38M manufacturing plant as it moves into round the clock production to meet growing demand.

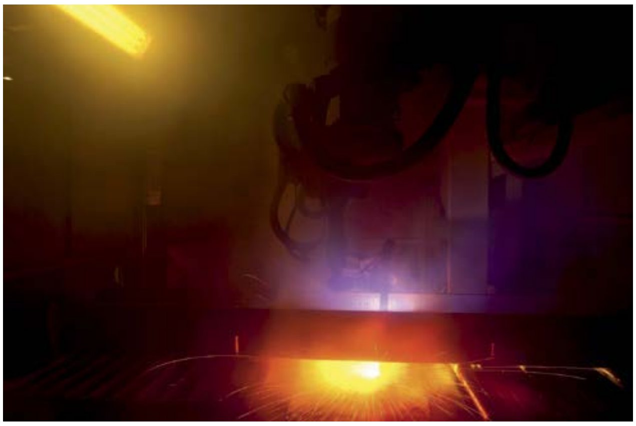
The company has also sealed its biggest order to date with a multi-million pound deal to supply 35 towers for German turbine manufacturer Nordex. A total of 14 of these towers will be installed at Pant-Y-Wal wind farm in South Wales, the first time towers sited in Wales will be made in Wales.

The increase in workforce levels is necessary to meet the growing demand for Mabey Bridge's wind turbine towers. The firm will be running full night shifts for the first time and is expected to announce further new contract wins imminently.

Mabey Bridge UK Director Alex Smale said: "We are delighted to announce the second stage of our recruitment drive at Mabey Bridge which shows how far we have come in our bid to become a major player in the renewables market.

"Our aim is to provide around half the UK's requirement for wind turbine towers – something we are on track for delivering on. We have an exciting future and we are looking for new employees who share our vision and drive."

Purpose built factory includes plasma cutting line



ASD Westok has relocated to a new purpose built production facility adjacent to the company's head office and central stockholding division in Leeds.

"During the course of six weeks our entire production facility and all of our workforce moved into our new facility," said Martin Clarke, ASD Westok Managing Director.

The move is the first phase of a five year investment plan which encompasses staff, software and manufacturing technology. To improve efficiency ASD Westok has installed a Kaltenbach fully automated robotic plasma cutting line in the new facility, supported by new software developed by AceCad.

Steel helps to reinvigorate former railway station

More than 12,500m² of Kingspan access flooring is being installed in a new civic headquarters and customer service centre for York Council on the site of a Grade II listed former railway station within the walls of the historic city.

A Kingspan partner contractor is installing particleboard and steel encapsulated panels for the new-build steel framed element of the scheme and areas of the former railway station which are being redeveloped.

The particleboard panels were installed with a finished floor height (FFH) ranging from 60mm to 150mm, and the FFH of the steel encapsulated panels was 250mm.

The new civic headquarters and customer service centre, known as West Offices, will enable York Council to rationalise its offices from 16 to four, providing an estimated saving of £17 million over the next 25 years.

Main contractor for the project is Miller Construction and the developer is York Investors, a team comprising of Buccleuch Property and S Harrison Developments.

Colorcoat brightens web

Tata Steel has launched a Colorcoat Project Showcase (http://projects.colorcoat-online.com.) to provide an invaluable resource for those specifying, designing and constructing steel clad buildings.

The project showcase is an integrated feature of *www.colorcoat-online.com*, which together offers architects and specifiers unprecedented access to the complete Tata Steel Colorcoat range of pre-finished steel products and services, as well as expert advice on all aspects of metal envelope design, specification and construction.

Dr Peter Barker, Product Development Manager, Tata Steel said: "Colour plays an integral role in both our natural and built environments – it has a real influence on the way people experience and respond to a building. At Tata Steel, we have specifically developed our Colorcoat products to help design teams meet the aesthetic requirements of modern architecture, as well as delivering against functional needs."

Included in the new project showcase section is a unique area known as Source which explores the creative thinking that

continues to shape the built environment. Source enables you to find out how the Aztec period, homes in Burano and Venice and even coffee have all inspired the Colorcoat colour palette.

NEWS IN BRIEF

New Steel Construction can now be ordered and downloaded online at *www.steelconstruction.org*

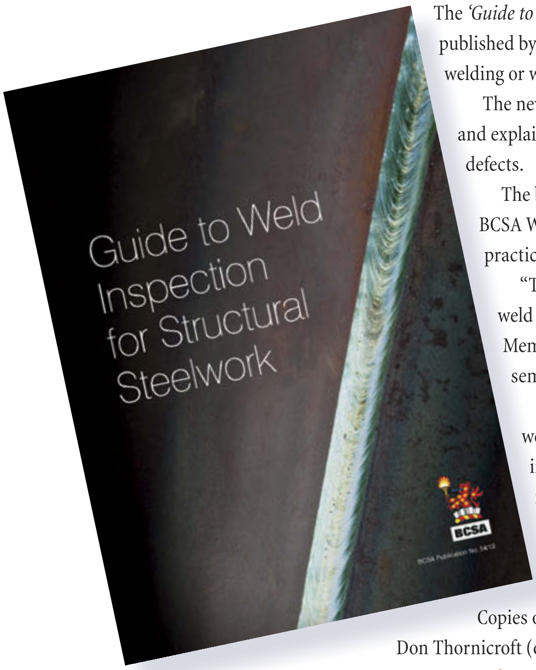
Dr. Graham Couchman, Chief Executive of **SCI**, has delivered a lecture to students on the University of Cambridge's new Master's degree course in Construction Engineering as part of a Design for Construction themed residential week. He addressed the students on the latest innovations in steel design and approaches for sustainable construction. The aim of the course is to revolutionise the construction sector, break down traditional barriers and help transform the future of the industry.

Netherlands-based manufacturer **Voortman** has launched the V330S machine, a split plate processing system which is said to allow simultaneous drilling and cutting. The unit has a split configuration system working with two separate gantries, which the company claims, guarantees a high output.

SCI Technology Services has appointed a new Senior Software Engineer, Ramesh Nadella who has an MSc in Computer Science and is an accredited Dot Net Technology specialist. His appointment strengthens SCI's already talented Technology Services team and further enhances SCI's in house capabilities.

A number of engineers from SCI have contributed their technical knowledge and expertise to the 7th edition of the **Steel Designers Manual.** Leading industry experts joined senior SCI engineers in contributing a wide range of topics covering steel construction. For the first time this edition is based upon the Eurocodes, and recognises the growing importance of light gauge steel, sustainability and the increasing use of computer methods in analysis procedures.

Practical guide to weld inspection published by BCSA



The *'Guide to Weld Inspection for Structural Steelwork'* (Pub No. 54/12) has been published by the BCSA to provide invaluable information for those involved in welding or welding inspection.

The new publication gives guidance on weld inspection for structural steelwork and explains how techniques and testing are used to identify and characterise defects.

The book has been researched and written primarily by Jeff Garner, former BCSA Welding and Fabrication Manager and BCSA Consultant Roger Pope, with practical advice and research also added from BCSA member companies.

"This is the only book of its kind giving such practical guidance for weld inspection," said Dr David Moore, BCSA Director of Engineering. "Our Members will find it extremely useful and those attending the BCSA welding seminars will get a free copy."

Within the publication there are clear explanations on the causes of weld defects and the measures that may be taken to avoid them. Clear images accompany the text, showing the defects pictorially and allowing readers to see exactly what they should be looking for.

The guide is intended for use primarily by persons undertaking, or responsible for, weld inspection in fabrication facilities manufacturing structural steel components that are designed for static loading.

Copies of the design guide can be obtain from the BCSA publications manager, Don Thornicroft (don.thornicroft@steelconstruction.org) or ordered from the BCSA web site *www.steelconstruction.org.*

Rapid rail system aids quick steel assembly

The new Rapid Rail Support System launched by Metsec is said to allow steel erectors to assemble the side rail supports without the need for tools, nuts, bolts or washers, thereby reducing installation time.

The system comprises a new 55mm deep channel with two new end fixings, a locater end and a lock end, which clip together through the standard holes provided in the rail. The system comes complete with a start/ finishing cleat leaving a flush finish and removing the need for countersunk bolts, countersunk holes or packing plates.

The new system is currently available for Metsec 142, 172, 202, 232 and 262 section series and the company said it has already been trialled on several major projects.

Sculpture immortalises Big Yin

A steel sculpture of Billy Connolly (Big Yin) has been erected to signal the completion of the first phase of a landmark residential housing project in Anderston, Glasgow.

The metal artwork, made from steel bars by artist Andy Scott, is hung high on an elevation of the first phase to be completed.

Property and construction consultancy McBains Cooper are project managers on the five phase residential rebuild of Anderston, working with client Sanctuary Housing, and the sculpture of Billy Connolly is high up on the elevation overlooking Glasgow.

"We occasionally get celebrities turning up at launches and openings, but it'll be nice to drive past the sculpture of the Big Yin every day and be reminded that we played a part in putting Anderston back on the map – after Billy Connolly did it first time round," said Alan Hannah of McBains Cooper.

Diary

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For BCSA events contact *Gillian Mitchell, tel:* 0207 747 8121 email: *gillian.mitchell@steelconstruction.org*

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Leicester

14 & 15 March 2012
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BCSA RWC Training Course
Thorpe Park Hotel, Leeds

21 & 22 March 2012
Design of Steel Bridges
Leeds

29 March 2012
Floor Vibration
Slough

24 & 25 April 2012
BCSA RWC Training Course
Thorpe Park Hotel, Leeds

Landmark bridge kicks off stadium opening

A signature steel bridge has been opened in St Helens to link the new rugby league stadium to the town centre. NSC reports.

FACT FILE
Saints Footbridge, St Helens
Main client: St Helens Council
Architect: Moxon
Main contractor: Galliford Try
Structural engineer: Flint and Neill
Steelwork contractor: Rowecord Engineering
Steel tonnage: 120t
Project value: £73M

Last month (January) saw the official opening of an iconic footbridge in the centre of St Helens, a structure which has already captured the public's imagination with its eye-catching design.

The Saints Footbridge will take pedestrians to and from the town centre to the new rugby league stadium and a large Tesco store. The stadium officially staged its first match last month, and many of the attending spectators used the bridge to cross the busy A58.

Adding to the bridge's symbolic status, it is said that viewed from above, the steel arches on the structure are shaped like a rugby ball, which is more than apt for a town synonymous with the sport of rugby league.

"We wanted an iconic footbridge," says St Helens Council Project Engineer Les Fairclough. "One which would stand out and become a landmark."

Galliford Try won a £1.2M design and build contract for the project and initially appointed architect Moxon and structural engineer Flint & Neil to come up with a unique design. The scheme has delivered a sleek 4m wide x 54.6m long bridge, which has a deck suspended via flat plate hangers from two parabolic arches formed from 610mm diameter CHS sections.

The project kicked off in February with site clearance work that involved more than 2,000t of material being excavated and then reused for the approach footpaths. After this 24 concrete bored piles were installed into each of the two embankments.

Above ground, the bridge's superstructure is made of structural steelwork, fabricated, supplied and erected by Rowecord Engineering.

Explaining the choice of steelwork contractor, Mr Fairclough says: "The bridge arches required some extremely complex fabrication for each of the base plate connections and the structural engineer recommended we use a BCSA member in order to guarantee getting the necessary quality."

Before any steelwork arrived on site, however, Galliford Try had to liaise with all of the project team members to address the main risks to the project associated with the installation of the bridge. Its unique shape presented challenges both from potential settlement and the difficulty of installing fixed length hangers between the deck and arches.

"We expected a 75mm sag when the bridge was erected so the structure has some leeway incorporated into its design," says Mark Foster, Galliford Try Site Agent.

The bridge could be prone to movement when it accommodates the large numbers of spectators on match days. This has been guarded against with the installation of tuned mass dampers which absorb the vibration energy and reduce accelerations caused by collective footfalls to an acceptable level.

There are four dampers in total, two positioned at approximately the third points in the span. The structure is also future-proofed with bays for extra dampers to be installed in the arches and one more in the deck.

The continuous arch is said to resemble a rugby ball when viewed from above

Bespoke hangers connect the arch to the deck

The assembled arch is lowered onto the U-shaped connection

Erecting the steelwork began with the deck being brought to site in three pieces, each complete with parapet panels. Using a 250t capacity mobile crane, Rowecord initially lifted in the central 27m-long central span and then the two outer sections. They were all landed on temporary trestles and then bolted together through the end diaphragms which acted as a backing strip for the welds between the sections.

With the deck in place and still resting on trestles, the arches, which are positioned either side of the bridge, were installed. These tubular sections were brought to site in six pieces; two end U-shaped sections with temporary bolted connections at the ends and two further sections for each of the two arches with matching bolted connections.

"We assembled the arches on temporary trestles and welded them together," explains Rowecord Project Manager Peter Samworth. "They were then lifted by crane and bolted to the splices on the end U-sections which had previously been installed. The tube was then completed over the splices to give a structurally continuous member."

Each fully assembled arch is approximately 42m-long and weighs in the region of 29t.

The final piece of the erection process involved connecting the arches to the deck via a series of hangers. Fabricated from 50mm thick and 200mm wide plate, there are 14 of these bespoke hangers for each arch. They range in length from 2.5m up to 6.5m.

"The hangers are all individual and don't necessarily match the corresponding member on the other side of the bridge," explains Mr Foster. "This was again to allow for tolerance and any potential sag."

Once the hangers were installed, the bridge was jacked down on to its bearings, the trestles removed and the structure's handrail completed.

In total Rowecord was on site for one month, erecting, assembling and painting the steelwork. All of the steel was given three coats of paint prior to being erected.

Prior to the bridge's January opening, the final works included the installation of LED lighting along the deck and four LED spotlights on the corners of the embankments. Adding further to the structure's landmark status, the lighting will illuminate the bridge with changing colour from dusk to dawn.

"The bridge arches required some extremely complex fabrication for each of the base plate connections and the structural engineer recommended we use a BCSA member in order to guarantee getting the necessary quality."

The sleek steel bridge has already become a local landmark

The main west stand takes shape

Football club gets a home from home

When it opens this summer, Rotherham United's new stadium will see the club return to its home town after a four year exile. Martin Cooper reports on the part structural steelwork has played in this soon to happen homecoming.

FACT FILE
Rotherham United Community Stadium, Rotherham
Main client: Rotherham United FC
Architect: S & P Architects
Main contractor: GMI Construction
Structural engineer: 3e Consulting Engineers
Steelwork contractor: Elland Steel Structures
Steel tonnage: 1,150t

The forthcoming 2012-13 football season will see Rotherham United FC (The Millers) once again playing its home matches in its own stadium in the South Yorkshire town. In July a new 12,500 seater capacity ground will be officially opened and Rotherham United's homecoming, after four years of exile in Sheffield, will be complete.

Built on the site of the former Guest & Chrimes foundry, the new football stadium forms part of a larger regeneration project, taking place on either side of the River Don. This has already included the construction of the new Borough Council Civic Buildings (reported in *NSC* March 2011), which are situated adjacent to the stadium.

Building on a former industrial zone usually means the preliminary works include some sort of site remediation. This was the case on this site, but the biggest task was to raise the level of the entire site by two metres, a job which required the importation of 54,000m^3 of inert material.

"The area suffered some serious flooding in 2007 when the River Don burst its banks," explains Gary Oates, GMI Construction Senior Project Manager. "In order to protect the site we had to build up the site and install gabian support walls along the project's riverside boundary."

With these important preliminary works and the installation of steel piles finished, Elland Steel Structures began its steelwork erection programme during week six of the project.

"We have a tight schedule to meet and the coming football season won't wait for us," says Mr Oates. "But by using steelwork for the project we are assured a quick construction programme."

The stadium consists of four interlinked, but structurally separate stands, built with steel columns and rakers which support precast terrace units. Covering two of the stands (west and east) are cantilever roofs formed with cellular rafters, while the two end stands (north and south) have roofs supported and stabilised with 4m high masts and connecting backstays.

The 3,500 seat capacity west or main stand houses the majority of the stadium's 3,000m^2 commercial space as well as two floor levels of executive boxes and hospitality suites. For this stand, and all of the stadium's structures, a grid pattern of 7.6m and 7.1m has been used for the steel frame.

"These are optimum grids for a stadium giving each seat enough width and also

Long cellular beams form the west stand's cantilever roof

Main columns at the back of the north stand will be connected to and support roof masts

"We have a tight schedule to meet and the coming football season won't wait for us. But by using steelwork for the project we are assured a quick construction programme."

allowing for the minimum distance requirement between exits," explains Alan Liddell, 3e Project Engineer.

Only two areas deviate from these grids and these are the west stand's first floor function rooms and second floor executive boxes. Here larger open plan areas with 15m spans have been formed with the insertion of long cellular beams; basically the longer sections miss out one column line.

Steelwork's flexibility has come to the fore as all eight of the executive boxes can be converted into one large room as they are divided by moveable partition walls. In all, this stand has five internal floor levels, all containing concessionary areas and toilets.

Forming the main stand's cantilever roof are a series of 20m-long cellular beams, bolted to large 610 x 305 columns, situated towards the back of the terrace. These tapered rafters were brought to site by Elland Steel in two pieces, assembled on the pitch and then lifted into place as completed sections.

The rear portion of the west stand's roof is clad, while the front 8m wide section will be covered with a translucent material, allowing natural daylight to reach all areas of the pitch and so helping the grass grow. The north and south stands both have the same 50:50 mix of cladding and translucency, while the east stand's roof is completely covered in the see-through material.

The other (north, south and east) stands are all slightly smaller than the west, each accommodating approximately 3,000 seats. In order to make the size discrepancy from the west stand to the north and south ends a feature element, these end roofs have five steps, each descending by 1.5m and so lowering the roof levels to meet the smaller east stand.

Two of the most visually striking features of the stadium, at least if viewed from above, are the 245mm diameter tubular masts and back stays which support the two end roofs. There are 14 masts per stand, one on each primary grid line and they are integral to the roof's overall structural stability.

"The back stays are made from tubular steel up to 245mm diameter," says Mr Liddell. "Connected to the rear columns, the stays act as the primary restraint to the cantilever roof system, providing support for gravity and wind uplift loads."

As well as steel erection and metal decking installation, Elland Steel is also supplying and lifting into place the precast terrace units and stairs. At most times, the company had four mobile cranes on site, a 25t and a 50t capacity unit for the steelwork, and a 50t and a 100t capacity crane for the precast installation.

Steelwork erection followed a sequential programme with the majority of the west stand completed first, followed by the south stand going up while the main stand's roof was completed. The north and east stands were then completed after the south stand structure was finished.

Precast installation followed on behind the steel erection and once each stand's rakers were in place, the terrace units were lifted in. Elland Steel is scheduled to complete its work this month (February).

Rotherham United's new stadium, meanwhile will be handed over on 9 July, in time for pre-season friendlies and the start of the new football season.

Impression of completed stadium

Steelwork has assured the client of a quick construction programme

FACT FILE
Emirates Air Line, London
Main client: Transport for London (TfL)
Architect: Wilkinson Eyre
Main contractor: Mace
Structural engineer: Buro Happold
Steelwork contractor: Watson Steel Structures
Steel tonnage: 1,150t

Once Watson Steel fully erected the intermediate tower it then installed the cable car running gear

Up, up and away

The first of three signature towers for London's newest river crossing has been fully erected. NSC embarks on the Emirates Air Line.

A new and iconic addition to the capital's infrastructure is under construction in east London. The Emirates Air Line will be the UK's first urban cable car and form a vital link across the River Thames with a capacity to carry up to 2,500 passengers per hour in each direction.

The cable car will stretch across the Thames between two terminals, one in North Greenwich, home of the O_2 - Europe's largest entertainment venue - and the other at the Royal Docks on the north bank, which is the location of the Excel conference and exhibition venue.

Three steel towers will support the Emirates Air Line, one on the south bank and two on the north shore, including an intermediate structure. Last month (January), the North Intermediate Tower was the first to be fully erected. Although the smallest tower it still stands at over 65m tall and weighs more than 290t. The other two towers will top out at 90m and weigh in excess of 550t each. All three towers are due to be erected by late spring.

The first tower was built within days of its steel pieces being delivered to site. Every piece of steel for the project is being fabricated in Bolton by Watson Steel Structures. Over half of the two hundred employees at the factory are dedicated to this project and will continue to be until the last piece is manufactured.

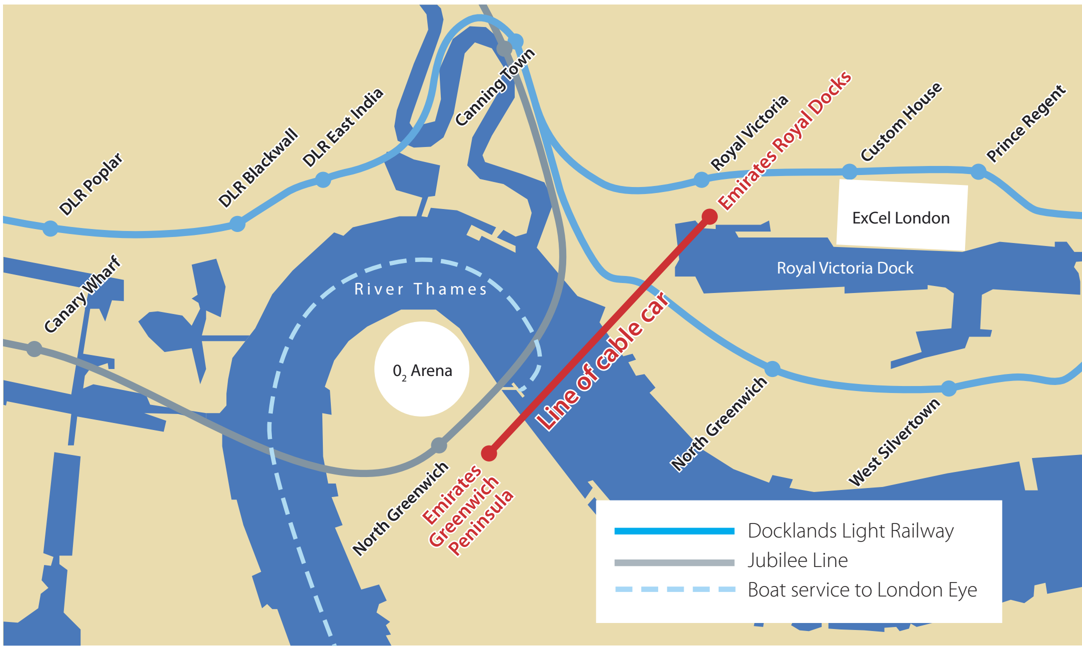
As all of the towers are similar, the design, fabrication and erection of each structure will be the same. Innovation has been at the heart of the design and construction of the Emirates Air Line with the latest methods and technologies used to create this unique addition to London's transport network. Watson Steel planners took the design for each of the towers and using cutting-edge 3D modelling created the accurate templates for each piece. This intricate modelling saw designs for each part drawn to within a millimetre to ensure every piece fits together like a jigsaw.

"Tower sections with a diameter of less than 4m are delivered to site fully complete," explains Peter Miller, Director at Watson Steel Structures. "Above this size and up to the largest 10m diameter sections for the bases, these are fabricated and delivered in halves and site welded before being erected."

All of the tower sections are lifted into place by crane, a 500t capacity mobile crane did the intermediate tower, while a 1,200t capacity crawler is being used for the southern structure. Once each tower section is lifted into place they are bolted to the steelwork below via an internal flange plate.

Worker access for the bolting up is from the inside of the tower, which negates anyone working on the outside of the tall structures. "During the design stage we had to take the erection sequence into consideration and as the towers will have

A complex helix like structure, which has been specially designed for the inside of the towers, will provide the strength and stability needed to transport the thousands of passengers up the towers every hour.



permanent access for passengers we've used this as temporary access for our erectors. All of the splices have been designed to correspond with internal platforms," explains Mr Miller.

Each tower will be made up of hundreds of separate pieces of steel plate that vary between 10mm and 50mm in thickness. A complex helix like structure, which has been specially designed for the inside of the towers, will provide the strength and stability needed to transport the thousands of passengers up the towers every hour.

The helix structure is already fully assembled inside of completed tower sections, but for those that need to be site welded, the helix is delivered as individual elements along with four separate 'ribbons' that form the vertical part. These complex pieces of steelwork are compound sections of tubular and flat plate which were doubly curved during fabrication.

The completion of the first tower comes as the Emirates Air Line achieved another first - appearing on the internationally renowned London Underground Tube map. It is the first time in the Tube map's 78 year history that a commercial brand has been able to put its name to a transport link and station as a result of a partnership with TfL. The map also highlights how the new scheme will integrate into the wider transport network by providing an additional step free access interchange between the Jubilee line and the DLR – two key lines in east London.

Mayor of London, Boris Johnson, says: "The Emirates Air Line is a vital part of the regeneration of east London, providing a much needed river crossing in this part of the capital. Investment in infrastructure such as this is essential for London's economic recovery, generating jobs and showing to the world that this city is looking to the future with vision and confidence. It is also showing off the ingenuity of the UK firms that are crafting these magnificent towers.

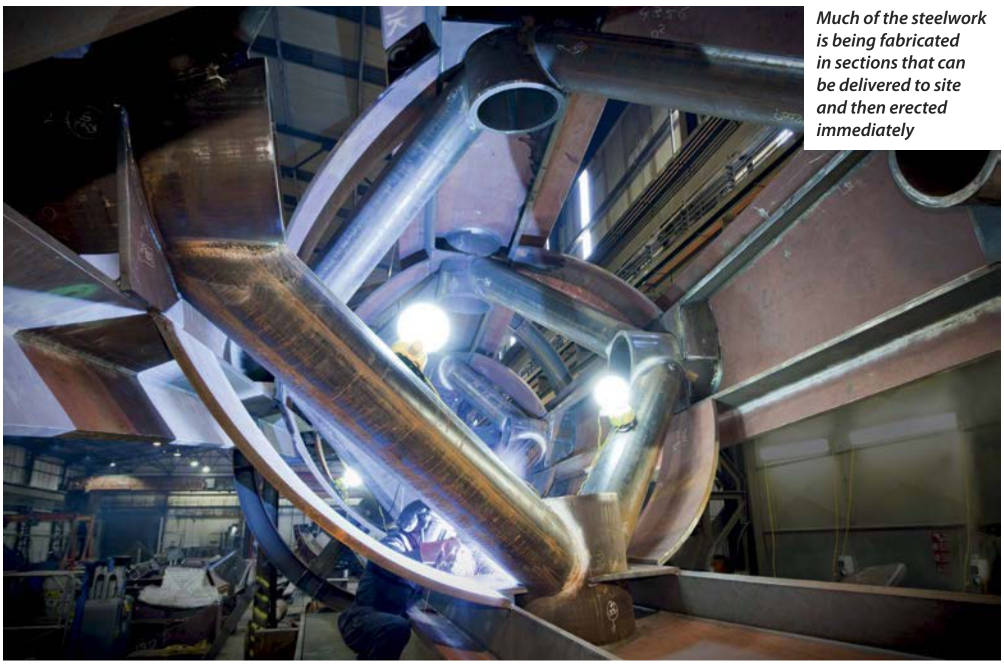
Danny Price, TfL Emirates Air Line Operations Manager, says: "The completion of the first tower for the Emirates Air Line is a major milestone in the project and helps everyone to visualise how unique and exciting London's new travel experience will be. I look forward to seeing the other graceful towers rise up over the next few months. It's a great source of pride that this crucial job is being carried out in the UK, providing a brilliant example of the best of British manufacturing."

The Emirates Air Line will provide a new river crossing for east London, a key objective for the Mayor to help unlock further the economic potential of this part of the Capital. The scheme supports the Mayor's vision to transform this area into a bustling metropolitan quarter with new businesses, homes and job opportunities. It will also draw tourists from across the globe adding to the ongoing regeneration of east London.

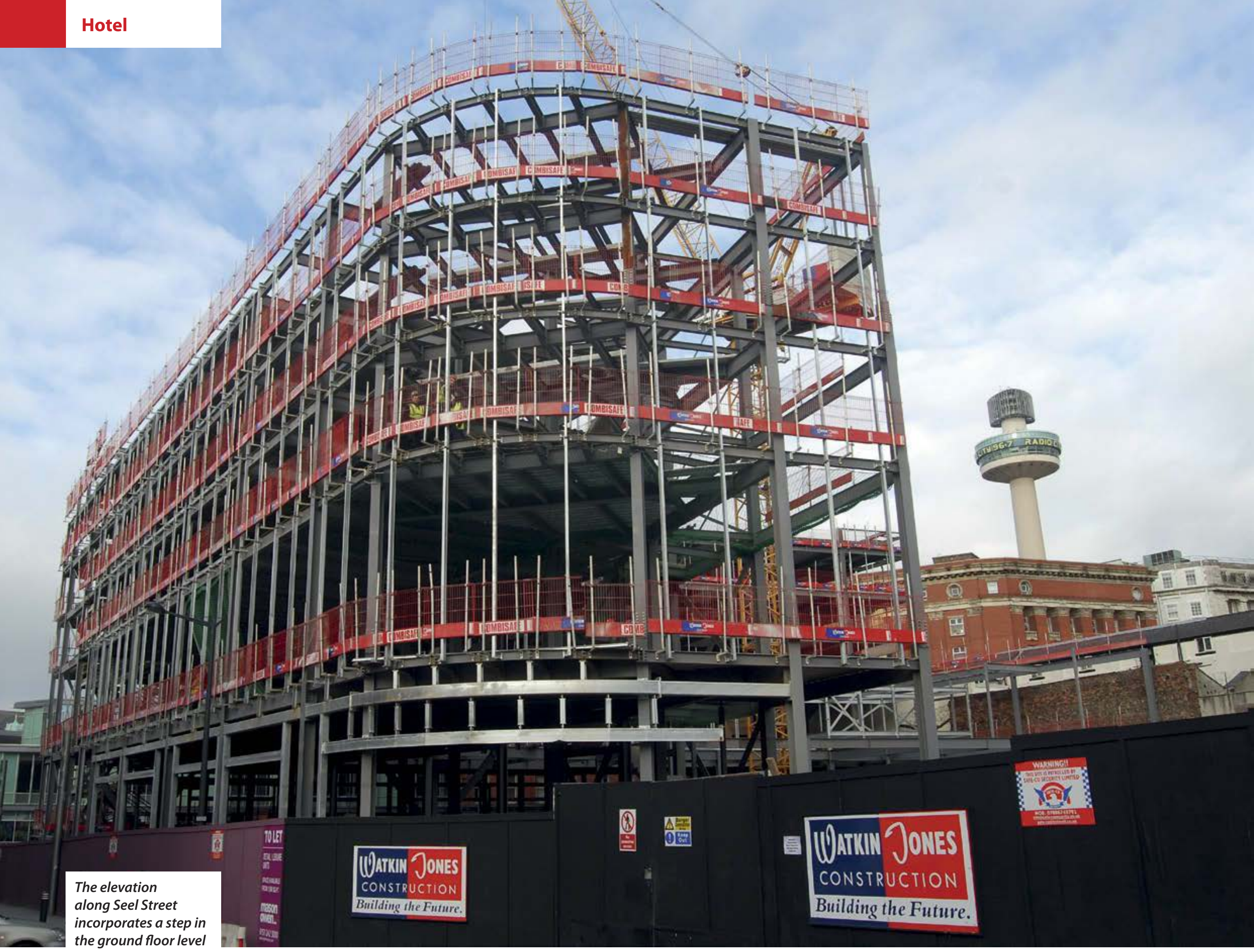
The number of passengers using the link will be equivalent to the hourly number of people travelling through the Blackwall Tunnel

Once the towers have been completed, Watson Steel also has the steel erection of the two terminals to complete as well as a gondola storage building to be located close to the south station.

The Emirates Air Line is due to open later this summer.



Much of the steelwork is being fabricated in sections that can be delivered to site and then erected immediately



The elevation along Seel Street incorporates a step in the ground floor level

Steel accommodates new hotel

Construction work on a new hotel in the centre of Liverpool is progressing in quick time due to the choice of structural steelwork for the main frame.

Liverpool has been transformed over the past decade as millions of pounds have been invested in construction projects in the city centre and along the River Mersey's waterfront. Retail developments as well as leisure and entertainment facilities have been a key success as they have attracted people to the rejuvenated city and helped Liverpool become a visitor destination.

In order to satisfy the increased number of visitors new hotels have been built and one of the latest developments is a new Premier Inn currently being constructed on Hanover Street.

Located at the entrance to the Liverpool One retail development, this will be the third Premier Inn for the city, as the hotel operator already has a presence in the business centre (Vernon Street) and the entertainment area (Albert Dock).

John Bates, Head of Acquisitions for Whitbread Hotels & Restaurants, says: "Premier Inn is the most successful budget hotel operator in the UK and we want to ensure that ongoing success by investing in key locations. By adding a new hotel at Liverpool One, we can be part of this exciting regeneration story."

This latest Premier Inn will offer 183 bedrooms and the development also includes ground level retail units and restaurants. Getting the hotel up and running as fast as possible is a key requirement for the client and the main reason for choosing structural steelwork as the main framing material. A 15-month build programme is scheduled for this project with the hotel due to open this autumn.

"Steel offers a quick construction, as the frame is up fast and this allows the floors to be completed and then other trades can get started," explains Nick Bumby, Contracts Manager for Watkin Jones.

The site of the project was formerly a car park, but this had already been demolished when Watkin Jones started work last July. With a cleared footprint the early works included installing pad foundations and ground beams, in readiness for the steelwork erection to begin.

Because the site slopes downwards towards the main elevation on Hanover Street, the structure has five levels along two sides but only four on the rear facade. Overall the structure forms a squared horseshoe shape, with the central area used as a covered plant and retail back-of-house zone.

The disparity in floor levels is absorbed

Due to the proximity of busy roads all steelwork has been erected from inside the project's footprint

Below: Steel erection began on site in October

FACT FILE
Premier Inn, Liverpool
Main client: Whitbread Hotels & Restaurants
Architect: Allison Pike
Main contractor: Watkin Jones Construction
Structural engineer: Curtins Consulting
Steelwork contractor: EvadX
Steel tonnage: 900t
Project value: £12M

into the design of the ground floor retail and restaurant units, where the shops at the front along Hanover Street incorporate a double floor to ceiling height. The units along the sloping Seel Street have a progressively shallower floor to ceiling height the further up the road they are; a step in the ground floor is accommodated by a retaining wall. The restaurants along the rear elevation, consequently have a single level height.

This then means that the hotel, which starts at level 2, consists of four floors on all three elevations.

The majority of the steel frame is based around a regular column grid pattern of 7.2m x 7.7m. With a central corridor and equal sized rooms either side, the design required three lines of columns including the perimeter members, with a central row positioned in the corridor. The exception to this pattern is the ground floor where some of the central columns have been omitted, by including transfer beams, in order to open up the retail areas.

The steel frame derives its stability via bracing which has been secreted into lift shafts, stairways and partition walls. Each of the wings has to have its own independent stability because of the central void and the lack of linking floorplates.

"We've also inserted some sway frames which consist of larger connections and add to the overall structural rigidity," explains Steve Morris, EvadX Project Manager. "These are predominantly located close to stairways."

"Each of the tubes has a structural insert or connection which allows them to be temporarily tied during erection. Welding them up afterwards ensures full load capacity,"

Steelwork contractor EvadX has erected the steel and installed the precast stairs using the on-site tower crane, a unit which has a 2.8t capacity. Non of the steelwork is too heavy for the crane, although the stairs have been produced off-site with the machine's capacity in mind.

The final element of the steelwork will be erected this month (February). This is the project's piece de resistance and will form the hotel's glazed entrance and the main staircase core.

"Coordination has been vital while designing this part of the frame," explains Dave Jones, Curtins Consulting Project Engineer. "The architect was concerned with the finish, the glazing contractor was concerned with the glass, while ourselves and EvadX had to make sure the steel design worked."

The design for this part of the job has been ongoing while the rest of the steelwork package got erected. EvadX has left the main corner element of the structure open, so the entrance can be inserted last and bolted to the existing steelwork frame.

The entrance steelwork is a triangular feature which overhangs the adjacent paths and fans-out as it gets higher. Formed from SHS and CHS members, it incorporates its own bracing and will be left exposed behind the glazing as part of the stair core and as the hotel's feature element.

EvadX will deliver the entrance steelwork in a number of small pieces to be bolted together on site and erected by the tower crane. Two members, however, are too long for the crane as in full length they would dangerously overslew the street when being lifted into place. These two 22m and 19m-long tubular columns will be brought to site in halves and then site welded.

"Each of the tubes has a structural insert or connection which allows them to be temporarily tied during erection. Welding them up afterwards ensures full load capacity," says Mr Morris.

The glazing of the steel entrance structure will form a centrepiece for the project as it will incorporate an abstract artwork within 18 of its glass panes. The art will reflect the area's ropemaking and nautical heritage with depictions of old industries and maps.

The design and detail of this prominent steel structure was developed with the aid of computer software. Curtins used RAM Structural Systems software to design an economical frame that had the ability to accommodate the dimensional restrictions of featured glazing, finishes and M&E services. During the design development period, in order to provide high quality, visually aesthetic exposed steelwork connections to satisfy the architectural criteria, Curtins with the assistance of Evadx, produced full scale prototypes.

"Advantage was taken of our expertise in Building Information Modeling (BIM) during the tender and construction stage where we generated a 3D model using Revit to integrate the architectural package within the structural model. This accelerated the review and coordination process," explains Mr Jones.

Summing up, Mr Bumby adds steelwork will be completed this month and the material has helped keep the project, despite the recent windy weather, to its scheduled completion date.

The hotel's entrance will feature an abstract artwork within its glazing

Framing hospital excellence

A new 800 bed acute hospital is rapidly taking shape in north Bristol, a project which is making use of more than 6,000t of structural steelwork and aiming to achieve a BREEAM 'Excellent' rating.

Bristol's new Southmead Hospital is being constructed in two phases with most works being completed in phase 1. The main hospital which includes the clinical and ward blocks is programmed to complete at the end of March 2014 after which the new hospital will open. The second phase picks up the remaining elements including external works and landscape and will be complete towards the end of 2015.

During the construction programme the existing hospital remains open, although some buildings have had to be demolished to make space for the new build. Prior to phase two of the works beginning, all of the old hospital buildings will be demolished.

Structurally the new main building is split in two, with a concrete framed clinical block containing operating theatres, medical rooms and the emergency department separated from a steel framed ward block by a large steel framed and glazed atrium/ concourse.

Both the clinical and ward block are subdivided into thirds, with two movement joints positioned along the structure's length. For the steel framed ward building the movement joints connect to the structure's three concrete cores. Due to space constraints, the usual double column movement joint configuration could not be employed and steelwork contractor Severfield-Reeve Structures has installed a single beam with a sliding joint.

The ward block's frame is a beam and column structure supporting profiled metal decking with concrete infilled floors designed compositely with the floor beams. Loads are transferred vertically down the columns which are supported on pad foundations or piles.

Building a hospital with two framing materials has offered advantages to the project team, according to Jack Mitchell, TPS Associate Director. "Both blocks are going up simultaneously and this will mean an earlier fit-out. Also, by having two production streams, we weren't putting all of our eggs into one basket from a design perspective which in turn has helped maintain the construction programme."

Vertical movement joints consequently divide the ward building into three sectors (1,2 and 3), each consisting of two wings which form an enclosed courtyard within a horseshoe shape. Each sector steps down in height, with sector 1 comprising of seven levels, sector 2 having six levels and sector 3 stepping down to four levels.

"The grid pattern layout for the wards has been adapted to suit the clinical needs of the hospital," explains Mr Mitchell.

Steel framed ward blocks form enclosed courtyards

"The structural design was developed to accommodate these needs."

The width of the ward block has been divided into 8.35m and 5.75m bays to suit corridor positions. Longitudinally maximum bays of 9.3m are used, while secondary beams at 3.1m centres divide the long bays to limit the decking span.

Stability for the steelwork derives from three concrete cores and by the diaphragm actions of the composite floor deck transferring forces back to a combination of steel braced bays and portalised sections of the structure.

Vertical circulation is provided via lifts and stairs located in the three central cores within the atrium. The steel stairs cantilever out from the cores and were fabricated by Atlas Ward Structures. They arrived on site fully assembled in flights, which aided a quick erection process.

An atrium running the full length of the building forms a natural separation between the ward and clinical blocks. This has a glazed roof which is supported by a series of prestressed single post trusses using a bottom string of Macalloy bars. The atrium roof has three pyramid features (wind catchers) flanked by sloping wings, along its length. These roof structures incorporate movement joints and also make provision for differential building movement across the atrium.

Erecting the feature atrium roof pyramids presented the Severfield erectors (SteelCraft) with their trickiest work, says Steve Harrington, Severfield-Reeve Structures Site Manager.

Each feature, measuring 23m long × 9m high × 18m wide, was fully assembled on the ground before being lifted into place. Basically, the pyramids are trusses which will support the atrium's glazing, however each one took a week to assemble and one hour to lift into position.

"The pyramids are formed from ▶

FACT FILE
Southmead Hospital, Bristol
Main Client: North Bristol NHS Trust
Architect: BDP
Main contractor: Carillion
Structural engineer: TPS
Steelwork contractor: Severfield-Reeve Structures
Steel tonnage: 6,500t

The stairs cantilever out from the cores and were fabricated by Atlas Ward Structures. They arrived on site fully assembled in flights, which aided a quick erection process.

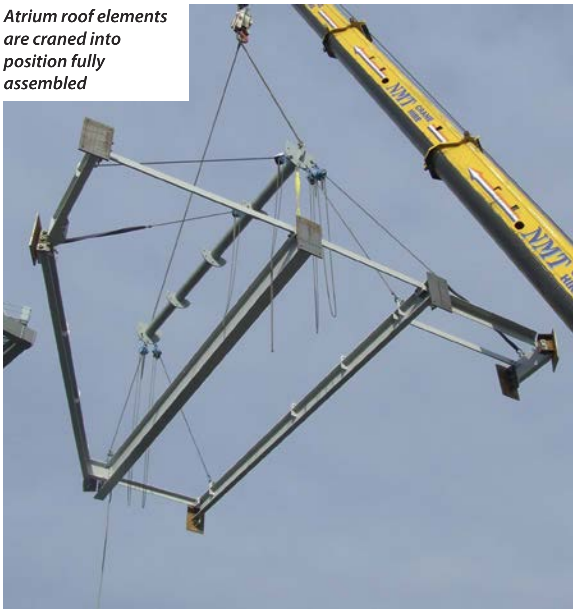
Steel has been erected by a combination of mobile crane and cherry picker

A feature wind catcher is craned into position

Trusses will support the central atrium's glazed roof

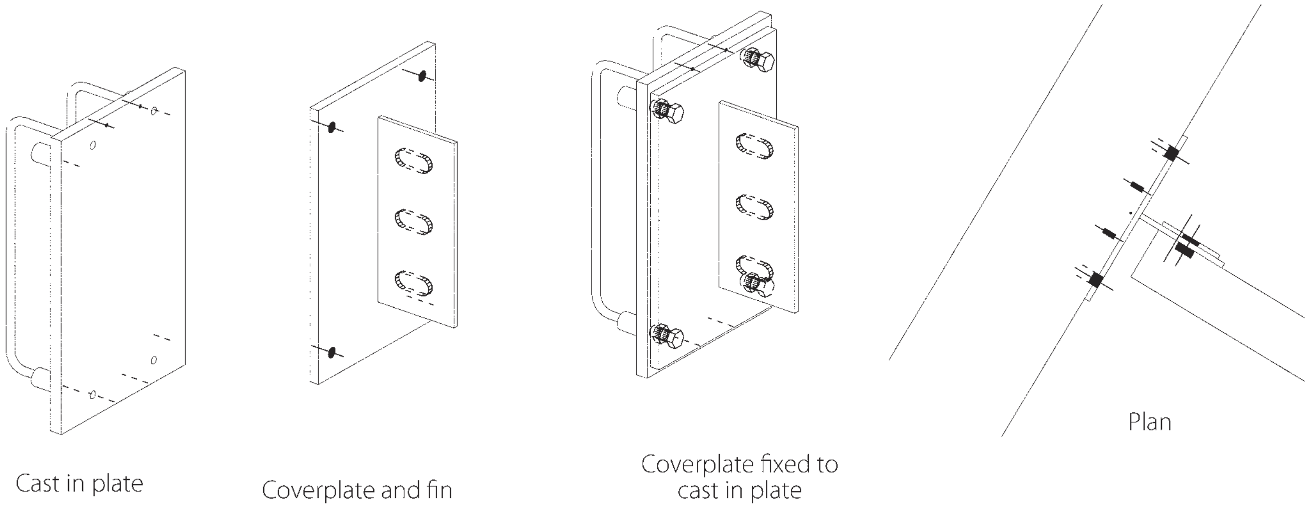
All blocks will have a covered rooftop plant area

Visualisation of the completed hospital



Atrium roof elements are craned into position fully assembled

Safe practice saves time



When it came to the initial sections of steelwork to be erected, those which connect to the cores, steelwork contractor Severfield-Reeve Structures used a new time saving method.

"The cast-in plates in the concrete cores already had cleats with pre-drilled holes in place," says Steve Harrington, Severfield Site Manager. "With taps in-place and already surveyed the connecting beams were quicker to install, which saved a lot of time."

This new methodology meant that a fin plate was welded to the connecting beam on the ground and prior to the member being lifted into place. Importantly, the procedure negated the need to weld aloft from a cherrypicker eliminating the risks and hazards associated with working at height.

Severfield used a similar method for the cores internal steelwork, which form landings for all floor levels. Internal cast-in plates were put in place during the core's construction and then surveyed. The survey results were then returned to the drawing office where fabrication drawings were prepared in accordance with the received information, which allowed bespoke steelwork to be fabricated.

Each level's steelwork was assembled on the ground and lowered into the core fully complete. Once in position retractable connections were extended to bolt directly to the core's embedded plates. Once a level was decked, this procedure was then repeated for each floor level, using the completed steelwork below as a working platform.

horizontal box sections and vertical tubes," says Mr Harrington. "Assembly was difficult as there is little room on the ground for storage, and so all the steel members had to arrive in a correct sequence."

Sequencing has also played a significant role in the overall steelwork erection programme. Severfield programmed and controlled deliveries to ensure steelwork arrived in a just-in-time basis, which has allowed most of the steelwork to be erected immediately it gets to site.

Quick treatment

The top floor of the extension accommodates a plant area

Flexibility and speed of construction were crucial factors in the decision to use structural steelwork for a new extension at the Royal Oldham Hospital.

Construction work is progressing on schedule for a new women's and children's facility at the Royal Oldham Hospital in Greater Manchester. Consisting of six floors, the new steel framed extension will include operating theatres, delivery suites, post natal wards, outpatients, an A&E unit and a 30 bed assessment unit. Overall the new build has a floor area of 10,158m^2 and includes shell space for future developments.

This is the fourth project main contractor Vinci Construction UK (IHP) has undertaken at the hospital. Previous work, included the reconfiguration of pathology services at the Royal Oldham site, including the construction of new state of the art facilities and refurbishment to the existing pathology building, a three-storey build of an ambulatory radiotherapy centre and the construction of a new women's and children's department at North Manchester General hospital as well as, the configuration to the existing A&E and X-ray departments while remaining operational. The current work also includes a fair amount of refurbishment, with 2,700m^2 of existing first floor wards and hospital corridors adjacent to the new extension being modernised.

Work on the extension began early last year and it has faced the usual challenges of projects on confined sites and being in close proximity to the general public. The refurbishment works will be undertaken while the hospital is fully operational and as with the main construction programme to erect the extension, has had to proceed with a great deal of planning to limit disruption to patients and visitors alike.

Using structural steelwork for the extension's main frame has helped with its speed of construction, which meant fit-out and internal works were able to kick-off before the 14 week steelwork programme was even completed.

"Speed of erection was very important and the main reason for choosing steel for the structural frame," says John Fowler, Vinci Construction UK Project Manager. "Hospitals always have lots of services and this job is no exception. We wanted the internal fit-out to get started quickly as possible."

The site was formerly a car park and it is hemmed in on all sides by the hospital's existing buildings. The tight confined site has little or no room for material storage, consequently all of the steelwork had to be delivered to site on a just-in-time basis.

Using its own mobile cranes for the erection process, steelwork contractor James Killelea divided the work into four phases, with each segment being individually constructed to full height, before moving onto the next area.

Prior to the steel erection starting, the sloping site required a cut and fill programme before a series of CFA piles were installed. Steel columns were then erected and sit directly onto the piled foundations.

Because of the site's sloping topography, half of the extension's footprint encompasses a lower ground floor, used as a plant area. Above, all of the other levels (ground,1st, 2nd and 3rd) cover the entire footprint, as does the 4th floor level which is a covered rooftop plant zone.

The extension is constructed around a central courtyard, which begins at ground floor level. The new structure is approximately square except for a skewed elevation which adjoins the existing concrete framed hospital.

The new steel frame is attached to the existing hospital along this elevation, but it is structurally independent. The steelwork abuts the existing concrete frame structure and there are two break-through points where the existing corridor enters the new extension.

Because of the numerous usages each floor level will house, the steelwork's grid pattern changes, although it is predominantly based around a 7m x 7m configuration. The main columns were brought to site in 12m lengths and this meant the structure only needed one splice, located halfway up the building.

Even though most of the structure is fairly regimented in its construction, some floor configurations were modified at quite a late stage. "By using steelwork we had the flexibility to accommodate some design changes to the frame while the job was in progress," says Peter Bryan Associate Partner at consulting engineers Alan Johnston Partnership.

The beam and column construction, with metal decking, uses the composite floor plates for diaphragm action along with

FACT FILE
The Royal Oldham Hospital
Client: The Pennine Acute Hospitals NHS Trust
Architect: Taylor Young
Main contractor: Vinci Construction UK
Structural engineer: Alan Johnston Partnership
Steelwork contractor: James Killelea
Steel tonnage: 900t
Project value: £25.5M

Impression of the completed extension (with green roof) sitting adjacent to the existing hospital

vertical bracing to negate any sway issues. The frame also incorporates some deep voids, of 600mm in the theatres, to accommodate the large amount of necessary services. These service zones are achieved by the shallow beam depths provided by the composite design.

K-bracing formed from RHS box sections gives the extension's steel frame its stability. The problem the designers had was where to put the bracing, especially as the structure has a lot of windows - along exterior elevations - and numerous openings in its interior partitions. This dilemma was solved by locating much of it inside three large steel framed service risers.

The hospital extension will, as previously mentioned, be heavily serviced, so the necessary large risers, measuring 3.5m x 4m provided the perfect location for the project's bracing.

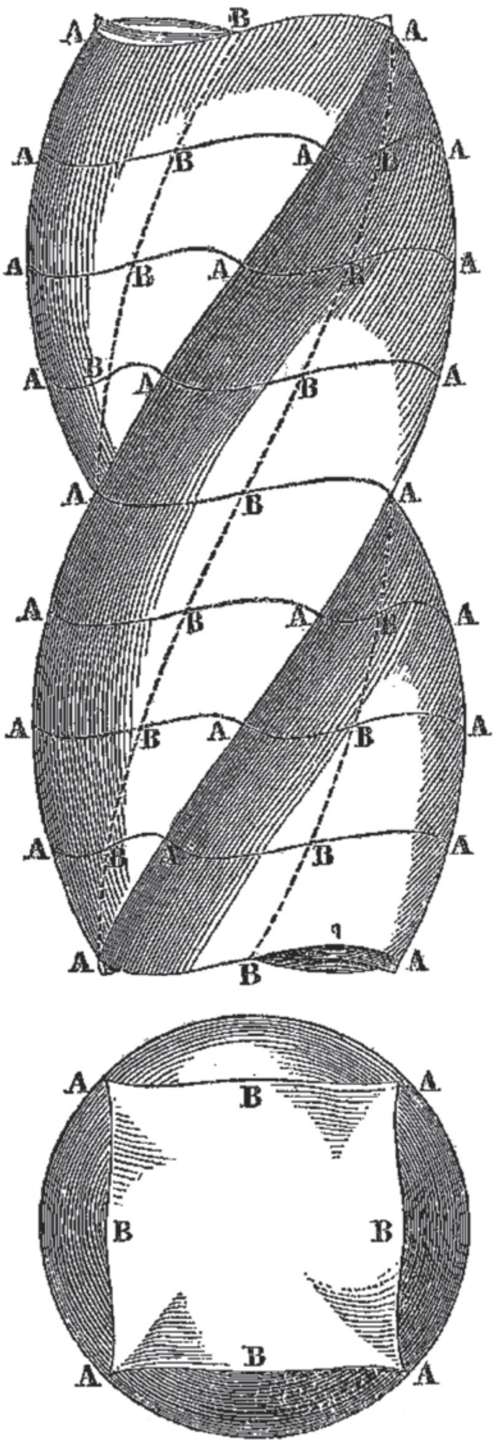
Summing up, Mr Fowler says the project is on schedule and the steelwork erection, which was completed on time, has helped with the overall programme. "The quicker the frame goes up the sooner the follow-on trades can start and this was an important consideration when choosing the framing material for this project."

The extension is due to be completed and open by the end of this year, while Vinci Construction UK's refurbishment programme will be finished in 2013.

The site is extremely confined and surrounded by functioning hospital buildings

A view of Torsion – Part One

SCI's Alastair Hughes writes the first of three articles on torsion, concentrating on textbook material such as design guides.



In a steelwork designer's view, torsion is best avoided. Partly because conventional open steel sections are not very good at resisting it, but also because its analysis poses mathematical challenges that can make normal people feel rather weak. Yet it can't always be avoided, as evidenced by the popularity of SCI's P-057 which remains a best-seller 20 years after publication. The time has come for a Eurocode-aligned revision. Publication of P-385: 'Design of Steel Beams in torsion' is immanent.

What is torsion?

Just another word for twisting. Either the action of twisting (the application of Torque) or the effect (twistedness). With steelwork we are dealing with linear members, and a twisting moment is a moment about the longitudinal axis – in Eurocode terms, the x-axis. A doubly symmetrical section will twist about its centroidal axis, and will stay straight (assuming it was straight to start with, and there is no bending). The torsional displacement is manifest as rotation (φ) that varies along the length of the member. (A member that rotates bodily is not twisting.)

'Torsional moment', though really synonymous with 'twisting moment' and 'torque', is given a special meaning in P-385. In the publication, and in this article, the term is exclusively for the internal moment, an effect, symbolized T_E, whereas 'torque' is reserved for the action, T. The distinction between action and effect really matters where torsion is concerned. For a single member with equal and opposite T applied at its ends, they are numerically the same, but if the member is held at each end with T applied at midspan, each half's torsional moment T_E is equal to $T/2$. Here is a context in which time is well spent writing those little subscripts.

How is torsion resisted by steel sections?

In two very different ways. One is called **'warping'**, something of a misnomer but one which has become entrenched. The other is named after **St Venant** (short for Adhémar Jean Claude Barré de Saint-Venant), a French civil engineer/mathematician who developed the theory of elastic torsion and identified the phenomenon of warping. This drawing, from his 'epoch-making' memoir of 1856, depicts the pattern of warping in a square bar. We are grateful to the Radcliffe Science Library, Oxford, for this magnificent example of pre-computer draftsmanship (left).

What is warping is the cross-section – in other words plane sections do not remain plane. The only sections immune to it are circular: CHS and round bars.

Having admired this drawing, it is now necessary to concede that the warping it depicts is of purely academic interest. The effects are real, but they make no significant contribution to the torsion resistance of this bar. For practical purposes, the resistance mechanism labelled 'warping' is only available to cross-sections with two flanges – such as the I-beams which are the stock-in-trade of steel framework.

In this and other respects, steelwork designers take a very selective interest in torsion theory. Our concern is for long prismatic members composed of thin elements – which can be summarized as $L>>h>>t$. This allows a simpler view of the subject, including the generalization just made about warping. For our purposes, so-called 'warping' is better described as **differential flange bending**. Replace torque T by a couple of equal and opposite sideways forces $\pm T/(h - t_f)$, each of which is resisted by its respective flange acting as a rectangular beam. Essentially, that is the resistance mechanism known as warping. What provides the resistance is not warping, nor (as some would have it) restraint of warping, but in-plane bending of the flanges. The warping – plane sections not remaining plane – is a side effect. The web of an I-beam, astride the neutral axis of both flanges, is disengaged, and may as well be ignored in 'warping' calculations.

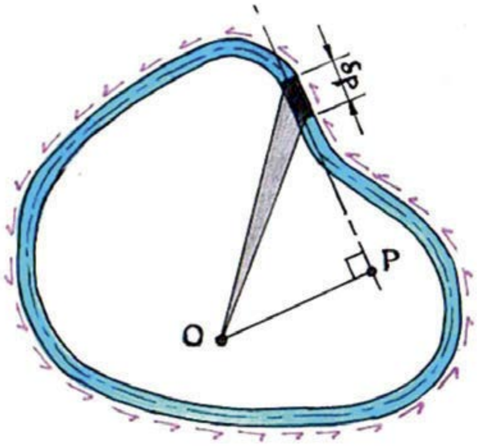
Of course the flanges can only display resistance if they have something to react against, so differential flange bending is not available to an isolated bar which is picked up and twisted from end to end, but in most practical situations it can act.

It is quite legitimate, with two parallel flanges available, to disregard St Venant and

verify torsion resistance in the manner just described, using familiar bending theory without reaching for a specialist Design Guide. Conversely, if two parallel flanges are **not** available (e g angle, cruciform and T-sections) 'warping' can and should be disregarded – it has virtually nothing to contribute.

St Venant resistance

That leaves the other resistance mechanism. In some textbooks, St Venant is all there is to torsion. It is variously described as 'pure' or 'uniform' torsion, but both these labels leave something to be desired and the choice of 'St Venant' for the Eurocodes is to be applauded.



The simplest explanation of the way it works is to consider a thin-walled hollow section (of any shape, see the diagram above). The torsional moment T_E is resisted by a shear force which flows around the perimeter. Suppose the wall thickness is uniformly t and the shear stress is τ, which is assumed to be constant as the wall is thin. Each element of perimeter δp, such as the one arbitrarily picked out on the sketch, provides a force $\tau t \delta p$ acting with a lever arm OP about an arbitrary axis O. The moment it exerts is equal to τt times twice the area of the shaded triangle. Since τt is constant around the perimeter, it follows that the total torsional moment resistance is equal to τt times twice the area enclosed by the mean perimeter A_p, and the torsional section modulus W_t (= T_E/τ) is $2tA_p$.

Let us try this out on a 508 × 20 CHS: $W_t = 2 \times \pi \times 0.244^2 \times 0.02$ = 7.48E–3 m^3, a reasonable approximation to the 'exact' figure of 7200cm^3 in the Tata Steel Tubes handbook. Incidentally, W_t is what used to be symbolized C and described as 'torsional modulus constant'. 'St Venant torsional section modulus' seems a more helpful way to describe it.

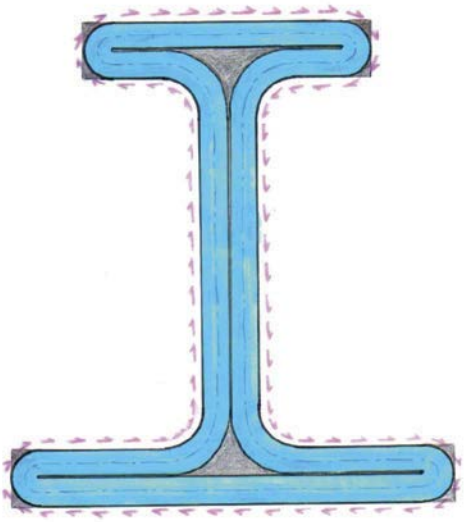
The other important section property is the 'St Venant torsional constant', traditionally symbolized J but now to be referred to as I_t.

GI_t is the St Venant torsional stiffness, analogous to bending stiffness or flexural rigidity EI. Just as EI is the slope of the graph of bending moment versus curvature, GI_t is the slope of the graph of torsional moment versus φ', the first derivative of φ with respect to x. Over length L the member will rotate by $T_E L/GI_t$ (assuming constant torsional moment and no warping).

To estimate I_t for the thin-walled hollow section, consider unit length of member rotating T_E/GI_t. The work done per unit length is T_E^2/GI_t. The entire section is stressed to τ, so strain energy per unit volume is τ^2/G. Per unit length this is $\tau^2 pt/G$ where p is the length of the mean perimeter. Equating the two, and substituting $2tA_p\tau$ for T_E, we get $I_t = 4\,A_p^2 t/p$.

Again, let us try this out on 508 × 20 CHS: $I_t = 4 \times (\pi \times 0.244^2)^2 \times 0.02/(\pi \times 0.488)$ = 1.825E–3 m^4. Not a bad approximation; the handbook value is 183000 cm^4 (1.83E–3 m^4).

To show that there is no fundamental difference, try the formula on a (carefully chosen) I-section. Here a hollow section of uniform thickness t = 20 mm is squashed into the form of 300 ASB 249, which happens to have equal thickness ('T' = 40 mm) all round:



The area enclosed by the mean perimeter can be calculated as $[(b_t - T) + (b_b - T) + (h - 1.5T)]T/2 + 2\pi(T/4)^2 + (4 - \pi)(r + T/4)^2$ = 16.16E–3 m^2 , and the mean perimeter is $2[(b_t - T) + (b_b - T) - (T + 2r) + (h - 2T - 2r)] + 2\pi(3T/4 + r)$ = 1.458 m.

$I_t = 4\,A_p^2 t/p = 4 \times (16.16\text{E}{-3})^2 \times 0.02/1.458$ = 13.5E–6 m^4, which compares with 2004 cm^4 (20E–6 m^4) in the handbook.

While the result is in the right order, the comparison is nothing like as good, as the thin-walled hollow section assumption has been stretched too far. In this case it would imply an abrupt change in the direction, but not the magnitude, of the shear stress at mid-thickness. So long as it remains within the elastic range, the St Venant shear stress in a parallel sided element will actually increase linearly from zero at mid-thickness to a peak at each surface.

St Venant torsion in typical I-sections, whose webs are thinner than their flanges, is still more complicated and will be the subject of Part Two.

But first imagine unfolding the squashed section into a 484 mm diameter CHS. It would become $4(\pi \times 0.232^2)^2 \times 0.02/1.458$ = 1.57 E–3 m^4, which is getting on for **eighty** times as stiff. The superiority of the hollow section in terms of strength is also immense, though not as simple to compare. In part, that is because conventional sections are relatively likely – indeed almost certain – to reach a limit state of excessive deformation long before their resistance is exhausted.

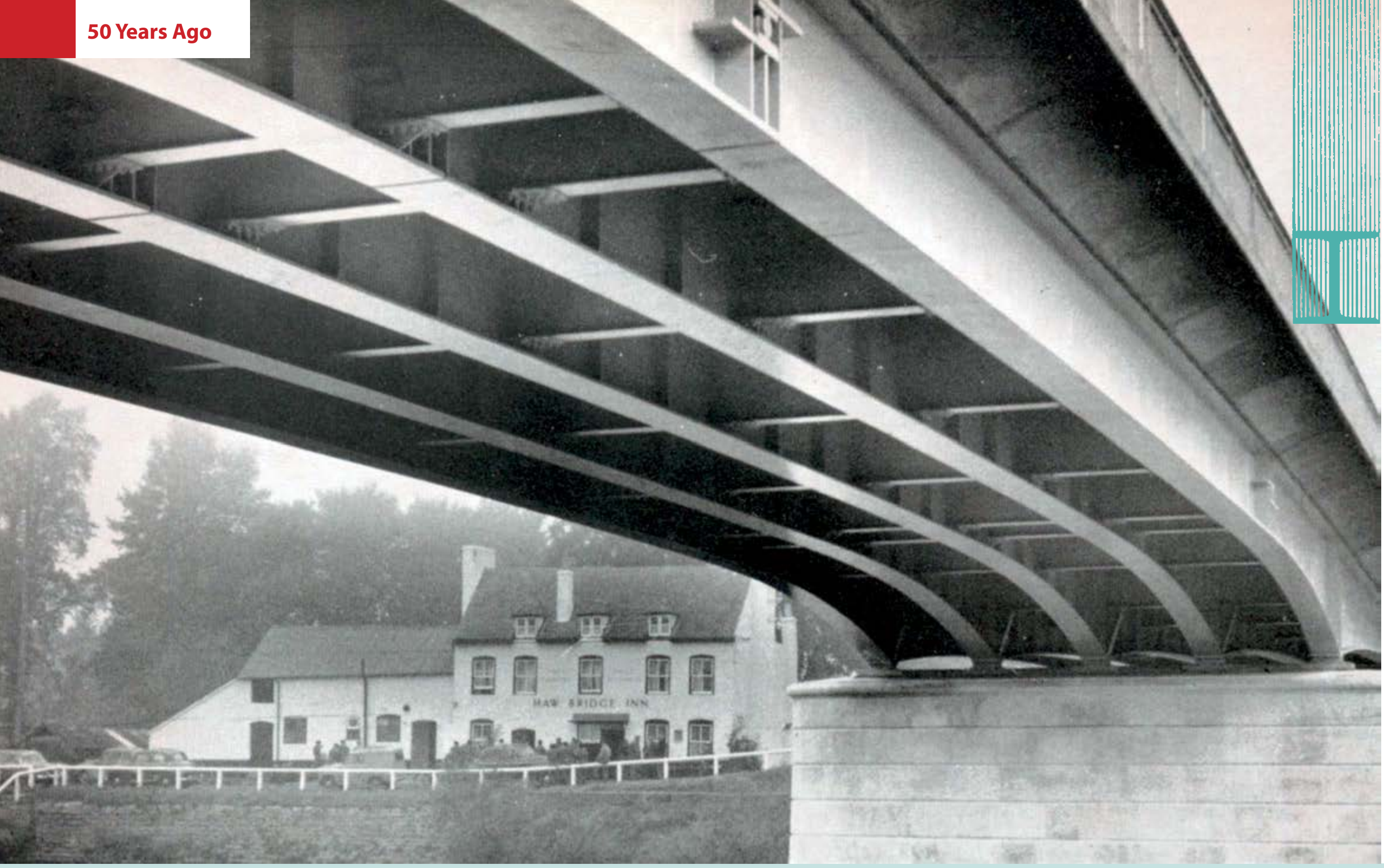
Where torsion is at large, there is a compelling case for checking serviceability ahead of strength, advice which applies with hollow sections as well as open ones. Not for nothing is torsion a favourite of suspension designers looking to absorb elastic strain energy.

Serviceability checking involves comparison of calculated displacement – in this context, rotation – with a subjectively set limit of acceptability. The Eurocode and NA provide no quantitative guidance, though P-385 offers some tentative advice. Serviceability limits are, properly, a matter of case-by-case designer judgement.

It is appropriate to end Part One with three mantras:

- Try to avoid torsion by lining beams up with their load
- If serious torsion cannot be designed out, preferably resist it with a hollow section
- Don't let torsionally induced displacements get out of hand

In Part Two: insight into St Venant, by means of the membrane analogy.



Bridges

FROM BUILDING WITH STEEL, FEBRUARY 1962

The illustrations above and below give an excellent impression of the graceful and pleasing lines of the new steel Haw Bridge over the River Severn.

HAW BRIDGE

The new steel Haw Bridge over the River Severn in Gloucestershire, was opened last autumn (1961), replacing a three-span cast iron bridge which was built in 1825 and was used until a vessel collided with it in 1958.

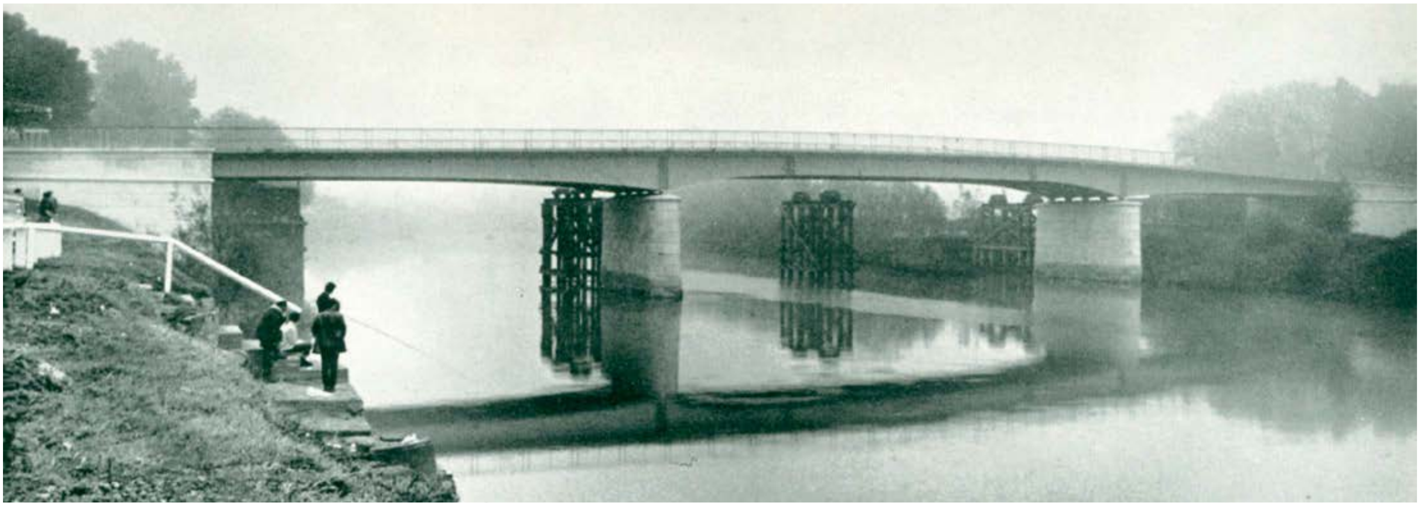
The new structure has a central span of 130 ft and two side spans of 88 ft 6 in. The superstructure, designed for full highway loading, is of double cantilevers with a central suspended span. The plate-web sections were shop welded from notch ductile steel and act compositely with the in situ reinforced concrete deck. The cantilevers are 120 ft long and project 30 ft beyond the piers to support the 70-ft suspended span girders. There are five lines of girders along the length of the bridge at 7-ft centres, with transverse beams, to distribute the loading, at 16-ft centres. All components, including the 120-ft cantilevers, were designed to be prefabricated and were given an anti-corrosive metal coating before delivery.

High strength bolts were used for the connection of cross girders and site welding was not used. Web sitiffeners have been confined to the inside faces of main girders to present a clean elevation and enhance the slenderness of the superstructure. Expansion has been provided for with roller-rocker bearings at each end of the bridge and one end of the suspended span. There are rocker bearings at the other end of the suspended span and at both piers. The parapet is of welded steel panels, hot dip galvanized before delivery and capped with a teak handrail.

The bridge was designed in the office of Mr. R. A. Downs, B.Sc., M.I.C.E., M.I.Mun.E., county surveyor, by Mr S. C. Brown, M.I.Struct.E, A.M.I.C.E.

TAMAR BRIDGE

Britain's longest suspension bridge – the Tamar Bridge – is now (February 1962) officially open to road traffic. This bridge, linking Devon and Cornwall between Devonport and Saltash, has a single central span of 1,100 ft. It is greatly easing traffic problems in South Devon and Cornwall, especially in the Plymouth area where it is situated at the site of the old Saltash ferry and close



The Tamar suspension bridge, illustrated above, is now open to road traffic; approximately 2,800 tons of structural steelwork were used in its construction.

Below: Cable spinning for the new Forth Road Bridge. Engineers can be seen clamping together the first of the spun cables, many of which form the main suspension cable. The task entails spinning 40,000 miles of steel wire. *Consulting engineers:* Mott Hay and Anderson.

to the site of the famous Brunel Bridge. The Saltash ferry is being withdrawn from service.

The bridge has a central span of 1,100 ft. and side spans of 374 ft. It provides for a carriageway of 33 ft wide and two 6-ft footpaths.

The suspended structure contains approximately 2,800 tons of steelwork, and about 1,000 tons of steel wire were used in the main cables and suspenders.

The bridge is suspended between two 250-ft.-high reinforced concrete towers. The two main cables each have 31 locked coil wire ropes of 2.37 in diameter whose sockets are connected to anchor rods at the anchorage tunnels. The 31 strands in each of these cables are surrounded by a protection of wire to prevent seepage of water and corrosion. Hangers supporting the stiffening truss are suspended from the main cables. The stiffening truss, in turn, supports the reinforced concrete deck of the bridge.

Consulting engineers: Mott, Hay and Anderson, London S.W.1.

THE SEVERN BRIDGE

A patented bridge design has been incorporated in the new 3,240-ft.-long Severn Suspension Bridge between Aust and Beachley, Gloucestershire. Preliminary work has started on the foundations, including two main piers forming the bases of the steel towers and the anchorages for the main cables, but the bridge will take about five or six years to build. Two large gantries have been erected.

The bridge is a suspension bridge was a torsion box girder serving as a stiffening girder and roadway.

When completed the Severn Bridge will be the fifth largest bridge in the world. The road level will be about 130 ft. above high water and 150 ft in the centre. It will carry two highways of two tracks. The bridge will make possible a new route between the South of England and South Wales and will also form links with the Birmingham- Bristol motorway and will ultimately link with the motorway between London and industrial Wales.

A bridge over the River Wye is part of the project and will be 1,340 ft long with twin carriageways.

Joint Consulting engineers: Mott, Hay and Anderson & Freeman, Fox and Partners, London S.W.1.

Liverpool Street Station

For:
Network SouthEast, BRB

Architects:
Architecture & Design Group, BRB

Structural Engineers:
Network Civil Engineer
Network SouthEast, BRB

Steelwork Contractor:
Robert Watson & Co
(Constructional Engineers) Ltd

Main Contractor:
Balfour Beatty
Civil Engineering Ltd

Judges' Comments:

Meticulous attention to detail and a good understanding of modern technology have been used to extend a celebrated metal structure from a previous age to cope with today's increased demands, not onl;y preserving but enhancing one of London's famous railway stations and providing a public arena with a tremendous feeling of space and light.

Taken from
STEEL CONSTRUCTION
December 1991

Liverpool Street Station is being modernised within the massive Broadgate Development in the City of London.

The transformation of one of London's most famous terminals will include a new concourse area, new LRT interchange and ticket hall and 3,700m^2 of retail shopping. A new roof has been added to the southern end in a style that looks the same as the original structure with all the previous Victorian character retained.

It is British Rail's biggest station redevelopment in the last 20 years and is likely to be the last Victorian reconstruction of a mainline station.

The design brief to match the old Victorian structure was achieved by using main principal roof members made up of welded 'T' sections, together with cast iron filigrees assembled using dome headed tension control bolts to give the appearance of a riveted structure. The main members span 33 metres with a network of latticed purlins, valley rafters and lantern arches forming interconnected naves, transepts and side arches. The whole structure provides support to the part glazed/part clad roof covering.

There is a steel framed support system spanning platforms and tracks to carry the elevated walkways and shopping area. A further steel framed structure supports the track bays over a new underground Ticket Hall.

British Rail took tracings from the original wrought iron trusses before reproducing the new structural grade cast iron filigrees. They verified the structural design by load testing a full sized 'section' of the arches at their Stratford Sidings before proceeding.

Work commenced on site in January 1989 on the £18m total contract. Robert Watson started erecting the steel roof structure in May 1989 experiencing severe restrictions in access, storage of materials and erection equipment. The roof structure was built above a crash deck of heavy steel beams supporting layers of railway sleepers strong enough to support a 30 tonne mobile crane – the idea being to minimise disruption to the 200,000 commuters passing through the station daily.

The new roof has a design life of 120 years and is painted in the original Great Eastern Railway colours. The original structure will be painted to match the new roof.

Waterloo International trial roof erection

The successful trial erection of a bay of the roof for BR's £120 million Waterloo International Terminal has been carried out at Wetherby, Yorkshire.

The first abseiling tests were successfully completed over the high-tech structure on Wednesday, 23 October. The roof, when erected on site, will be 400 metres in length and have 35 bays. Designed by architects Nicholas Grimshaw & Partners, the roof will be the crowning glory of the new terminal which will become the new 'Gateway to Europe". Structural Engineers are YRM Anthony Hunt & Associates, and steelwork contractors Westbury Tubular Structures plc.

The whole roof comprises two and a half acres of stainless steel and two acres of glass.

Joints in Steel Construction: Simple Joints to Eurocode 3 (P358)

This publication is one of a series of "Green Books" that cover a range of steelwork connections. This publication provides guidance for nominally pinned joints (the most common joint type in steel building structures) that primarily carry vertical shear and, as an accidental limit state, tying forces. The connections are designed in accordance with Eurocode 3 and its UK National Annexes.

This publication is cited in the UK National Annex; Joints designed in accordance with the principles within this publication can be classed as nominally pinned without calculation of connection stiffness.

Resistance tables are provided for the commonly used connection types, including partial depth end plates, fin plates, splices and column bases. A new full depth end plate (i.e. welded to both flanges) has been introduced, which offers a significantly increased tying resistance compared to a partial depth end plate. Detailed design checks are included to cover non-standard joints and facilitate the development of design software.

A companion publication (expected to be published in 2012) will cover moment-resisting joints.

Full Price £80.00
(BCSA and SCI member price £60.00)

Catalogue number	**P358**
ISBN number	987-1-85942-201-4
Authors	BCSA (The British Constructional Steelwork Association Limited), SCI (The Steel Construction Institute)
Pagination	462 pp
Pages	A4 Paperback
Publication date	2011

To purchase your copies please contact: SCI +44 (0) 1344 636505 www.steel-sci.org

Strength from Advisory Service

Designing and building in steel has never been as straightforward as it is today, and steel still remains the material of choice for construction in the UK. The steel sector provides comprehensive and in-depth technical back up to ensure that those using steel have all the guidance and support they could need at their finger tips.

The co-ordinated and comprehensive support provided by the BCSA's Structural Advisory Serivce is free of charge to specifiers, clients and designers. Technical experts are on hand to provide an extensive range of services, including design assistance on structural form, performance of steel buildings, seminars and in-house CPD presentations, etc.

Richard Dixon, Manager, Structural Advisory Services, who heads up the network of Regional Technical Managers throughout the UK and Ireland said: "We have a team of experienced regional engineers who are on hand to offer design support and advice to designers, and to point them to the wide range of technical guidance and resources available to them and inform them in a practical way on key topics like EC3 and the sustainability of steel construction through in-house CPDs."

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AD 365
Welding of shear studs to galvanized steel beams

This Advisory Desk note confirms the advice that shear studs should not be welded to hot-dipped galvanized beams. This advice at first appears to contradict the common practice of through-deck welding of shear studs, as steel decking itself is formed from hot-dipped galvanized steel. It is the purpose of this Advisory Desk Note to clarify why through-deck welding of shear studs is acceptable but welding to galvanized supporting steel beams is not.

Welding shear studs directly to non-galvanized steel beams is normally done using electric arc stud welding involving the drawn-arc process. The power source and the stud welding control system are set to control the amperage and the arc duration, which vary due to the type of stud, stud diameter, and base steel conditions. The welding sequence is to initiate a weld current, then lift the stud, creating an arc and a pool of molten metal, and finally to plunge the stud into the molten pool.

The presence of zinc in the weld pool would be a contaminant that would affect the weld metallurgy, causing brittle welds. Generally, when welding to galvanized material, zinc must therefore either be eliminated locally before welding or the galvanizing removed locally (an expensive option) or the galvanizing must be carried out after the studs are welded to the beam.

In the case of galvanized metal decking, removing zinc from the area of the weld is impractical. However, for through-deck welding of shear studs a modified welding sequence was developed that involves a (lower current) pilot arc to burn off the zinc on the profiled sheet (but see further comments below about health and safety concerns) and then higher current arc is developed to make the stud-to-beam fusion weld through the sheeting. This sequence prevents the zinc volatising in the arc drawn between the stud and the beam, thus avoiding gross porosity and fusion defects. The strength of the weld is not prejudiced because the small quantity of zinc present on the decking (typically a total of 275 g/m^2, half on the top surface and half on the bottom surface) has been burnt off locally.

Steel decking may be specified with a thicker galvanized coating, up to 600 g/m^2 of zinc, but through-deck welding of shear studs is not recommended for galvanised decking with more than 350 g/m^2 of zinc coating because of the risk of substandard weld quality.

For galvanized steel beams, the same drawn-arc process cannot be performed because the quantity of zinc will be considerably greater than the quantity present on steel decking. Referring to Table 3 of BS EN ISO 1461:2009, the minimum mean coating thickness for an element greater than 6 mm is 610 g/m^2. In fact, often the coating is greater than 610 g/m^2 when the appropriate corrosion class is selected from BS EN ISO 14713-1:2009. It is clear that even with the minimum thickness of the zinc coating, the quantity of zinc present will be much greater than the case where the beam is not galvanized. Therefore shear studs should not be welded to a galvanized steel beam, either through decking or directly.

When carrying out through-deck welding, the fumes from the burnt zinc are a potential health and safety hazard which should be considered. Good ventilation is essential.

Contact: **J A Lucey**
Tel: **01344 636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates December 2011 and January 2012

BRITISH STANDARDS

BS 2853:2011
Specification for the testing of steel overhead runway beams for hoist blocks
Supersedes BS 2853:1957

BRITISH STANDARDS REVIEWED AND CONFIRMED

BS 4-1:2005
Structural steel sections. Specification for hot-rolled sections

UPDATED BRITISH STANDARDS

BS EN ISO 5173:2010+A1:2011
Destructive tests on welds in metallic materials. Bend tests
AMENDMENT 1

NEW WORK STARTED

PD 6696-2:2007/A1
Background paper to BS EN 1994-2 and the UK National Annex to BS EN 1994-2. Eurocode 4. Design of composite steel and concrete structures. General rules for bridges

EN 1998-1:2004/A1
Eurocode 8. Design of structures for earthquake resistance. General rules, seismic actions and rules for buildings

EN 10088-1
Stainless steels. List of stainless steels
Will supersede BS EN 10088-1:2005

EN 10088-2
Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
Will supersede BS EN 10088-2:2005

EN 10088-3
Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
Will supersede BS EN 10088-3:2005

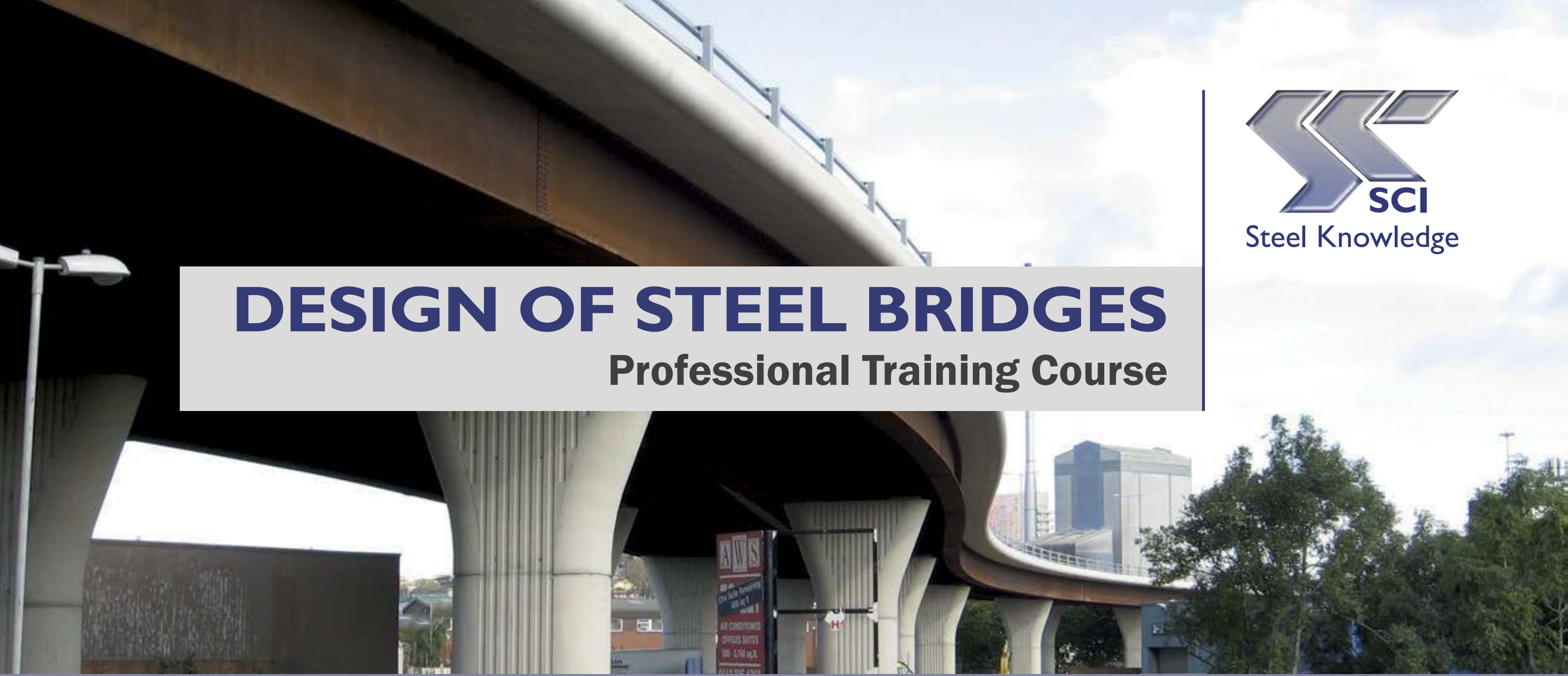
EN 10293
Steel castings and forgings. Steel castings for general engineering uses
Will supersede BS EN 10293:2005

CEN EUROPEAN STANDARDS

EN 1090-1:2009+A1:2011
Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components

DRAFTS FOR PUBLIC COMMENT

11/30250538 DC
BS EN ISO 18275 Welding consumables. Covered electrodes for manual metal arc welding of high-strength steels. Classification



SCI
Steel Knowledge

DESIGN OF STEEL BRIDGES

Professional Training Course

21 & 22 March 2012 in Leeds

This two day course is aimed at graduate engineers with a basic knowledge of bridge design.

Speakers include designers and steelwork fabricators actively involved in highway bridge design. The course therefore provides the latest best practice design guidance.

For structural design reference is made to the Eurocodes - their use is required by client authorities for all new bridge design projects.

All the presentations will be accompanied by a comprehensive set of notes.

Paper and pdf copies of a range of SCI, BCSA and Tata Steel publications related to bridge design will also be provided.

Course objectives

- Give an overview of common forms of steel bridge used in the highway infrastructure
- Explain the design basis set out in the Structural Eurocodes and the evaluation of bridge loading
- Examine the modelling techniques for bridges to determine internal forces and moments
- Explain the basis for determining the resistance of structural members, bracing systems and connections
- Examine requirements for fatigue design
- Give practical guidance on material selection, connection detailing, bridge articulation and support
- Give guidance on design for economical and durable construction

Fee and Registration

The cost of the course is: **£250 + VAT (BCSA & SCI members)**
£300 + VAT (non-members)

Lunch and refreshments included on both days.

Sponsored by:

TATA STEEL

BCSA

Please contact:

Jane Burrell on +44 (0)1344 636500

education@steel-sci.com www.steel-sci.org/courses

Steelwork contractors for buildings

BCSA is the national organisation for the steel construction industry.
Membership of BCSA is open to any Steelwork Contractor who has a fabrication facility within the United Kingdom or Republic of Ireland.
Details of BCSA membership and services can be obtained from

Gillian Mitchell MBE, Deputy Director General, BCSA, 4 Whitehall Court, London SW1A 2ES
Tel: 020 7747 8121 Email: *gillian.mitchell@steelconstruction.org*

Applicants may be registered in one or more Buildings category to undertake the fabrication and the responsibility for any design and erection of:

- **C** Heavy industrial platework for plant structures, bunkers, hoppers, silos etc
- **D** High rise buildings (offices etc over 15 storeys)
- **E** Large span portals (over 30m)
- **F** Medium/small span portals (up to 30m) and low rise buildings (up to 4 storeys)
- **G** Medium rise buildings (from 5 to 15 storeys)
- **H** Large span trusswork (over 20m)
- **J** Tubular steelwork where tubular construction forms a major part of the structure
- **K** Towers and masts
- **L** Architectural steelwork for staircases, balconies, canopies etc
- **M** Frames for machinery, supports for plant and conveyors
- **N** Large grandstands and stadia (over 5000 persons)
- **Q** Specialist fabrication services (eg bending, cellular/castellated beams, plate girders)
- **R** Refurbishment
- **S** Lighter fabrications including fire escapes, ladders and catwalks
- **QM** Quality management certification to ISO 9001
- **SCM** Steel Construction Sustainability Charter (● = Gold, ● = Silver, ● = Member)

Notes

(1) Contracts which are primarily steelwork but which may include associated works. The steelwork contract value for which a company is pre-qualified under the Scheme is intended to give guidance on the size of steelwork contract that can be undertaken; where a project lasts longer than a year, the value is the proportion of the steelwork contract to be undertaken within a 12 month period.

Where an asterisk (*) appears against any company's classification number, this indicates that the assets required for this classification level are those of the parent company.

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	SCM	Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●											Up to £2,000,000
ACL Structures Ltd	01258 456051			●	●	●	●				●				●		Member	Up to £2,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●		Member	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●												Up to £1,400,000
Advanced Fabrications Poyle Ltd	01753 531116				●		●	●	●	●	●				●	✓		Up to £400,000
Alex Morton Contracts Ltd	028 9269 2436			●	●	●	●		●	●	●			●	●			Up to £400,000
Angle Ring Company Ltd	0121 557 7241												●					Up to £1,400,000
Apex Steel Structures Ltd	01268 660828				●		●			●	●							Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●						Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●			Up to £800,000*
ASD Westok Ltd	0113 205 5270												●			✓		Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●					●	●			●	●	✓		Up to £1,400,000*
Atlas Ward Structures Ltd	01944 710421		●	●	●	●	●	●	●	●	●	●		●	●	✓	Gold	Above £6,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●							●				Up to £2,000,000
Austin-Divall Fabrications Ltd	01903 721950			●	●		●	●		●	●			●	●			Up to £200,000
B&B Group Ltd	01942 676770			●	●	●	●	●		●	●	●		●		✓		Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●				Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✓		Up to £1,400,000
Barnshaw Section Benders Ltd	01902 880848												●			✓		Up to £800,000
BHC Ltd	01555 840006	●	●	●	●	●	●							●				Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●		✓	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●		✓	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✓		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●	●			●	●	✓	Gold	Up to £2,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✓	Silver	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●			Up to £6,000,000
Cordell Group Ltd	01642 452406	●			●	●	●	●	●	●	●					✓		Up to £3,000,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●			Up to £800,000
D H Structures Ltd	01785 246269				●		●				●			●				Up to £40,000
Discain Project Services Ltd	01604 787276				●					●	●				●	✓		Up to £800,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●			●					✓		Up to £6,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✓	Silver	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✓	Gold	Up to £3,000,000
Fisher Engineering Ltd	028 6638 8521		●	●	●	●	●	●	●	●	●	●				✓	Gold	Above £6,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●							Up to £3,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●				Up to £800,000
Graham Wood Structural Ltd	01903 755991		●	●	●	●	●	●	●	●	●	●		●			Silver	Up to £6,000,000
Grays Engineering (Contracts) Ltd	01375 372411				●	●		●		●	●				●			Up to £100,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✓		Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●						Member	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✓		Up to £2,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✓	Silver	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●				✓		Up to £2,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121			●	●	●	●	●										Up to £3,000,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●			Up to £3,000,000
Hillcrest Fabrications Ltd	01283 212720				●			●							●			Up to £400,000
Hills of Shoeburyness Ltd	01702 296321									●	●				●			Up to £1,400,000

Company name Tel C D E F G H J K L M N Q R S QM SCM Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	SCM	Contract Value (1)
J Robertson & Co Ltd	01255 672855									●	●				●			Up to £200,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●					●		●				Up to £6,000,000*
Kiernan Structural Steel Ltd	00 353 43 334 1445			●	●	●	●	●	●	●	●	●		●	●	✓	🟠	Up to £4,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●						🟢	Up to £1,400,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✓		Up to £3,000,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●			Up to £1,400,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●	●	●		✓	🟠	Above £6,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✓		Up to £800,000
Maldon Marine Ltd	01621 859000				●			●	●	●					●			Up to £1,400,000
Mifflin Construction Ltd	01568 613311		●	●	●	●	●				●							Up to £3,000,000
Newbridge Engineering Ltd	01429 866722			●	●	●	●								●	✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●						✓		Up to £4,000,000
On Site Services (Gravesend) Ltd	01474 321552				●		●	●		●	●				●			Up to £200,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●			Up to £400,000
Paddy Wall & Sons	00 353 51 420 515			●	●	●	●	●	●	●	●							Up to £6,000,000
Painter Brothers Ltd	01432 374400								●		●				●	✓	⚪	Up to £6,000,000
Pencro Structural Engineering Ltd	028 9335 2886			●	●	●	●	●	●		●			●	●	✓		Up to £2,000,000
Peter Marshall Steel Stairs Ltd	0113 307 6730									●					●			Above £6,000,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●			Up to £1,400,000
REIDsteel	01202 483333		●	●	●	●	●	●	●	●	●	●		●				Up to £6,000,000
Rippin Ltd	01383 518610			●	●	●	●	●										Up to £1,400,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	🟠	Above £6,000,000
Rowen Structures Ltd	01773 860086		●	●	●	●	●	●	●	●	●	●		●				Above £6,000,000*
S H Structures Ltd	01977 681931						●	●	●	●						✓	⚪	Up to £3,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	🟠	Above £6,000,000
Shipley Fabrications Ltd	01400 231115			●	●	●	●		●	●	●				●			Up to £200,000
SIAC Butlers Steel Ltd	00 353 57 862 3305		●	●	●	●	●	●	●		●	●				✓	🟢	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●				●	●				✓	⚪	Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●		●								●			Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●			Up to £1,400,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●	●			●			Up to £200,000
The AA Group Ltd	01695 50123			●	●	●	●			●	●	●		●	●		⚪	Up to £4,000,000
Traditional Structures Ltd	01922 414172		●	●	●	●	●	●	●		●	●		●		✓	⚪	Up to £2,000,000
Tubecon	01226 345261						●	●	●	●				●	●	✓		Above £6,000,000*
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●			Up to £4,000,000
W I G Engineering Ltd	01869 320515				●					●					●			Up to £200,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✓		Up to £6,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	🟠	Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●			●		●	●	●	●	●				●	✓		Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●					✓	⚪	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●		✓	🟠	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	SCM	Contract Value (1)

Corporate Members

Corporate Members are clients, professional offices, educational establishments etc which support the development of national specifications, quality, fabrication and erection techniques, overall industry efficiency and good practice.

Company name	Tel
Balfour Beatty Utility Solutions Ltd	01332 661491
Griffiths & Armour	0151 236 5656
Highways Agency	08457 504030
Roger Pope Associates	01752 263636
Sandberg LLP	020 7565 7000
SUM Ltd	0113 242 7390

Associate Members

Associate Members are those principal companies involved in the direct supply to all or some Members of components, materials or products. Associate member companies must have a registered office within the United Kingdom or Republic of Ireland.

1 Structural components
2 Computer software
3 Design services
4 Steel producers
5 Manufacturing equipment
6 Protective systems
7 Safety systems
8 Steel stockholders
9 Structural fasteners
SCM Steel Construction Sustainability Charter
(●) = Gold, (●) = Silver, (●) = Member

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
AceCad Software Ltd	01332 545800		●								
Albion Sections Ltd	0121 553 1877	●									
Andrews Fasteners Ltd	0113 246 9992									●	
ArcelorMittal Distribution – Birkenhead	0151 647 4221								●		
ArcelorMittal Distribution – Bristol	01454 311442								●		
ArcelorMittal Distribution – South Wales	01633 627890								●		
ArcelorMittal Distribution – Scunthorpe	01724 810810								●		
Arro-Cad Ltd	01283 558206			●							
ASD Interpipe UK Ltd	0845 226 7007								●		
ASD metal services - Biddulph	01782 515152								●		
ASD metal services - Bodmin	01208 77066								●		
ASD metal services - Cardiff	029 2046 0622								●		
ASD metal services - Carlisle	01228 674766								●		
ASD metal services - Daventry	01327 876021								●		
ASD metal services - Durham	0191 492 2322								●		
ASD metal services - Edinburgh	0131 459 3200								●		

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
ASD metal services - Exeter	01395 233366								●		
ASD metal services - Grimsby	01472 353851								●		
ASD metal services - Hull	01482 633360								●		
ASD metal services - London	020 7476 0444								●		
ASD metal services - Norfolk	01553 761431								●		
ASD metal services - Stalbridge	01963 362646								●		
ASD metal services - Tividale	0121 520 1231								●		
Austin Trumanns Steel Ltd	0161 866 0266								●		
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●									
BAPP Group Ltd	01226 383824									●	
Barnshaw Plate Bending Centre Ltd	0161 320 9696	●									
Barrett Steel Ltd	01274 682281								●		
BW Industries Ltd	01262 400088	●									
Cellbeam Ltd	01937 840600	●									
Cellshield Ltd	01937 840600							●			
CMC (UK) Ltd	029 2089 5260							●			

Steelwork contractors for bridgework

The Register of Qualified Steelwork Contractors Scheme for Bridgeworks (RQSC) is open to any Steelwork Contractor who has a fabrication facility within the European Union.

Applicants may be registered in one or more category to undertake the fabrication and the responsibility for any design and erection of:

FG Footbridge and sign gantries
PG Bridges made principally from plate girders
TW Bridges made principally from trusswork
BA Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
CM Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
MB Moving bridges
RF Bridge refurbishment
AS Ancilliary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
QM Quality management certification to ISO 9001
SCM Steel Construction Sustainability Charter ((●) = Gold, (●) = Silver, (●) = Member)

Notes
(1) Contracts which are primarily steelwork but which may include associated works. The steelwork contract value for which a company is pre-qualified under the Scheme is intended to give guidance on the size of steelwork contract that can be undertaken; where a project lasts longer than a year, the value is the proportion of the steelwork contract to be undertaken within a 12 month period.
Where an asterisk (*) appears against any company's classification number, this indicates that the assets required for this classification level are those of the parent company.

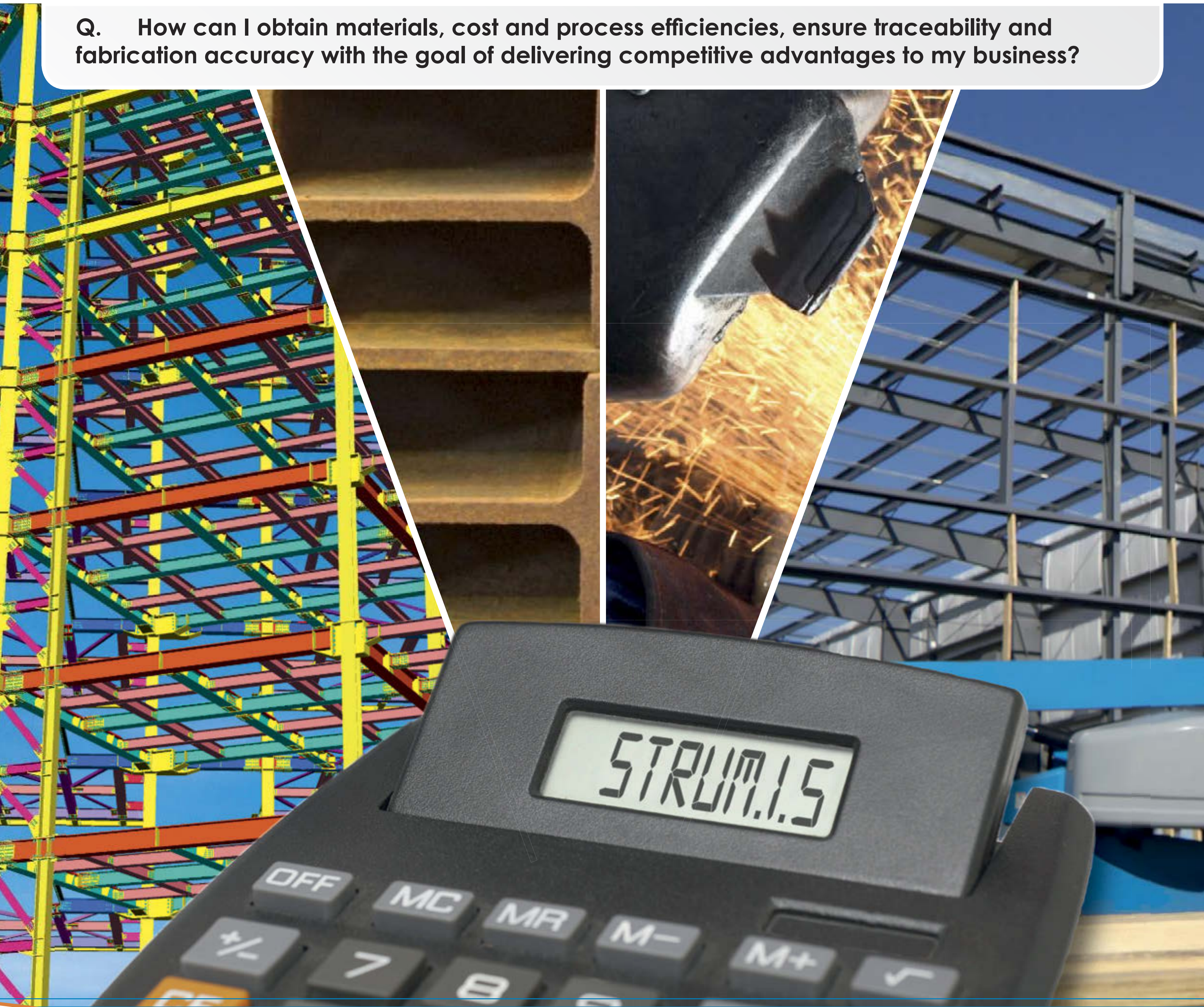
BCSA steelwork contractor member	Tel	FG	PG	TW	BA	CM	MB	RF	AS	QM	NHSS 19A	NHSS 20	SCM	Contract Value (1)
B&B Bridges Ltd	01942 676770	●	●	●	●	●	●	●	●	✓				Up to £1,400,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓				Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓			Gold	Up to £2,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	✓		Silver	Above £6,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓			Member	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●	●	●	●			●	●	✓			Gold	Up to £800,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	✓	✓	✓	Gold	Above £6,000,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓	✓	✓		Up to £4,000,000
Painter Brothers Ltd	01432 374400	●		●					●	✓			Silver	Up to £6.000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	✓	✓	✓	Gold	Above £6,000,000
S H Structures Ltd	01977 681931	●		●	●	●			●	✓			Silver	Up to £3,000,000
SIAC Butlers Steel Ltd	00 353 57 862 3305	●	●	●	●	●		●	●	✓			Member	Above £6,000,000
TEMA Engineering Ltd	029 2034 4556	●	●	●	●	●	●	●	●	✓				Up to £1,400,000*
Varley & Gulliver Ltd	0121 773 2441	●						●	●	✓		✓		Up to £4,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	✓			Gold	Above £6,000,000
Non-BCSA member														
ABC Bridges Ltd	0845 0603222	●								✓				Up to £100,000
A G Brown Ltd	01592 630003	●						●	●	✓				Up to £400,000
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●	●	✓				Up to £1,400,000
Cimolai Spa	01223 350876	●	●	●	●	●	●			✓				Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●		●	●		●	✓			Member	Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	✓	✓	Member	Up to £1,400,000
Francis & Lewis International Ltd	01452 722200							●	●	✓			Silver	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓				Up to £2,000,000
Hollandia BV	00 31 180 540540	●	●	●	●	●	●	●	●	✓				Above £6,000,000
Interserve Project Services Ltd	0121 344 4888							●	●	✓				Above £6,000,000
Interserve Project Services Ltd	020 8311 5500	●	●	●	●		●	●	●	✓				Up to £800,000*
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		✓				Up to £800,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓				Up to £3,000,000*
The Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓			Member	Up to £2,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
Composite Profiles UK Ltd	01202 659237	●									
Computer Services Consultants (UK) Ltd	0113 239 3000		●								
Cooper & Turner Ltd	0114 256 0057									●	
Cutmaster Machines UK Ltd	01226 707865					●					
Daver Steels Ltd	0114 261 1999	●									
Development Design Detailing Services Ltd	01204 396606			●							
Easi-edge Ltd	01777 870901							●			●
Fabsec Ltd	0845 094 2530	●									
FabTrol Systems UK Ltd	01274 590865		●								
Ficep (UK) Ltd	01924 223530					●					
FLI Structures	01452 722200	●									●
Forward Protective Coatings Ltd	01623 748323						●				
Graitec UK Ltd	0844 543 888		●								
Hadley Rolled Products Ltd	0121 555 1342	●									●
Hempel UK Ltd	01633 874024						●				
Hi-Span Ltd	01953 603081	●									●
Highland Metals Ltd	01343 548855						●				
Hilti (GB) Ltd	0800 886100									●	
International Paint Ltd	0191 469 6111						●				●
Jack Tighe Ltd	01302 880360						●				
Jamestown Cladding and Profiling	00 353 45 434288	●									
Jotun Paints (Europe) Ltd	01724 400000						●				
Kaltenbach Ltd	01234 213201					●					
Kingspan Structural Products	01944 712000	●									●

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
Leighs Paints	01204 521771						●				●
Lindapter International	01274 521444									●	
Metsec plc	0121 601 6000	●									●
MSW	0115 946 2316	●									
National Tube Stockholders Ltd	01845 577440								●		
Northern Steel Decking Ltd	01909 550054	●									
Panels & Profiles	0845 308 8330	●									
John Parker & Sons Ltd	01227 783200								●	●	
Peddinghaus Corporation UK Ltd	01952 200377					●					
Peddinghaus Corporation UK Ltd	00 353 87 2577 884					●					
PPG Performance Coatings UK Ltd	01773 814520						●				
Prodeck-Fixing Ltd	01278 780586	●									
Rainham Steel Co Ltd	01708 522311								●		
Richard Lees Steel Decking Ltd	01335 300999	●									●
Structural Metal Decks Ltd	01202 718898	●									●
Studwelders Composite Floor Decks Ltd	01291 626048	●									
Tata Steel	01724 404040				●						
Tata Steel Distribution (UK & Ireland)	01902 484100								●		
Tata Steel Service Centres Ireland	028 9266 0747								●		
Tata Steel Service Centre Dublin	00 353 1 405 0300								●		
Tata Steel Tubes	01536 402121				●						
Tekla (UK) Ltd	0113 307 1200		●								
Tension Control Bolts Ltd	01948 667700						●			●	
Wedge Group Galvanizing Ltd	01909 486384						●				

The Answer is **StruM.I.S...**

Q. How can I obtain materials, cost and process efficiencies, ensure traceability and fabrication accuracy with the goal of delivering competitive advantages to my business?



www.**acecadsoftware**.com

AceCad Software has over 25 years of experience in the structural steelwork industry and develops specialist software products for project collaboration, estimating and fabrication management.